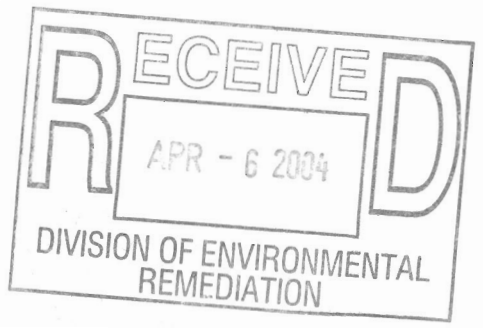
Niagara Mohawk

A **National Grid** Company



April 1, 2004

James Van Hoesen, P.E., Chief, Remedial Section D
Division of Environmental Remediation
New York Stated Department of Environmental Conservation
625 Broadway
Albany, NY 12233-7014

Re: Remedial Action Report
Greater Amsterdam Riverlink Park
Amsterdam (Front Street) Former MGP Site
Amsterdam, New York

Dear Mr. Spellman:

In accordance with the Voluntary Cleanup Agreement (VCA), Index Number: D4-0001-99-03, Niagara Mohawk, a National Grid Company (Niagara Mohawk) is providing the attached four copies of the Remedial Action Report (RAR) for the Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site, Amsterdam, New York (the Site).

As required by the VCA, the evaluation and selection of the proposed remedy for the Site as provided in this RAR has been prepared considering the factors set forth in 6 NYCRR 375-1-10(c). These factors are consistent with the criteria specified by the New York State Department of Environmental Conservation (NYSDEC) in its Technical Administrative Guidance Memorandum (TAGM) No. 4030 which incorporates the National Contingency Plan (NCP) by reference, with the exception (absence) of community acceptance. As indicated in the VCA, NYSDEC will complete the assessment of community acceptance after issuing a notice in the *Environmental Notice Bulletin*.

For ease of review, and as requested by NYSDEC during a February 11, 2004 Niagara Mohawk/NYSDEC meeting on MGP sites, the appendices to the RAR are provided as a CD, with the exception of one copy of the RAR which contains both a CD and a paper copy of the appendices.

With submission of this RAR, Niagara Mohawk continues to be committed to the initiation of remedial construction activities in late summer/early fall 2005 at the site. Niagara Mohawk is confident that the attached RAR, with its close attention to technical detail and compliance with the State's promulgated regulations, will fully support the recommended remedial alternatives for the site and facilitate NYSDEC's review/approval. This support can then be translated into timely development of the Remediation Work Plan, as required by the VCA, by Niagara Mohawk and initiation of the remedial construction in late summer/early fall 2005. As all parties are aware, the project schedule, by all accounts, is very aggressive, requiring effective and efficient communication by all project team members. Niagara Mohawk sincerely hopes that all parties will continue to work cooperatively together to meet the overall project schedule.

Please contact me at your earliest convenience if you have any comments or questions regarding the enclosed report or any other questions on this project.

Sincerely,

James F. Morgan

James F. Morgan
Lead Sr. Environmental Engineer

JFM/plf

Enclosure: Remedial Action Report, Greater Amsterdam Riverlink Park, Amsterdam New York

cc: Mr. Robert W. Schick, P.E., New York State Department of Environmental Conservation (w/out enclosure)
Mr. John Spellman, P.E., New York State Department of Environmental Conservation (w/out enclosure)
Mr. Joseph Crua, New York State Department of Health (two copies)
Mr. John R. Dergosits, P.E., New York State Canal Corporation
Ms. Jeanne Hewitt, New York State Department of Transportation
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REPORT

Remedial Action Report

Greater Amsterdam Riverlink Park
Amsterdam (Front Street) Former Manufactured Gas Plant Site
Amsterdam, New York

Niagara Mohawk, a National Grid Company
Syracuse, New York

April 2004

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

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Executive Summary

Historical operations at the Amsterdam (Front Street) Former Manufactured Gas Plant (MGP) in Amsterdam, New York (the Site) impacted the area that is now the Greater Amsterdam Riverlink Park and a nearby limited portion of the Mohawk River. In 1999, Niagara Mohawk, a National Grid Company (Niagara Mohawk) cleaned up the eastern portion of the Park allowing the City of Amsterdam to construct the Phase I Area of the Park and open the area to the public on June 15, 2001. The successful 1999 cleanup was a first step for the Site – more work remains to address the Phase II Area of the Park and impacted locations in the Mohawk River. To accomplish the goal of developing appropriate measures to address the remainder of the Site, Niagara Mohawk, the New York State Department of Transportation, and the New York State Canal Corporation (collectively referred to as the Volunteers, the latter two own the property on which the Park is located) entered into a Voluntary Cleanup Agreement with the New York State Department of Environmental Conservation (NYSDEC) on November 25, 1999.

While this *Remedial Action Report* is not required under the Voluntary Cleanup Agreement, due to the complexity of the Site and the number of parties involved, the NYSDEC and the Volunteers agreed this report was an important interim step to facilitate and streamline the development of the *Remediation Work Plan* – the document that will lay out the specific elements of the remedy designed to address the historical impacts of the Amsterdam (Front Street) Former MGP.

Development of the technical details and information in this report has been a collaborative and multi-step process involving the Volunteers, the NYSDEC, and the City. This process has included a number of meetings, conference calls, and submittals/correspondence, as detailed in this report and the cited references. In general, the remedial alternatives identified and evaluated are those presented by Niagara Mohawk in a submittal dated December 3, 2003 and NYSDEC's December 19, 2003 letter to Niagara Mohawk, which provided responses and recommended additional alternatives for evaluation. The alternatives proposed by Niagara Mohawk and NYSDEC were evaluated in accordance with the requirements of the Voluntary Cleanup Agreement. A recommended remedial approach was selected after a detailed and comparative analysis of the options relative to seven NYSDEC-required evaluation criteria.

The recommended remedy for the Site – detailed in Section 8 – is a comprehensive approach that will effectively address Site-related materials in both the Phase II Area and adjacent Mohawk River. It would achieve the best balance of the seven evaluation criteria, provide overall protection of human health and the environment, enhance the future use of the Site as a public recreation area, allow for expansion of Riverlink Park, and support use of the Site for access to the Route 30 bridge. The total estimated cost for the recommended remedy is $14,000,000. The primary components of the remedy include:

- Installation of a barrier wall along the winter low-water line adjacent to the Phase II Area, connected to a subsurface perimeter barrier wall around the eastern, western, and potentially northern boundaries of the Phase II Area;
- Placement of backfill behind the low-water barrier wall up to the grade of the Phase II Area (this action would permit expansion of the Park);
- Installation of collection wells inside the barrier wall to collect NAPL (non-aqueous phase liquids) from the Site;
- Excavation of material from the Phase II Area to allow for installation of a multi-layered cover across the entire area;

- Focused removal of riverbed materials from the River;

- Establishment of institutional controls to reduce the potential for exposure to impacted materials and prohibit the use of the Site for other than its contemplated uses (these controls are required by the Voluntary Cleanup Agreement); and

- Long-term monitoring to assess and document the effectiveness and performance of the remedy.

Implementation of the recommended remedy for the Site will result in a number of significant Site-wide improvements, provide long-term protection of human health and the environment, and support desired future uses of the Site by the community. The remedy will:

- Protect visitors to the Park, the general public, and wildlife from potentially coming into contact with impacted materials;

- Mitigate the potential for NAPLs to migrate to the Mohawk River;

- Include a habitat restoration plan that would provide higher quality habitat than currently exists in the area;

- Reduce volume and concentrations of Site-related materials in the Mohawk River; and

- Provide numerous community benefits that will have a direct and positive impact on the social and economic climate for those near the waterfront, including:

  - significantly increasing the Phase II portion of the Park by approximately 45% (0.8 acres);
  - increasing the waterfront docking (an additional 4+ slips);
  - providing sufficient space for installation of a sound barrier along north side of Phase II Area;
  - providing a safer and more stable river edge;
  - increasing the potential seating capacity for the Phase II Amphitheater by approximately 300 people (relative to an Amphitheater in a smaller Phase II Area); and
  - increasing the potential for construction of an interpretive center along the north side of the Phase II Area.

The anticipated remedial construction schedule is November 2005 through April 2006, a time period when the Park is closed. It is possible, however, that some elements of the remedy may be constructed at a later date in conjunction with the Park development activities.

Once the recommended remedy for the Site has been agreed upon by NYSDEC and the Volunteers, Niagara Mohawk will carry out additional studies necessary to complete the remedial design and prepare the *Remediation Work Plan*. At the same time, the NYSDEC will issue a notice in the *Environmental News* Bulletin to inform the public of its opportunity to comment on the proposed remedy. As described in the Voluntary Cleanup Agreement, the *Remediation Work Plan* will specify the remedial actions to be implemented by Niagara Mohawk to address onsite and offsite conditions. The work plan will also include the specific implementation and construction details of the various elements of the remedy along with "biddable quality" documents for the remedial design.

1. Introduction

1.1 General

This *Remedial Action Report* (RAR) presents an evaluation of potential remedial alternatives that may be implemented for part of the Greater Amsterdam Riverlink Park (Park), Amsterdam (Front Street) Former Manufactured Gas Plant (MGP) Site in Amsterdam, New York. The remedial alternatives were developed and evaluated for the Phase II Area of the Park and the Mohawk River near the Park (hereinafter collectively referred to as the "Site") to address conditions relating to Site-related MGP materials. The evaluation of the potential remedial alternatives was performed in accordance with the November 25, 1999 Voluntary Cleanup Agreement (VCA) (Index Number: D4-0001-99-03) between the New York State Department of Environmental Conservation (NYSDEC) and the Volunteers – Niagara Mohawk, a National Grid Company (Niagara Mohawk), the New York State Department of Transportation (NYSDOT), and the New York State Canal Corporation (NYSCC) (NYSDEC, 1999b). Blasland, Bouck & Lee, Inc. (BBL) prepared this RAR on behalf of Niagara Mohawk.

One requirement of the VCA is to develop a *Remediation Work Plan* (RWP) that provides for the remediation of both onsite and offsite existing contamination resulting from the former MGP operations. As detailed in Paragraph I.D.3 of the VCA, the RWP is to include, among many other items, an evaluation of the proposed remedy considering the factors set forth in 6NYCRR Part 375-1.10(c) and "biddable quality" plans and specifications for the remedial design that have been prepared, signed, and sealed by a NYS-licensed Professional Engineer (NYSDEC, 1999b). Preparing this RAR is not a requirement of the VCA; however, due to the complexity of the Site and the number of parties involved, the NYSDEC and the Volunteers developed and agreed to the concept of this report as an interim submittal to facilitate and streamline the development of the RWP.

To facilitate development of this RAR, Niagara Mohawk prepared a draft *Remedial Alternatives Development Document* (RADD), which presented a preliminary screening of potential remedial technologies/management options (TMOs) and identified the proposed remedial alternatives for additional, detailed evaluation. The RADD was submitted to the NYSDEC on December 3, 2003 (Morgan, 2003g). The RADD provided a mechanism for communications between Niagara Mohawk , the NYSDEC, the other Volunteers, and the City of Amsterdam (City) during development of the RAR, thereby facilitating its development.

After submittal of the RADD, Niagara Mohawk and BBL held a meeting on December 10, 2003 to discuss the information presented in the RADD as well as additional technical information developed by BBL to support the RAR (e.g., results of groundwater flow and hydrodynamic modeling, riverbed stability analyses). In addition to Niagara Mohawk and BBL, the meeting was attended by the Honorable Paul D. Tonko of the New York State Assembly, NYSDEC, the other Volunteers, and representatives of the City (the Project Team). Following the meeting, the NYSDEC provided a December 19, 2003 letter to Niagara Mohawk presenting comments on the RADD, including approved remedial components and comments to be addressed regarding the remedial alternatives to be developed (Spellman, 2003d). This RAR addressed the comments provided by the NYSDEC.

1.2 Purpose of Report

The purpose of this RAR is to identify and evaluate potential Site-specific remedial alternatives that are protective of human health and the environment, and compliant with applicable rules and regulations. The intent of this RAR is to recommend appropriate remedial alternatives that satisfy the remedial action objectives (RAOs) for the Site including its future use as a public recreation area and a public highway (State Route 30 bridge). Moreover, this report provides a mechanism for the NYSDEC, the other Volunteers (NYSDOT and NYSCC), and the City to review, comment, and as appropriate, approve the proposed remedial alternatives at a conceptual level prior to development of the RWP. Additionally, as requested by the NYSDEC, this RAR also provides information to support the NYSDEC's issuance of a public notice in the *Environmental Notice Bulletin*.

1.3 Report Organization

This RAR is organized into the following sections:

Section	Purpose
1. Introduction	Presents the purpose and organization of this RAR.
2. Background Information	Presents relevant background information, including a description of the Interim Remedial Measure (IRM) activities conducted to date.
3. Remedial Action Objectives	Presents the RAOs established for the Site.
4. Identification of Areas to be Considered	Describes the areas to be considered in this RAR, and presents details on how these areas were developed and the approvals obtained.
5. Additional Data Collection and Assessments	Presents a brief description of the additional data collection activities conducted since completion of the Mohawk River Investigation in 2001, followed by a summary of the results of the additional technical assessments conducted to support the development and evaluation of potential remedial alternatives for the Site.
6. Remedial Technologies/Management Options Screening and Development of Remedial Alternatives	Identifies and screens potential TMOs for the areas to be considered at the Site, and develops the remedial alternatives to be analyzed in detail.
7. Detailed and Comparative Analysis of Remedial Alternatives	Analyzes the remedial alternatives in detail against NYSDEC-approved criteria and presents a comparative analysis of the alternatives.
8. Conclusions and Recommended Remedy	Summarizes and discusses the results of this RAR. Also provides the information necessary for the NYSDEC to publish a notice in the *Environmental Notice Bulletin*.
9. References	Presents a list of references used in this report.

This RAR is supported by a number of technical documents, which are provided as appendices and identified below.

- ***Appendix A - Groundwater Modeling Report:*** Describes the numerical, three-dimensional (3-D) groundwater flow model developed by BBL to assess potential containment remedial alternatives for the Site.

- ***Appendix B - NAPL Mobility Calculations:*** Presents numerical calculations regarding dense, non-aqueous phase liquid (DNAPL) flow direction and velocity, and the potential non-aqueous phase liquid (NAPL) mobility following implementation of a proposed remedial alternative.

- ***Appendix C - NAPL Monitoring Data:*** Summarizes the NAPL thicknesses and approximate volume of NAPL removed from Phase II Area monitoring and recovery wells during the NAPL monitoring and removal program initiated by Niagara Mohawk in April 1999. This program is ongoing.

- ***Appendix D - Riverbed Stability Analysis:*** Presents an analysis of the hydrodynamic conditions in the Mohawk River to evaluate the stability of the riverbed under different flow regimes. The analysis was performed using a two-dimensional (2-D) hydrodynamic model called RMA2. This appendix also presents the results of supplemental riverbed activities conducted since completing the Mohawk River Investigation in 2001, including: riverbed reconnaissance, grain size analyses, and bathymetric survey.

- ***Appendix E - Three-Dimensional Data Visualization Model:*** Presents the fully 3-D data visualization computer model of the Site to depict the vast amounts of subsurface data collected during the various investigation activities conducted since 1999.

- ***Appendix F - Evaluation of Suitability of Mohawk Riverbed Materials for Monitored Natural Recovery:*** Presents an evaluation of the composition of polycyclic aromatic hydrocarbons (PAHs) detected in the Mohawk riverbed. The PAH compositions are compared to the conceptual model of PAH emplacement and the current riverbed stability analysis, thereby developing an understanding of the potential for monitored natural recovery (MNR) as a remedial alternative for the Mohawk River.

2. Background Information

This section summarizes the background information as it pertains to the development of this RAR, including a summary of site features, site history, and prior investigation activities. In addition, this section summarizes the IRM activities that have been completed at the Phase II Area to date.

The background information used in this RAR was obtained primarily from the project-related documents (listed below) that were developed as a result of the investigation activities conducted between 1999 and 2002 and the IRM conducted between July 1999 and January 2000 at the Site.

- Harza Northeast's (Harza's) February 1999 *Preliminary Site Assessment* (PSA) *of the Amsterdam Riverlink Park* (Harza, 1999a), and July 1999 *Sediment Sampling Report* (Harza, 1999b);

- BBL's *Preliminary Interim Remedial Measure Investigation Report, Greater Amsterdam Riverlink Park Amsterdam (Front Street) Former MGP Site* (IRMI Report) (BBL, 1999b); *Phase II Area Investigation Report, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site* (BBL, 2001); and *Mohawk River Investigation Summary Report, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site* (BBL, 2002); and

- BBL's *Final Engineering Report, Riverlink Plaza Area, Interim Remedial Measure* (IRM Report) (BBL, 2003).

2.1 Site Description and Features

The Park is located along the northern bank of the Mohawk River/Erie Canal in Amsterdam, New York, just southeast of the State Route 30 bridge. The Park covers an area of approximately 4.75 acres and consists of two adjacent properties -- the NYSDOT property to the west and the NYSCC property to the east (Figure 1). Assessment and remedial activities for the Park have been divided into the Phase I and Phase II Areas; these areas are described below:

- The Phase I Area encompasses the NYSCC property and a small portion of the eastern end of the NYSDOT property. An active terminal wall is located along the southern side of the Phase I Area. This terminal wall was rebuilt by the NYSCC in 1998 to replace the pre-existing deteriorating terminal wall. The Phase I Area of the Park was officially opened on June 15, 2001.

- The Phase II Area encompasses the balance of the NYSDOT property and is the subject of this RAR, along with the portion of the Mohawk River near the Park (collectively referred to herein as the "Site"). Current conditions in the Phase II Area generally consist of an unvegetated or lightly vegetated ground surface with a riprap-covered riverbank along the southern edge of the area. An 8-foot high chain link fence is located along the northern, eastern, and western borders of the Phase II Area.

A storm sewer traverses the Park, roughly north to south, near the Phase I/Phase II Area boundary line and discharges to the Mohawk River via a 30-inch diameter outfall. This system is located approximately 10 to 15 feet below grade and drains surface water runoff from the Phase I Area. Storm water from the City historically discharged through this system, but was rerouted during the Park construction to discharge through a 60-inch diameter located approximately 25 feet upstream of the Phase II Area, near the State Route 30 bridge. This bridge, constructed between approximately 1968 and 1972, traverses over the western portion of the Phase II

Area and an abutment for the bridge is located within the Phase II Area. An overhead pedestrian bridge and a support tower are located near the northeastern corner of the Phase II Area.

The portion of the Mohawk River adjacent to the Park is located between Locks 10 and 11 of the New State Canal System. The lock system was installed in 1918 to provide flow control methods to reduce ice-related flooding. The water level of the Mohawk River is regulated by a series of dams and locks, with the river level being raised each April by closing a series of dams so that the average high water level is attained by May 1, when the river is opened to commercial and recreational boat traffic. The river is then lowered each November, with a net change in the river level between the summer and winter seasons within the Site of approximately 10 feet.

The width of the Mohawk River near the Park ranges from approximately 500 feet at the State Route 30 bridge to approximately 1,000 feet just east of the eastern end of the terminal wall as shown on Figure 2. Given the fluctuations of the river level caused by the operations of the canal system and the narrowing of the river near the State Route 30 bridge, the riverbed in the area of the Park is extensively scoured; therefore, the riverbed is essentially void of soft, fine-grained material. In the area of the Park, the riverbed and riverbanks are generally armored with cobbles, boulders, and gravel.

Two areas in the Mohawk River are addressed in this RAR, as detailed in a technical memorandum attached to Niagara Mohawk's March 14, 2003 letter to NYSDEC (Morgan, 2003c) and summarized in Section 4 of this report: an approximate 1-acre area, which measures about 550 feet long and up to 100 feet wide, located adjacent to the Phase II Area riverbank; and an approximate 0.1-acre area, which measures about 150 feet long and 40 feet wide, located at the eastern end of the Phase I Area, downstream of the first area. Figure 2 presents the approximate boundaries of these areas, and Section 4 presents more information about these areas addressed in this RAR. In a June 19, 2003 letter, the NYSDEC approved these two areas to be considered in the RAR (Spellman, 2003a), with the condition that a post-remedial monitoring program be implemented.

2.2 Site History and Project Background

Based on the findings of Harza's PSA (Harza, 1999a), the general history of the Phase I and Phase II Areas is summarized as follows:

- Chuctanunda Gas Light Company began operating an MGP on the NYSDOT property in 1866; MGP operations continued until the 1930s. In 1930, Chuctanunda Gas Light Company merged with New York Power and Light Corporation, a corporate predecessor of Niagara Mohawk. Around 1963, the NYSDOT appropriated the property from a Niagara Mohawk predecessor to construct the State Route 30 bridge over the Mohawk River. Construction of the bridge began around 1968 and was completed in 1972.

- The MGP operations changed and increased in production and capacity though time. At the time of shutdown, the MGP appears to have consisted of three gas holders (Gas Holders Nos. 1 and 2 were apparently constructed with below-grade foundations, while Gas Holder No. 3 was apparently constructed with a foundation at grade), several retort buildings, three purifying buildings, and several associated support buildings and structures (e.g., boiler, coal shed, tool shed, and tar well). Figure 1 shows the approximate locations of the historical buildings and known sub-grade structures formerly located onsite.

- The NYSCC property was used as a canal terminal for loading and unloading commercial goods along the Erie Canal. Commercial buildings, including warehouses, were present in the eastern portion of the Park from the 1920s until the 1960s, and were demolished by 1968.

As previously mentioned, the Phase I and Phase II Areas are being redeveloped by the City into a waterfront park. In 1998, the redevelopment project was delayed by the discovery of subsurface impacts relating to the former MGP. The NYSDOT reported the discovery of the subsurface impacts to the NYSDEC (NYSDEC Spill Report Case Number 9805979). On August 24, 1998, the NYSCC issued a Stop Work Order to the City and all construction activities were suspended. Subsequently, the NYSDOT retained Harza to perform a PSA of the Park. The PSA, which included soil, groundwater, and sediment sampling, was performed in 1998 and early 1999. The investigation results were submitted to the NYSDEC in the *PSA Report* (Harza, 1999a) and *Sediment Sampling Report* (Harza, 1999b).

From April to June 1999, Niagara Mohawk performed an Interim IRMI for the Phase I Area to generate information to develop an IRM Work Plan for the Park. The IRMI included a soil and groundwater investigation, vapor monitoring, and a NAPL assessment. The results of the IRMI were submitted to the NYSDEC in the IRMI Report (BBL, 1999b).

From July 1999 to January 2000, an IRM was performed to remediate a portion of the Park so that development activities could recommence. The results of the IRM were submitted to the NYSDEC in the IRM Report (BBL, 2003). The IRM activities implemented at the Park included:

- Excavation of soil from the Riverlink Plaza Area to remove MGP-related source materials (including the contents and concrete base of Former Gas Holder No. 3, associated MGP-related source materials, and concrete piles underneath the concrete base) and to provide for a 2-foot soil cover.

- Placement of backfill to provide for a 2-foot soil cover (less the depth of topsoil to be placed by the Redevelopment Contractor) in areas that were not to be covered by structures as part of the redevelopment of the Riverlink Plaza Area, and to provide grade elevations in the other areas that facilitate, to the extent appropriate/practicable, the redevelopment of these areas.

- Modification of the existing storm sewer catch basins to minimize the potential for vapor migration out of the storm sewer system into the Riverlink Plaza Area, in accordance with the specifications provided by The Saratoga Associates (TSA; the Architect of Record for the redevelopment).

- Removal of approximately 500 gallons of tar/water within the tar/water separator structure located below grade and west of the Riverlink Plaza Area, and subsequent removal of the structure and surrounding soil.

- Installation of three NAPL recovery wells to facilitate the collection of NAPL in the areas where measurable thicknesses of NAPL were previously observed in monitoring wells located within the Phase I Area.

- Installation of three "sentinel" wells along the Phase I/Phase II Area boundary to monitor NAPL and, if observed, collect NAPL.

- Handling and treatment and/or disposal of waste materials generated during implementation of the IRM activities, in accordance with applicable rules and regulations.

- Installation of a hot-rolled, interlocking steel sheetpiling shallow barrier wall east of former Gas Holder No. 2 as a means to limit the potential eastern migration of NAPL or oils that may be present within or around this former gas holder.

After substantial completion of the IRM, additional construction work for the Phase I Area of the Park recommenced on September 5, 2000. The official opening for this portion of the Park was held on June 15, 2001.

Since completion of the IRM, Niagara Mohawk has conducted an extensive investigation and evaluation of the Site. Between November 1999 and June 2000, an investigation of the Phase II Area was performed, including the following efforts: geophysical investigation; soil, riverbed material, and groundwater investigations; surface-water and stormwater investigation; NAPL monitoring and removal program; riverbank assessment; qualitative human exposure evaluation; fish and wildlife impact analysis; and cultural resources investigation. The results of the investigation were submitted to the NYSDEC in the *Phase II Area Investigation Report* (BBL, 2001); the NYSDEC's letter of May 14, 2001 provided the Department's approval of that report.

On behalf of Niagara Mohawk, BBL performed a series of comprehensive investigative activities in the Mohawk River from May to July 2001, and again in December 2001. The purpose of these investigative activities was to further define the nature and extent of MGP-related constituents in riverbed materials. Reconnaissance riverbed probing was performed, followed by collection of riverbed samples. A southern bank investigation was also performed, across the river from the Park. These activities and the associated results/conclusions were detailed in the *Mohawk River Investigation Summary Report* (BBL, 2002). The NYSDEC accepted this report as final in an August 26, 2002 letter, but also stated "the Department does not necessarily agree with the report's arguments regarding the background PAH concentration levels and the origin of PAHs in sediment." Niagara Mohawk responded to the NYSDEC's comment in a September 24, 2002 letter (Stucker, 2002f).

The results of the investigations at the Phase II Area and Mohawk River provide the basis for this RAR; as such, the conclusions presented in those reports are summarized below.

2.3 Summary/Conclusions from Investigations

This subsection presents the summaries and conclusions from the *Phase II Area Investigation Report* (BBL, 2001) and *Mohawk River Investigation Report* (BBL, 2002).

2.3.1 General Site Geology and Hydrogeology

The Phase II Area is generally underlain by four main overburden units, including, from upper to lower units: a fill unit, silt unit, sand-and-gravel unit, and sand-and-silt unit with varying amounts of clay. A clay (which may be a till) unit and lower sand-and-gravel unit are also locally present below the sand-and-silt unit. The fill unit is generally composed of a heterogeneous mix of silt, sand, gravel, shell fragments, demolition debris (including bricks, wood, concrete, metal), subsurface structures (including gas holder walls, foundations of two purifying houses and a coke house, piping likely related to the manufactured gas process, and concrete piers related to the elevated State Route 30 bridge), and MGP-related waste (including ash, ash-like material [potential purifier waste], slag, cinders, hardened coal tar, and coke). Figure 3 presents the location map for geologic cross-sections, which were previously provided to the NYSDEC in the *Phase II Area Investigation Report* (BBL, 2001). The cross-sections are presented on Figures 4 and 5.

The bedrock surface underneath the overburden slopes steeply toward the Mohawk River with a more gentle dip to the east. The slope appears to steepen dramatically near the river shoreline. The bedrock depth beneath the Phase II Area ranges from 5 feet below ground surface (bgs) at soil boring SB-7 (along the northern edge of the

Phase II Area) to approximately 71 feet bgs at MW-4R (near the river). A geotechnical boring completed by the NYSDOT in 1957 along the northern river edge during design of the State Route 30 bridge was advanced to approximately 87 feet below grade, but did not encounter bedrock at that depth.

Three additional geologic cross-sections were included in the *Mohawk River Investigation Summary Report* (BBL, 2002) to support the refinement of the conceptual model for the Site. The locations of the cross-sections are shown on Figure 6, and the cross-sections are presented on Figures 7, 8, and 9. As shown on cross-sections B-B' and C-C' (Figures 8 and 9), the fill and silt units pinch out along the riverbank while the sand-and-gravel unit extends beneath the river, comprising the surface of the riverbed. As shown on Figure 8, the sand-and-gravel unit terminates near the southern bank of the Mohawk River, where clay, silt, and fine sand comprise the native overburden material. The surface of the riverbed is generally covered with coarse gravel, cobbles, and boulders, with some sand and silt in the interstitial spaces between the coarser materials.

Each November, the water level in the Mohawk River is lowered approximately 10 feet over a period of 1 week, causing a rapid discharge of groundwater from the fill and the upper portion of the silt unit as these units dewater. These units rewet in response to the river rise in the spring. Smaller fluctuations in the river level, particularly during the winter when the canal water level is not dam controlled (i.e., run of river, natural flow), causes similar, but smaller drainage and rewetting of the silt unit and possibly portions of the fill, depending on the magnitude of the river elevation change. During the summer, the water table generally occurs in the fill, while in the winter, the water table drops and generally occurs within the silt layer. A more detailed discussion can be found in the *Phase II Area Investigation Report* (BBL, 2001) and in the attached *Groundwater Model Report* completed as part of this RAR (Appendix A).

2.3.2 Phase II Area

A summary of the key findings regarding the nature and extent of MGP-impacted materials within the Phase II Area, as discussed in the *Phase II Area Investigation Report* (BBL, 2001), is provided below. Additional information developed as part of this RAR, and discussed further in Subsection 2.4 below, is also discussed where appropriate.

- Numerous potential sources of MGP-impacted materials are present within the Phase II Area, including in and around former MGP buildings and former utilities/structures.

- No discrete NAPL source areas were identified above the water table, and NAPL occurrence below the water table is widespread.

- NAPL, both DNAPL and light nonaqueous phase liquid (LNAPL), is present in the subsurface below the Phase II Area. In the area between the Phase I Area of the Park and the western side of the State Route 30 bridge, NAPL is present (both as separate-phase tar and sheen) to depths of up to approximately 50 feet below the water table throughout much of the vertical thickness of the saturated overburden. Additionally, NAPL has been observed to discharge to the river along the riverbank west of the existing terminal wall at one small discrete point during the annual lowering of the Mohawk River in 1998 and 1999. Following submittal of the *Phase II Area Investigation Report* (BBL, 2001), BBL conducted riverbank observation activities during the annual lowering of the Mohawk River in 2002 and 2003. The discrete NAPL discharge was observed in 2002; however, during the 2003 lowering of the river, no NAPL or sheens were observed along the riverbank. Hardened, immobile tar is also present on the riprap just east of the State Route 30 bridge.

- NAPL has not been observed in the competent bedrock underlying the area, nor has the bedrock groundwater quality been significantly impacted. The lack of significant impact within the bedrock may be the result of strong vertically upward hydraulic gradients that were observed between the underlying bedrock and saturated overburden along the north side of the river.

- The presence of NAPL in the deep overburden along the north bank of the Mohawk River, when combined with the potential for strong vertically upward hydraulic gradients into the river, suggests a potential for vertical migration of NAPL up into the riverbed from the deep overburden at the Site. Further evaluations, however, conducted as part of this RAR (see the NAPL Mobility Technical Memorandum included as Appendix B) suggest that the observed DNAPLs, if mobile, are sufficiently dense and the vertical component of hydraulic gradients low enough such that the DNAPLs would not be mobilized upward and into the base of the river from the deep overburden.

- Dissolved-phase groundwater concentrations of MGP-related constituents, while causing exceedences of NYSDEC Class GA Standards and/or Guidance Values (NYSDEC, 1998) for groundwater quality criteria in groundwater within the unconsolidated materials below the Phase II Area, were shown to not adversely impact the Mohawk River surface water quality near and downstream of the Site.

- Groundwater from the Phase II Area is not currently used as a source of drinking water. The potential future use of groundwater as a drinking water source will be prevented by imposing a land use restriction in accordance with the VCA (NYSDEC, 1999b). Direct contact with Site groundwater by the general public is not likely because of the depth below the surface to groundwater.

- The Phase II Area was found to be of poor wildlife habitat quality; therefore, no further evaluation of the terrestrial exposure pathway was warranted.

2.3.3 Mohawk River

A summary of the key findings of the investigations performed in the Mohawk River in 1999 through 2002, as presented in the *Mohawk River Investigation Summary Report* (BBL, 2002), is provided below. Additional information developed as part of this RAR, and discussed further in Subsection 2.4 below, is also discussed below where appropriate.

- The borings completed beneath the Mohawk River and on the southern bank of the river have delineated the extent of MGP-related NAPL/sheens below the base of the river. While NAPL was observed as far as 400 feet south of the Site, approximately 40 to 44 feet below riverbed surface, additional borings/monitoring wells on the southern bank, approximately 500 feet south of the Site, did not indicate the presence of NAPL/sheens or significant concentrations of potentially MGP-related constituents.

- The absence of MGP-related constituents beneath the southern bank is likely the result of a change in the geologic conditions present in this area. The southern bank was observed to be underlain by interbedded sand, silt, and clay units that produce horizontal and vertical gradients toward the river. In contrast, measurable vertical or horizontal gradients were not observed in the laterally and vertically extensive sand-and-gravel unit present below the Site. The lack of vertical gradients at locations where DNAPL was observed at depth below the river indicates that the DNAPL has not been and therefore will not likely be remobilized by existing hydraulic stresses (including the seasonal changes in the river level) within the unit

(this is verified by the NAPL mobility calculations discussed in Subsection 2.4 and provided in Appendix B to this RAR).

- The probing information revealed that the river adjacent to the Phase II Area is generally void of fine-grained material with only a very limited area located just downstream of the terminal wall. Within 50 feet of the shoreline adjacent to and downstream of the Phase II Area, PAHs were detected in the surficial riverbed materials at concentrations that were locally at and above those reported in background samples within the river. Some of the PAHs detected within the samples are related to MGP byproducts. Elevated concentrations of MGP-related PAHs and MGP-related sheens/NAPL were also reported at significant depths (of up to 44 feet below riverbank surface) in locations toward the center and southern half of the river.

- A comparison of the mean total PAH concentration from riverbed samples collected upstream and downstream of the Site showed no statistical difference at a 95% confidence interval. Additionally, benthic aquatic life toxicity criteria (both NYSDEC [1999] and other related criteria) were exceeded in both upstream (background) and downstream samples. Exceedences near the Site were restricted to within approximately 50 feet , as measured into the river from the north bank/terminal wall of the Mohawk River. Elevated concentrations of PAHs were noted in surficial background samples and visual observations indicate that these materials may be subject to erosion and transported downstream during the low (winter) river water levels. A compositional analysis of PAHs from this deposit suggests that these are background PAHs that are non-MGP-related. Compositional analysis also indicates that surficial riverbed samples which contain MGP-related PAHs exhibit compositional features resulting from natural attenuation processes and/or mixing with background-derived PAHs.

- The criteria-specific analyses presented in the Fish and Wildlife Impact Analysis performed as part of the Phase II Area Investigation identified the potential for ecological effects, based on a comparison of riverbed data to conservative non-Site-specific screening values (BBL, 2001). Further analyses indicate that PAHs have the highest potential for ecological effects (based on the frequency/magnitude of screening value exceedence). Total PAH concentrations throughout this area of the Mohawk River (including areas well upstream of the Site and on the opposite side of the river) frequently fall within the range between the Effects Range-Low (ERL) and the Effects Range-High (ERM) (i.e., 4 to 45 milligrams per kilogram [mg/kg]). Only six of the 22 surficial (top foot) riverbed samples had total PAH concentrations greater than the ERM. Three of these samples were located adjacent to or just downstream of the Park, within approximately 50 feet of the north bank or the terminal wall. The three remaining samples were from an isolated nearshore area immediately upstream of the Park, near a storm water outfall and the State Route 30 bridge. Two of these three samples have PAH assemblages, which suggest that the PAHs in the sample are not related to an MGP source and are consistent with typical urban/industrial background PAH composition formed through incomplete combustion, or pyrolysis, of fuel, wood, and coal. As detailed in the *Mohawk River Investigation Summary Report* (Appendix E - Evaluation of PAH Compositions and Sources), the first line-of-evidence supporting this conclusion was the fluoranthene to pyrene (Fl/Py) thermal signature, which was predominately less than 1 in Site-adjacent samples (consistent with MGP tars associated with carbureted water gas production processes), but was greater than 1 in these samples (SS-2 and SS-3). The second line of evidence supporting this conclusion was the absence of naphthalene, 2-methylnaphthalene, and acenaphthylene in these two samples.

3. Remedial Action Objectives

The NYSDEC approved the following six RAOs for the Phase II Area and the Mohawk River in a November 7, 2002 letter to Niagara Mohawk (Spellman, 2002c):

- RAOs that apply to the Phase II Area:
  - Eliminate, to the extent practicable, discharges of NAPL from the Phase II Area to the Mohawk River; and
  - Prevent exposure to Phase II Area-related constituents in soil and groundwater by the general public/visitors to the Phase II Area once construction of the Park is completed.
- RAOs that apply to the Mohawk River:
  - Prevent, to the extent practicable, human exposure to riverbed materials containing Site-related constituents above background concentrations; and
  - Prevent, to the extent practicable, fish and wildlife exposure to riverbed materials containing Site-related constituents above background concentrations that pose unacceptable ecological risks.
- RAOs that apply to both the Phase II Area and the Mohawk River:
  - Eliminate and/or control the Site-related source(s) of groundwater impacts to the extent practicable; and
  - Restore groundwater quality to prerelease conditions to the extent practicable.

4. Identification of Areas to be Considered

This section describes the Phase II Area and the areas of the Mohawk River addressed in this RAR, and presents details on how these areas were developed and the approvals obtained from the NYSDEC.

4.1 Phase II Area

Figure 1 shows the extent of the approximately 2.1-acre Phase II Area, which comprises the area of the Park owned by the NYSDOT. The Phase II Area is bordered by the Mohawk River to the south, the Phase I Area to the east, active railroad tracks to the north, and the elevated State Route 30 bridge on the west.

In February 2003, Niagara Mohawk formally identified the boundary of the Phase II Area in a letter to the NYSDEC. The boundary is based on:

1) The RAOs presented in Section 3;
2) The findings of the environmental investigations completed to date;
3) The planned redevelopment of the area for future recreational uses; and
4) The interaction between the Phase II Area and the Mohawk River (Morgan, 2003a).

4.2 Mohawk River

Figure 2 presents the boundaries of the two areas to be considered within the Mohawk River:

1) An approximately 1-acre area located along the riverbank adjacent to the Phase II Area; and
2) An approximately 0.1-acre area located at the eastern end of the Phase I Area, downstream of the first area.

4.2.1 Delineation of River Areas

Taking into consideration the varying MGP-related and non-MGP-related sources of PAHs to the Mohawk River in the vicinity of the Site and the RAOs, the following factors were used to select the two areas in the Mohawk River to be considered presented in the March 14, 2003 letter from Niagara Mohawk to the NYSDEC (Morgan, 2003c):

- **Concentrations of PAH compounds detected in surficial and subsurface riverbed materials (down to 2 feet below the riverbed surface) adjacent to and downstream of the Phase II Area.** This provides for a conservative assessment of riverbed materials with the highest potential for human and ecological exposure via direct contact.

- **Concentrations of PAH compounds in surficial and subsurface riverbed materials (down to 2 feet below the riverbed surface) upstream of the Site** to determine whether observed PAH concentrations are influenced by the presence of non-MGP-related sources.

- **Presence/absence of sheens or NAPLs observed in the riverbed material samples.** Sheens or NAPLs in samples collected from the top 2 feet of riverbed material were primarily limited to near shore areas in the

vicinity of Former Gas Holder Nos. 2 and 3. Moving out into the river, a vertical separation of sheens/NAPL was observed (i.e., relatively non-MGP-impacted materials were observed between intervals observed to contain NAPL), and the depth to sheens/NAPL increased with distance from the shoreline.

- **Potential human exposure pathways to riverbed materials.** Human access to the riverbed materials near the Phase II Area is very limited when the Mohawk River is maintained at the high water mark for navigational reasons. The areas where riverbed materials are exposed during winter drawdown were considered when determining the areas of the Mohawk River to be considered.

In a June 19, 2003 letter, the NYSDEC approved these two areas to be considered in the RAR (Spellman, 2003b), with the condition that a post-remedial monitoring program be implemented.

5. Additional Data Collection and Assessments

5.1 General

Since completing the Mohawk River investigation activities in 2001, Niagara Mohawk completed additional field data collection activities, as well as technical data assessment activities needed to fully develop and evaluate remedial alternatives for the Site. The additional field activities were primarily focused on collecting the data required to support the technical data assessments related to the river.

These technical data assessments were completed using data collected during all investigations at the Site, and consisted of:

- Development of a numerical, 3-D groundwater flow model to assess existing conditions and potential containment remedial alternatives for the Site;
- Calculations regarding potential changes in NAPL mobility due to and following implementation of a proposed remedial alternative;
- Analysis of the hydrodynamic conditions in the Mohawk River to evaluate the stability of the riverbed under different flow regimes; and
- Evaluation of the composition of PAHs detected in the Mohawk riverbed. The PAH compositions were compared to the conceptual model of PAH emplacement and the current riverbed stability analysis, thereby developing an understanding of the potential for MNR as a remedial alternative for the river portion of the Site.

The additional data collection activities are briefly described below, followed by a summary of the results of the additional technical assessments.

5.2 Additional Data Collection Activities

The additional data collection activities conduced by Niagara Mohawk since completion of the Mohawk River investigation in 2001 are briefly described in the table below. These activities were presented in Niagara Mohawk's June 20, 2003 letter to the NYSDEC (Morgan, 2003d), with the exception of the riverbank assessment and NAPL monitoring programs.

Timeframe	Summary of Data Collection Activity	Purpose of Activity
April 1999 to present	A NAPL monitoring and removal program was initiated during IRMI activities and is ongoing.	The purpose of this program is to monitor for and remove accumulations of NAPL from wells if there is a measurable thickness of NAPL. A summary of NAPL thicknesses and approximate volume of NAPL removed from the wells is provided in Appendix C.

Timeframe	Summary of Data Collection Activity	Purpose of Activity
April 2003	Riverbank reconnaissance effort, which included photo-logging and measuring cobble size in areas where the riverbed was exposed. This reconnaissance was performed just prior to NYSCC's annual placement of the dams in the Mohawk River to raise the water level to the summer (navigable) water elevation.	As detailed in Niagara Mohawk's June 20, 2003 letter to the NYSDEC (Morgan, 2003d), the information from the reconnaissance effort helped focus the grain size assessment (described below) and is used in the riverbed stability analysis presented in Appendix D. In that appendix, a description of the observed riverbed materials/texture and stability of the fine sediments is provided.
July 2003	Visual observations of the riverbed by divers to evaluate grain size distribution. The divers also collected samples of riverbed material and took both photos and video.	This information is used in the riverbed stability analysis. The results of these efforts are summarized in Appendix D.
July 2003	Bathymetric data were collected from approximately 1 mile upstream of the Site to 3 miles downstream of the Site, with emphasis on the areas to be considered (discussed in Section 4.2).	This information is used as part of the riverbed stability analysis and to aid in remedial alternative development and evaluation. The results of these efforts are summarized in Appendix D.
November 2002 and 2003	Riverbank assessments were conducted during the annual lowering of the Mohawk River. These assessments conducted in November 2002 and 2003 were similar to those conducted in 1998 and 1999, as documented in the *Phase II Area Investigation Report* (BBL, 2001). During the November 2002 assessment, sheens and hardened tar were observed along the riverbank. However, during the November 2003 assessment, no sheens or active NAPL seeps were observed, including the area downgradient of Former Gas Holder No. 2 where the small discrete NAPL seep had been previously observed in 1998, 1999, and 2002.	The observations made during the riverbank assessments are considered in the identification and evaluation of potential remedial alternatives.

5.3 Technical Data Assessment Activities

A brief summary of the groundwater modeling, NAPL mobility assessment, river stability assessment, and the MNR assessment is provided below. As previously indicated, these assessments are provided in the attached appendices.

5.3.1 Groundwater Modeling

BBL developed a 3-D groundwater flow model using the United States Geological Survey (USGS) modular, 3-D, finite-difference groundwater flow model, also known as MODFLOW (McDonald and Harbaugh, 1988). The model represents overburden and bedrock groundwater flow on a regional and site-specific scale. The model was calibrated to existing static and transient conditions and then used to evaluate remedial alternatives at the Site and to predict water table configurations, hydraulic gradients, and groundwater flow rates associated

with potential remedial alternatives, including the effects of seasonal water level changes in the river. The results of this modeling work are summarized below.

- Predictive simulations included various configurations of a modeled barrier wall, assumed to be a sheetpile wall, to serve as a flow barrier and inhibit the potential for NAPLs to migrate to the river. The actual materials, hydraulic properties, and configuration of the barrier wall would be further refined during the remedial design. The findings of the predictive simulation results are summarized as follows:

  - Installation of sheetpiling into or through the sand-and-gravel unit in combination with a low permeability cap over the Phase II Area, even around the entire site perimeter, is not expected to cause the water table to rise to the ground surface either behind (the upgradient side) the sheeting or within the sheeted area.

  - A sheetpile wall installed only along the riverside of the Phase II Area (either through the top third or the entire thickness of the sand-and-gravel unit) will not provide hydraulic gradient control and appears unlikely to mitigate NAPL migration to the river.

  - A low permeability surface cap combined with a sheetpile wall installed to the base of the sand-and-gravel unit around the entire perimeter of the Phase II Area, or the west, south, and east sides of the Phase II Area, was predicted to substantially reduce the hydraulic interaction (in terms of both the groundwater discharge rates and hydraulic gradients) between Phase II Area and the river. These two remedial scenarios produced very similar results in terms of groundwater flow rates and hydraulic gradients, and both of these options were predicted to effectively isolate groundwater within the fill, silt, and sand-and-gravel units beneath the Phase II Area.

  - Installing a sheetpile wall would impede lateral flow to the river and protect the river with respect to horizontal NAPL migration from the Phase II Area to the river. Groundwater discharged into the area from upgradient (through bedrock) from below the wall and produced by recharge (assumed to be 1 inch per year through the cap) will gradually migrate beneath the wall, but as discussed in the *Phase II Area Investigation Report* (BBL, 2001), the reduced groundwater discharge to the river associated with this remedy will further reduce the already acceptable dissolved-phase loading to the river. The vertical components of the hydraulic gradient inside the sheetpile wall where LNAPL has been observed, or outside the sheetpile wall where DNAPL has been observed, were predicted to be minimal, even during river-drop events at the end of the boating season.

5.3.2 NAPL Mobility Assessment

A separate NAPL mobility assessment was prepared to evaluate potential mobility of LNAPL and DNAPL associated with the Site using the hydraulic gradients calculated by the groundwater flow model, plus the measured physical properties of LNAPL and DNAPL samples collected at the Site. The results of this assessment are summarized below.

- A barrier wall to the base of the sand-and-gravel unit around three or four sides of the Phase II Area, combined with a low-permeability cap, is expected to be highly effective at mitigating the potential for NAPL discharge to the river. LNAPLs with densities similar to or less than the measured value of 0.987 grams per milliliter (g/mL) would not be mobilized downward inside the proposed barrier wall based on simulated hydraulic gradients, even when the river level drops abruptly at the end of the boating season.

DNAPLs could migrate downward and under the barrier wall. DNAPLs with density values within the measured range of 1.008 to 1.066 g/mL (or denser), however, would not migrate upward due to the upward groundwater flow beneath the Mohawk River based on simulated hydraulic gradients, even when the river level drops abruptly at the end of the boating season.

- Based on the above assessment, the NAPLs observed at the Phase II Area have densities which would prevent them from entering the river if the barrier was in place. Given the modeled gradients, the range of density values whereby NAPL may be dense enough to migrate downward under the barrier wall and also light enough to migrate upward into the base of the riverbed is extremely limited (between 0.9986 and 1.001 g/mL), and it is possible that these neutrally buoyant NAPLs (if any are present) would be impeded with respect to vertical flow due to the capillary resistance of the geologic media. Neutrally-buoyant NAPLs, if present and at saturations above residual (mobilizable), would migrate extremely slowly. The total estimated travel time for neutrally buoyant NAPL to migrate down under the wall and up into the riverbed is over 680 years, accounting only for travel within the sand-and-gravel unit and neglecting travel through the fine sand and silt which would be located below the proposed barrier wall.

- Horizontal migration of LNAPL from the Phase II Area toward the river, if currently occurring, will be impeded by the proposed barrier wall.

- LNAPL currently in the shallow subsurface beneath the Mohawk River outside of the proposed barrier wall will continue to be subjected to very strong, rapidly changing hydraulic gradients. In this context, any mobilizable LNAPL (if present) beneath the river will be reduced to residual distribution and subject to enhanced dissolution and aerobic biodegradation. If mobilizable LNAPL exists outside of the proposed barrier wall and is not already reduced at residual saturation, it would discharge to the river within an estimated period of 1 to 2 years. However, the lack of visible NAPL or sheens during the most recent river-drop event and during the recently completed diving survey of the riverbed suggests that the LNAPL beneath the river, if it had been present in the past at a mobilizable saturation, is already reduced to residual saturation.

5.3.3 River Stability Assessment

A riverbed stability assessment was prepared to evaluate existing conditions and the erosion potential of the riverbed materials in the areas to be considered during high flow events. The results of the assessment are presented in Appendix D and summarized below.

- The surficial riverbed materials (determined through field and diver reconnaissance/data collection activities) are generally armored with gravels, cobbles, and boulders. Larger-diameter materials are generally found further into the river. Finer-grained materials present near the surface are located closer to the river's edge. These finer-grained materials are found in layers ranging in thickness from 3 inches to over 10 inches of silt overlaying larger cobbles and also in the interstitial spaces between the cobbles.

- Review of historical flow records from the nearest continuously monitored gauging station on the Mohawk River (located at Cohoes, New York, downstream of the site) indicate that the Mohawk River experiences high flow events during the non-navigation (winter) season. These higher flow events typically occur in the months of March and April as a result of snowmelt runoff and ice break-up.

- Fine-grained sediments are transient in the Mohawk River within the Site. Scouring of these surficial finer-grained materials has left a layer of material coarse enough to armor the bed from further scour during the high flow events. However, during navigation (summer) season when the river elevation is raised and the river velocities are lower, fine-grained materials may deposit and accumulate (as seen during the diver reconnaissance performed in July 2003).

- Under current conditions, and as part of the transient nature of fine-grained material, the materials that contain site-related and/or non-site related constituents are likely to be eroded during higher flow events and transported, mixed with non-site related constituents, and deposited downstream. The riverbed stability assessment also suggests that fine-grained materials suspended during the high flow event can be deposited along the southern end of the terminal wall in the vicinity of T15-25, as higher flow events recede.

5.3.4 MNR Assessment

As part of the MNR assessment, PAH compositions were compared to the conceptual model of PAH emplacement and the current riverbed stability analysis, thereby developing an understanding of the potential for MNR as a remedial alternative for the river portion of the Site. This assessment is provided in Appendix F.

Based on the results of the MNR assessment, two specific areas (e.g., T7-50 and T15-25) located outside of the winter low-water level in the river and within the limits of the areas to be considered, appear least likely to achieve the RAOs through MNR because of the presence of one or more of the following factors at these locations in the shallow riverbed materials (0 to 2 feet below the surface):

- Elevated concentrations (relative to upstream concentrations) of PAHs; and

- The presence of NAPL, and/or the presence of relatively unweathered assemblages of MGP-related PAHs in the shallow riverbed materials, when associated with elevated concentrations.

In the remaining river-related portions of the Site, PAH compositions of residues in riverbed materials provide a compelling line of evidence for ongoing natural attenuation (NA) of site-related MGP residues, (in addition to the generally low concentrations of PAHs in this area). The residue PAH composition factors suggesting NA include:

- Notably lesser concentrations of 2- and 3-ringed PAHs relative to benzo(a)pyrene (recalcitrant internal indicator used in a United States Environmental Protection Agency [USEPA] study, Brenner et al., 2002) in MGP-related residues in shallow riverbed materials where NA is most active; and

- Increasing extent of weathering/degradation in residues further from the Site, where migration from the Site appears to be less of a factor than mixing of MGP-related residues with ongoing background (i.e., non-MGP-related) sources of PAHs.

In summary, for the areas to be considered, with the possible exception of the two small areas(e.g., T-7-50 and T-15-25), MNR is appropriate as a remedial component for the river based on the following lines of evidence:

- The riverbed is stable below an existing naturally armored gravel, cobble, and boulder layer;
- Erosion of riverbed materials below this armor layer is not anticipated under even extreme flow events (e.g., 100-year flood);
- Under existing conditions (and prior to remediation), the current chemical evidence shows that the fine-grained surficial materials present above the armor layer exhibit significant weathering characteristics and/or characteristics indicating mixing with fine-grained materials from upstream of the Site (that contain non-MGP-related PAH constituents);
- Existing shallow riverbed material PAH concentrations for this area are similar to or below PAH concentrations observed upstream of this area – under current conditions; and
- Remediation, as discussed in subsequent sections, will mitigate potential new discharges to the riverbed from the Phase II Area.

The evidence for ongoing NA of site-related MGP residues and assessment of riverbed stability support a conclusion that the portion of the Mohawk River included as part of the Site is suitable for considering MNR as a remedial alternative.

6. Remedial TMOs Screening and Development of Remedial Alternatives

The screening of remedial TMOs and the development of remedial alternatives for the Site has been a multi-step process due to the complexity of the Site and the number of parties involved. After establishing the Site-specific RAOs (Section 3), Niagara Mohawk presented two groups of potentially applicable TMOs to the NYSDEC in the August 2003 updated outline for this RAR (Morgan, 2003e) – one set for the Phase II Area, and another for the two areas to be considered in the Mohawk River. The NYSDEC approved this outline, including the TMOs, in a September 9, 2003 letter to Niagara Mohawk (Spellman, 2003c).

Based on the NYSDEC-approved RAR outline and TMOs, Niagara Mohawk developed a draft RADD (Morgan, 2003g), which presented a preliminary screening of potential remedial TMOs and identified the proposed remedial alternatives. As noted in Section 1, the purpose of the RADD was to provide a mechanism for discussion between Niagara Mohawk , the NYSDEC, the other Volunteers, and the City during development of the RAR. Submittal of the RADD was followed by a December 10, 2003 Project Team Meeting. Following the meeting, the NYSDEC provided a December 19, 2003 letter to Niagara Mohawk presenting comments on the RADD, including approved remedial components and comments to be addressed regarding the remedial alternatives to be developed in the RAR (Spellman, 2003d). Since the NYSDEC's submittal of that letter and during development of this RAR, a series of Project Team conference calls have been held, as well as a Site meeting on March 19, 2004. The NYSDEC's comments presented in its December 19, 2003 letter and the conclusions from the subsequent Project Team meetings and conference calls held during development of this RAR have been incorporated herein.

In this section, potential remedial technologies are evaluated with respect to effectiveness and implementability in achieving the RAOs. The technologies retained after this screening are used as "building blocks" to assemble remedial alternatives for detailed screening for both the Phase II Area and the Mohawk River. General summaries of the TMOs for the Phase II Area and the Mohawk River are presented below, followed by the screening evaluation of the various TMOs. A summary of the TMO screening process for the Phase II Area and the Mohawk River is presented in Tables 1 and 2, respectively.

6.1 Technology/Management Options

General summaries of the TMOs for the Phase II Area and the Mohawk River are presented in the subsections below.

6.1.1 Phase II Area

The TMOs described and evaluated in this subsection provide a range of potential onsite remedial options for the Phase II Area. The use of offsite commercial facilities, in accordance with applicable rules and regulations, will also be incorporated, as appropriate, into the alternatives developed and evaluated in this document. An example of an offsite commercial facility is the Environmental Soil Management, Inc. (ESMI) low-temperature thermal desorption (LTTD) facility located in Fort Edward, New York, where MGP-related source materials removed during the 1999 IRM were treated and recycled. Because offsite commercial facilities are available,

they are retained and an evaluation/screening of offsite treatment/destruction options is not necessary and has not been included in this screening.

The TMOs identified as potential approaches to address site-related MGP materials in the Phase II Area include:

- Institutional controls;
- Onsite treatment;
- Removal;
- Engineered containment (capping);
- Source (NAPL) control; and
- Groundwater control/treatment.

These TMOs are briefly described below; the NYSDEC previously approved these TMOs in a September 9, 2003 letter to Niagara Mohawk (Spellman, 2003c).

6.1.1.1 Institutional Controls

Institutional controls generally consist of nonintrusive, legal, and/or administrative controls that reduce the potential exposure to MGP-impacted materials and/or mitigate the potential for jeopardizing the integrity of a remedy. These types of controls could be implemented as the primary remedy or in conjunction with other remedial technologies. In accordance with Paragraph XI of the VCA, institutional controls include prohibiting the Site from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting use of Site groundwater without treatment (NYSDEC, 1999b). Additionally, institutional controls can also specify procedures to protect and maintain the integrity of a remedy and associated engineering controls, and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities about health and safety considerations associated with MGP-impacted materials.

6.1.1.2 Onsite Treatment

Destruction, separation/treatment, and solidification/stabilization (S/S) are potential onsite treatment options to address MGP-impacted materials (soil and debris) in the Phase II Area. Onsite, MGP-impacted materials could be treated in-place (in-situ), or removed and treated above-grade (ex-situ). Due to Site-specific considerations, including schedule and space limitations, onsite, ex-situ soil/debris treatment options have not been included in the TMO evaluation/screening. Offsite commercial treatment/disposal facilities will be incorporated, as appropriate and in accordance with applicable rules and regulations, into the alternatives developed and evaluated in this RAR.

Before implementing an in-situ technology, treatability testing would be necessary to evaluate effectiveness and determine design/operating parameters and other factors that are related to using an in-situ technology. In-situ treatment technologies are briefly described below.

- Destruction technologies destroy or detoxify the materials using chemical, thermal, and/or biological methods. Chemical methods employ the addition of oxidizing agents to chemically convert/degrade organic constituents to less toxic by-products. Thermal methods employ heat, and include (for example) dynamic underground stripping (steam stripping) combined with hydrous pyrolysis/oxidation (DUS/HPO).

Biological methods include using microorganisms in an aerobic or anaerobic environment to degrade the MGP-related constituents.

- Separation/treatment technologies separate or concentrate the constituents of interest for further remediation. In-situ separation/treatment technologies include flushing, in-situ thermal desorption, and soil vapor extraction (SVE). For these in-situ technologies, flushed constituents and NAPLs are typically recovered and then treated or disposed in accordance with applicable rules and regulations.

- S/S processes immobilize constituents of interest within a solid mass (monolith) by injecting and mixing an immobilization agent into the soil. A variety of agents (e.g., portland cement, lime kiln dust, polymerics, and proprietary agents) are utilized.

6.1.1.3 Removal

Removal includes the physical removal of MGP-impacted materials (e.g., NAPL-impacted soil, MGP waste, structures, and piping) for subsequent treatment and/or disposal. Removal may also be conducted to facilitate construction of certain remedies, for example, a containment system. Typical excavation equipment would include excavators, backhoes, front-end loaders, bulldozers, compactors, scrapers, bucket-mounted cranes, and dump trucks.

6.1.1.4 Engineered Containment (Capping)

As a form of engineered containment, capping involves the covering or encapsulating of MGP-impacted materials with "clean" material(s) (e.g., clay, soil, asphalt, concrete, a synthetic membrane, and/or a building foundation) to mitigate exposure to Site-related constituents.

6.1.1.5 Source (NAPL) Control

Source control includes technologies that involve containing and/or controlling discharge of NAPL to the Mohawk River, and active or passive recovery of NAPL. NAPL containment options include: physical barriers (e.g., barrier walls), hydraulic containment, changing the physical properties of the NAPL, and density-based separation.

6.1.1.6 Groundwater Control/Treatment

Groundwater control includes technologies that control the discharge of MGP-impacted groundwater from the Phase II Area to the Mohawk River by actively pumping groundwater from the area. These technologies also include the removal of groundwater behind a physical barrier for hydraulic control. Groundwater treatment, whether in-situ or ex-situ, includes technologies that destroy constituents of interest present in groundwater or separate these constituents from the groundwater.

6.1.2 Mohawk River Areas

The August 2003 RAR Outline (Morgan, 2003e) identified five TMOs as potential approaches to address the riverbed materials impacted by MGP-related materials (PAHs and NAPL) in the two Mohawk River areas. These TMOs include:

- Institutional controls;
- In-situ treatment technologies;
- Removal;
- In-situ containment; and
- MNR.

Each of these TMOs is summarized below.

6.1.2.1 Institutional Controls

Institutional controls generally consist of nonintrusive, legal, and/or administrative controls that reduce the potential exposure to MGP-impacted materials and/or mitigate the potential for actions that could jeopardize the integrity of a remedy. For the Mohawk River riverbed materials, institutional controls could include actions such as sign posting to restrict human access to the river bottom during winter drawdown (if exposed), or anchoring restrictions to minimize river bottom disturbance.

6.1.2.2 In-Situ Treatment Technologies

In-situ treatment technologies are designed to immobilize, extract, and/or destroy organic constituents without removing them from the aquatic environment. Technologies that could be practically applied in-situ to treat riverbed materials are limited, due in part to the challenges posed by working through the water column (e.g., accessibility, controlling and monitoring a treatment process), and the saturated and possibly anaerobic condition of the riverbed materials. Two potentially applicable in-situ treatment technologies that were identified and screened include:

- S/S, which involves the injection/mixing of binding agents (e.g., portland cement, lime kiln dust, polymers, and proprietary agents) to alter the physical and/or chemical characteristics of the MGP-impacted riverbed materials and render them unavailable for ecological/human exposure; and

- Biological/chemical treatment, which involves the injection/mixing of microorganisms and/or nutrients (chemicals) to enhance the ongoing biodegradation process and reduce potential ecological/human exposure risks.

Before implementing in-situ treatment, a bench- and/or pilot-scale treatability study would be necessary to determine an effective additive/binding agent, dosage rate/quantity, delivery system, and other factors related to implementing an in-situ treatment technology.

6.1.2.3 Removal

Removal includes the physical removal of MGP-impacted riverbed materials for subsequent treatment and/or disposal. Various riverbed material removal techniques have been applied at other aquatic sites to reduce the potential exposure risks to chemical constituents in riverbed materials and/or prepare the area for cap placement. Depending on site-specific conditions, removal may be performed either through the water column (in-the-wet) using hydraulic or mechanical dredging equipment, or in-the-dry after containment and dewatering of the removal area. The applicability and effectiveness of a specific removal technique would be dictated by factors that include site accessibility, water depth, site hydrology, material composition, and the need for/extent of any subsequent treatment/disposal techniques.

Riverbed materials removed from the Mohawk River will require disposal. Prior to disposal/offsite shipment of the materials, physical treatment (e.g., addition of a stabilization agent) may be required to improve the stability and handling of the materials. After such treatment and subject to satisfying certain disposal requirements, processed materials would either be placed back onsite or be transported to an appropriate offsite facility (e.g., ESMI) permitted to accept such wastes for treatment/disposal.

6.1.2.4 In-Situ Containment

The following two methods of in-situ containment were considered:

- Engineered capping, which would include covering or encapsulating MGP-impacted materials with "clean" material (e.g., gravel, sand, organoclay, geotextile, membranes) and/or armoring to achieve physical, biological, and chemical isolation; and

- Vertical containment such as installing a barrier wall.

The cap and/or barrier wall design would be developed based on factors such as accessibility, NAPL presence and PAH concentrations, water depth and channel configuration (i.e., whether there is potential to hinder flow and/or navigation), hydrologic considerations, and the geotechnical characteristics of the materials to be capped or contained.

6.1.2.5 Monitored Natural Recovery

This TMO would include physical, chemical, and biological processes whereby concentrations of PAHs associated with MGP-impacted materials decrease, thus reducing the potential exposure risks to these materials. MNR would involve collecting and analyzing riverbed samples and/or performing visual reconnaissance to track conditions over time.

6.2 TMO Screening Evaluations

Potentially applicable TMOs and associated potential technology types and process options were previously agreed upon by the NYSDEC for both the Phase II Area and the areas of the Mohawk River to be considered. The identified TMOs and associated technology types were subjected to an initial screening on the basis of

effectiveness and implementability in achieving RAOs. The approach used in evaluating each TMO against these criteria was as follows:

Effectiveness

This criterion was used to evaluate the extent to which the technology or process option will mitigate potential risks to human health and the environment by achieving the identified RAOs, as well as the extent of reduction in toxicity, mobility, and/or volume of constituents in the affected media, as applicable. Experiences at other sites were taken into account, as appropriate, and both short- and long-term effectiveness were considered.

Implementability

This criterion was used to evaluate both technical and administrative implementability issues including: the ability to construct, reliably operate, and meet technical specifications or criteria relevant to each technology or process option; the availability of adequate space to construct and technical specialists to operate the equipment; and the timing and ease to secure necessary predesign data, approvals, and permits. The operation and maintenance (O&M) requirements after remedy implementation were also considered.

In addition, the screening evaluation was based on technical implementability derived from general knowledge, experience at similar sites, professional judgment, and relevant information from the literature. Technologies were not retained for further consideration if they have not been demonstrated to be technically implementable based on site conditions and/or the chemical/physical characteristics of the Site media or materials, or have not been successfully demonstrated (considering effectiveness) elsewhere on a full-scale basis. For example, specific issues that were considered and evaluated include potential property access issues related to mobilizing and transporting construction vehicles and equipment over CSX property to a work area, and issues related to constructing and implementing a potential remedy within the NYSCC's navigation channel and adjacent to the State Route 30 bridge piers and other structures (see Figure 1). Consideration of these potential issues, in conjunction with the timing involved in implementing a TMO (e.g., property access delays, bench-scale/pilot testing, permit requirements, regulatory Agency approvals) and whether such timing was consistent with the overall project schedule for future development of the Site, were also considered.

Implementability also considers the potential that the alternative could be implemented within the timeframe required for the project. Considering the overall project schedule, as presented in Niagara Mohawk's August 12, 2003 letter to the NYSDEC (Morgan, 2003e), construction activities associated with the selected remedial alternative would be targeted for completion during the fall or winter months of 2005/2006 when the Park and canal are not in use, to allow construction of the Park in the Phase II Area as early as spring 2006.

The results of the screening evaluation of process options for the Phase II Area and riverbed materials are summarized below. The process options retained after the screening are assembled into proposed remedial alternatives that are subjected to a detailed evaluation in Section 7.

6.2.1 Phase II Area Technology/Management Options

The TMOs identified to address the MGP-impacted materials within the Phase II Area include:

1) Institutional controls;
2) In-situ destruction;

3) In-situ separation/treatment;
4) In-situ S/S;
5) Removal;
6) Engineered containment (capping);
7) Source (NAPL) control; and
8) Groundwater control/treatment.

In this subsection, each TMO is screened relative to effectiveness and implementability. The TMOs and associated technology types and process options identified in this section for the Phase II Area were previously agreed upon by NYSDEC. The TMOs remaining after this screening are assembled into remedial alternatives for detailed and comparative analysis in Section 7.

6.2.1.1 Institutional Controls

Institutional controls generally consist of nonintrusive, legal and/or administrative controls that reduce both the potential exposure to MGP-impacted materials and/or the jeopardizing of the integrity of a remedy. These types of controls could be implemented as the primary remedy or in conjunction with other remedial technologies to achieve RAOs.

As discussed in the VCA (Paragraph XI), institutional controls for the Phase II Area include prohibiting the Phase II Area from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting use of site groundwater without treatment, without the express written waiver of such prohibitions by the NYSDEC (NYSDEC, 1999b). Additionally, institutional controls can also specify procedures to protect and maintain the integrity of a remedy and associated engineering controls, and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities on the Phase II Area of health and safety considerations associated with MGP-impacted materials.

Effectiveness

Institutional controls would reduce the potential exposure to MGP-impacted materials and/or mitigate the potential for jeopardizing the integrity of a remedy but would not, on their own, achieve the RAOs for the Phase II Area. These types of controls would remain in effect as long as the presence of MGP-impacted materials within the Phase II Area pose potential risks to human health and the environment, and until the restrictions are waived with the written consent of the NYSDEC in accordance with the VCA (NYSDEC, 1999b).

Implementability

Institutional controls are both technically and administratively implementable; require minimal activities, personnel, and equipment; and continue over the long term. The institutional controls for the Phase II Area would be administered by the NYSDOT, the owner of the property.

INSTITUTIONAL CONTROLS SUMMARY

Institutional controls would not, on their own, achieve the RAOs for the Phase II Area; however, when used in conjunction with other TMOs, they would effectively contribute to overall achievement of the RAOs. Institutional controls, in conjunction with other TMOs for the Phase II Area, have been retained for inclusion as a component of one or more proposed Site-wide remedial alternatives.

In accordance with the VCA, institutional controls must be a component of the remedy for the Phase II Area (NYSDEC, 1999b).

6.2.1.2 In-Situ Destruction

Destruction technologies destroy or detoxify materials using chemical, thermal, and biological methods. Chemical oxidation includes the addition of oxidizing agents (e.g., Fenton's Reagent, hydrogen peroxide, ozone) to chemically convert/degrade organic constituents to less toxic by-products. Dynamic underground stripping combined with DUS/HPO is an in-situ thermal destruction technology that requires recovery of mobilized constituents and NAPL, with subsequent treatment/disposal. Biodegradation includes using microorganisms in an aerobic or anaerobic environment to degrade the MGP-related constituents.

Effectiveness

Several site-specific considerations would limit the overall effectiveness and implementability (discussed below) of any in-situ treatment for addressing MGP-impacted materials present in the Phase II Area, and would render the treatment process difficult to control and monitor. These considerations include widespread presence of NAPL below the water table; limited available space for above-grade treatment/ancillary activities; considerable depth of MGP-impacted material; heterogeneity of subsurface; presence of State Route 30 bridge piers and other structures; proximity to the Mohawk River; and scheduling constraints to meet the stated objective of completing the remedial construction activities before spring 2006 to allow the construction of the Park on the Phase II Area.

Implementability

The success of DUS/HPO depends upon heating subsurface soil and groundwater to boiling temperatures and capturing the mobilized NAPL and MGP-related constituents. The proximity of the Mohawk River, and the hydraulic connection between the river and the sand-and-gravel unit, could make the required process temperatures difficult to achieve/sustain. In addition to the inherent difficulties in mobilizing and capturing NAPL at depth, the hydrogeologic conditions and the proximity of the river would further complicate implementation of DUS/HPO at the Phase II Area. Heating the subsurface could also potentially mobilize otherwise non-mobile NAPL into the river and some heated water may enter into the river. The numerous pieces of process equipment needed to implement the DUS/HPO process would be difficult to set up and operate/maintain in the limited space available in the Phase II Area. Also, DUS/HPO has not yet been well demonstrated full-scale at an MGP site.

Destroying NAPL using chemical oxidation is typically prohibitively difficult due to the volume of reagents required and by the limitations of mass transfer. Biodegradation is also not an efficient remediation technology for NAPL found at the Phase II Area due to availability to microorganisms (USEPA, 2000). In general, biodegradation or chemical oxidation of NAPL is typically considered infeasible.

In addition to the reasons discussed in the preceding text, none of the three types of in-situ destruction has been retained for further consideration due to several reasons. The lack of a discernable NAPL source area precludes using in-situ destruction to treat such an area. Heterogeneous subsurface conditions may cause uneven treatment (and recovery of by products) for in-situ technologies. These conditions, combined with the depth of MGP-impacted materials within the Phase II Area, the shallow depth to groundwater, thickness of the saturated

zone, and proximity of the Mohawk River, would make these processes inefficient and limit their overall effectiveness. In-situ destruction may alter the chemistry and bearing capacity of site soils making it infeasible for areas near the State Route 30 bridge piers and other structures. The timeframe for remedial construction is only 8 months and Park construction may start as soon as spring 2006 – an insufficient timeframe for in-situ destruction to be implemented.

At the December 10, 2003 Technical Team meeting to discuss the RADD, the NYSDEC acknowledged that in-situ treatment is not feasible for the Phase II Area. In addition, in its December 19, 2003 letter to Niagara Mohawk, the NYSDEC did not request that in-situ destruction be considered as a remedial alternative for the Phase II Area.

IN-SITU DESTRUCTION SUMMARY

The lack of a discernable NAPL source area, thickness of the saturated zone, widespread presence of NAPL below the water table, limited available space for treatment operations, considerable depth of MGP-impacted material, heterogeneity of the subsurface, presence of the State Route 30 bridge piers and other structures, proximity to the Mohawk River, and scheduling constraints make in-situ destruction infeasible for the Phase II Area. In addition, chemical oxidation and biodegradation are generally considered infeasible for addressing NAPL, and DUS/HPO has not yet been well proven on a full-scale basis for MGP sites. In-situ destruction may alter the chemistry and bearing capacity of soils within the Phase II Area making it infeasible for areas near the State Route 30 bridge piers and other structures.

For the technical reasons noted above, in-situ destruction has not been retained for further consideration. The Volunteers, City of Amsterdam, and NYSDEC/NYSDOH also previously agreed that in-situ destruction should not be retained.

6.2.1.3 In-Situ Separation/Treatment

Separation/treatment technologies separate or concentrate the constituents of interest for further remediation. In-situ separation/treatment technologies include flushing, in-situ thermal desorption, and SVE. For these in-situ technologies, flushed constituents and NAPLs are typically recovered and then treated or disposed of in accordance with applicable rules and regulations. In most cases, these types of remedial treatment technologies require long-term O&M of onsite systems.

Effectiveness

Several site-specific considerations would limit the overall effectiveness and implementability (discussed below) of any in-situ separation/treatment for addressing MGP-impacted materials present in the Phase II Area, and would render the treatment process difficult to control and monitor. These considerations include widespread presence of NAPL below the water table; limited available space for required above-grade treatment/ancillary activities; considerable depth of MGP-impacted material; heterogeneity of subsurface; presence of the State Route 30 bridge piers and other structures; proximity to the Mohawk River; and scheduling constraints to meet the stated objective of completing the remedial construction activities before spring 2006 to allow the construction of the Park on the Phase II Area. Treatability testing would need to be performed if an in-situ separation/treatment technology was selected as a proposed remedial alternative.

In addition, SVE may not be effective for addressing NAPLs, is not effective for saturated soils, and may have limited effect on PAHs due to their low volatilization potential. Flushing is capable of removing NAPL, however the site-specific considerations summarized above would limit the effectiveness of this type of treatment, including the ability to capture mobilized NAPL.

Implementability

Implementation of any in-situ separation/treatment technology would require long-term O&M, as well as treatment/disposal of recovered constituents and/or materials (e.g., NAPL). Space constraints would make implementation infeasible.

In-situ soil flushing has the potential to remove NAPL, however, the site-specific considerations summarized above would limit its overall effectiveness. Moreover, implementation of this technology has not been well demonstrated as effective for MGP sites. For example, at the Gowanus Former MGP Site in Brooklyn, New York, pilot tests of in-situ flushing (with hot water) and vapor extraction were not entirely successful and a revised remedial plan was developed (NYSDEC, 2001).

In-situ thermal desorption works best in unsaturated conditions (USEPA, 2000). The vast majority of NAPL within the Phase II Area is below the water table, which implies saturated conditions. In addition, in-situ thermal desorption has not yet been well demonstrated on a full-scale basis at a MGP site. At the Gulf States Utilities Company Superfund Site in Louisiana, a pilot-scale test of this technology was unsuccessful in 2001 because the groundwater system was unable to lower the water table enough for the technology to work satisfactorily (USEPA, 2003). Given the hydraulic connection between the sand-and-gravel unit and the river, lowering the groundwater level at that site is not practicable without additional and extensive hydraulic controls (e.g., containment).

Because the vast majority of the MGP-impacted soils are below the low (winter) water table, implementing SVE would require lowering of the water table in excess of 20 feet to increase the unsaturated zone of the soil in which the SVE system can extract volatile constituents. Given the hydraulic connection between the sand-and-gravel unit and the river, it is not practicable to lower the water table sufficiently within the Phase II Area to implement SVE without additional and extensive engineering controls (e.g., hydraulic containment).

In addition to the reasons discussed in the preceding text, in-situ separation has not been retained for further consideration due to several reasons. The lack of a discernable NAPL source area precludes using in-situ separation to treat such an area. Heterogeneous subsurface conditions, including the presence of subsurface structures (e.g., piping, tanks, foundations), may cause uneven treatment for in-situ technologies. These conditions, combined with the depth of MGP-impacted materials within the Phase II Area, the shallow depth to groundwater, and thickness of the saturated zone, would make these processes inefficient and limit their overall effectiveness. Because of the lengthy timeframes required to successfully perform in-situ separation, project scheduling constraints (i.e., Park construction is scheduled to begin in 2006) would also make implementing in-situ separation infeasible.

In-situ separation may alter the soil chemistry and bearing capacity making it infeasible for areas near the State Route 30 bridge piers and other structures. The proximity of the Mohawk River and the hydraulic connection to the sand-and-gravel unit could make the required process temperatures difficult to achieve/sustain for steam flushing and/or in-situ thermal desorption, and NAPL mobilized by the separation process, in addition to heated water, could potentially be transported into the river.

At the December 10, 2003 Technical Team meeting to discuss the RADD, the NYSDEC acknowledged that in-situ treatment is not feasible for the Phase II Area. In addition, in its December 19, 2003 letter to Niagara Mohawk, the NYSDEC did not request that in-situ separation/treatment be considered as a remedial alterative for the Phase II Area.

IN-SITU SEPARATION/TREATMENT SUMMARY

The lack of a discernable NAPL source area, thickness of the saturated zone, widespread presence of NAPL below the water table, limited available space for treatment operations, considerable depth of MGP-impacted material, heterogeneity of the subsurface, presence of the State Route 30 bridge piers and other structures, proximity to and hydraulic connection with the Mohawk River, and scheduling constraints make in-situ separation/treatment infeasible for the Phase II Area. Furthermore, any in-situ separation/treatment for addressing MGP-impacted materials present in the Phase II Area would be difficult to control and monitor due to site-specific considerations.

For the technical reasons noted above, in-situ separation/treatment has not been retained for further consideration. The Volunteers, City of Amsterdam, and NYSDEC/NYSDOH also agreed that in-situ separation/treatment should not be retained.

6.2.1.4 In-Situ S/S

S/S processes immobilize constituents of interest within a solid mass (monolith) by injecting and mixing an immobilization agent into the soil. A variety of agents (e.g., portland cement, limekiln dust, polymerics, and proprietary agents) are utilized for this purpose.

Effectiveness

Several site-specific considerations would limit the overall effectiveness and implementability (discussed below) of in-situ S/S for addressing MGP-impacted materials present in the Phase II Area, rendering the treatment process difficult to control and monitor. These considerations include widespread presence of NAPL below the water table; considerable depth of MGP-impacted material; heterogeneity of subsurface; presence of the State Route 30 bridge piers and other structures; proximity to the Mohawk River; and scheduling constraints. Additionally, the long-term stability and leaching characteristics of the solidified/stabilized materials are unknown.

Implementability

The heterogeneous nature of the fill unit, including debris and building foundations, and the considerable depth of MGP-impacted material would reduce the effectiveness of implementing and hence distributing the S/S agents. Moreover, there is no discernable NAPL source area where this process could be used and the process may negatively affect the bearing capacity of soils near the State Route 30 bridge piers and other structures. The volume of material onsite would be increased due to the addition of additives.

In-situ S/S has not been retained for the Phase II Area for reasons summarized herein. At the December 10, 2003 Technical Team meeting to discuss the RADD, the NYSDEC acknowledged that in-situ treatment is not feasible for the Phase II Area. In addition, in its December 19, 2003 letter to Niagara Mohawk, the NYSDEC did not request that in-situ S/S be considered as a remedial alterative for the Phase II Area.

IN-SITU S/S SUMMARY

The lack of a discernable NAPL source area, widespread presence of NAPL below the water table, limited available space for treatment operations, considerable depth of MGP-impacted material, heterogeneity of the subsurface, presence of the State Route 30 bridge piers and other structures, proximity to the Mohawk River, possible increase in soil volume, and scheduling constraints make in-situ S/S infeasible for the Phase II Area. Additionally, the long-term stability and leaching characteristics of the solidified/stabilized materials is unknown and site-specific considerations would impact the ability to monitor and control the in-situ S/S process.

For the technical reasons noted above, in-situ S/S has not been retained for further consideration. The Volunteers, City of Amsterdam, and NYSDEC/NYSDOH also agreed that in-situ S/S should not be retained for further consideration.

6.2.1.5 Removal

In the RADD, two levels of soil removal were screened: removal of MGP-impacted materials containing concentrations exceeding the NYSDEC's recommended cleanup objectives presented in Technical and Administrative Guidance Memorandum (TAGM) No. 4046 (NYSDEC, 1994) and removal of discrete NAPL source areas. Neither was proposed in the RADD to be retained for detailed analysis based on the effectiveness and implementability considerations reasons summarized below.

- The lack of a discernable NAPL source area(s) above the winter low water table. The vast majority (95%) of soil containing NAPL in the Phase II Area is located below the winter low water table, which is approximately 15 to 20 feet bgs. Partial removal of MGP-impacted soil/debris from the Phase II Area would not meet or facilitate meeting the RAOs due to the widespread presence of soil containing NAPL below the water table. The only discrete NAPL source area identified in the Phase II Area was the tar/water separator that was addressed during the IRM completed between 1999 and 2000 by Niagara Mohawk. During the IRM, the tar/water separator structure, surrounding soil, and the approximately 500 gallons of tar/water within the structure were removed and treated/disposed offsite.

- Technical impracticability issues associated with removing MGP-impacted materials containing concentrations in excess of the NYSDEC-recommended cleanup objectives in TAGM No. 4046, including the following:

  - Considerable depth of MGP-impacted materials (i.e., up to approximately 70 feet bgs);

  - Presence of State Route 30 bridge piers and other structures; and

  - Proximity of the Mohawk River and hydraulic connection between the sand-and-gravel unit and the river.

The following removal scenarios were specified by the NYSDEC in its December 19, 2003 letter (Spellman, 2003d):

- Remove NAPL, tar, purifier wastes, and associated structures where feasible in the Phase II Area, except for the area under the State Route 30 bridge;

- Remove Former Gas Holder No. 2;

- Remove the purifier waste and dispose offsite; and

- Confirm the contents of pipes with diameters greater than 6 inches, and remove if determined to be a source of MGP impacts.

As mentioned above and shown in Appendix E, the vast majority (95%) of soil containing NAPL in the Phase II Area is below the winter low groundwater level. This depth varies across the Phase II Area but is generally located approximately 15 feet bgs. Excavation below the winter low water table will intersect the sand-and-gravel unit, which is hydraulically connected to the river, at the western edge of the Phase II Area and may locally infringe on the sand-gravel unit elsewhere. This hydraulic connection and the proximity of the Mohawk River, combined with numerous additional technical and feasibility issues associated with excavating saturated soils from considerable depths (e.g., water handling, excavation stability, integrity of adjacent structures, etc.), make removal below the winter low water table impractical for the Phase II Area. This screening will consider both the full and partial removal of MGP-impacted materials (e.g., soil, structures, piping, and purifier waste) above the winter low water table. Removal of materials below the low winter water table and below the elevated State Route 30 bridge will not be evaluated further.

Effectiveness

Removal of all of the soil above the winter low water table at the Phase II Area would likely remove the majority of the onsite structures and associated piping, as well as the purifier waste. This volume is estimated to be approximately 22,000 cubic yards (cy). Based on the results of the 3-D data visualization model (see Appendix E), removing all of this material would only remove approximately 5% of the NAPL-containing soil in the Phase II Area. Removing this minimal amount of NAPL-containing soil would not significantly reduce the volume, toxicity, or mobility of NAPL/tar or satisfy the RAO of restoring groundwater quality to prerelease (i.e., prior to the beginning of MGP operations in 1866) conditions to the extent practicable. Additionally seasonally unsaturated soils (as is the case for the soil above the low water table) are not expected to contain mobile NAPL as the NAPL has likely achieved residual saturation by the seasonal fluctuations of the water table which are accompanied by approximately unit downward gradients. Nevertheless, this removal scenario will be developed into a remedial alternative and analyzed in detail, pursuant to the NYSDEC's request.

In its December 19, 2003 letter, the NYSDEC indicated that the location of Former Gas Holder No. 2 likely represents "a significant source of tar and NAPL that must be removed." While it is clear that Former Gas Holder No. 2 was a source of NAPL /tar and that area around and beneath this holder contains NAPL throughout much of the vertical thickness of the saturated overburden, it is not clear that the holder represents a significant ongoing source. "Free product" was observed in the bottom 1.5 feet of the holder only[1], and this volume of NAPL-containing soil totals less than 500 cy (less than 2% of the volume of material above the low winter water table). The bottom of Former Gas Holder No. 2 is believed to be approximately 13.5 feet bgs (based on SB-11 from the Harza PSA (Harza, 1991a) and, accordingly, does not penetrate the silt, which would likely limit the potential vertical movement of water below the holder. A considerable number of locations near, but outside,

[1] One soil boring (SB-11) and two test pits (TP-1 and TP-33) were completed in Former Gas Holder No. 2. "Free product" and wood chips were observed only in the bottom 1.5 feet of the soil boring (12 to 13.5 feet bgs), which was installed to refusal (assumed bottom of the holder). The two test pits installed in this holder (TP-1 and TP-33) were excavated to approximately 9 feet bgs: TP-33 had brown oil droplets at 8 feet bgs, and TP-1 did not contain NAPL, tar, or oil. Considerable debris was observed in this holder, including: bricks, slate tile, glass, gravel, slag, and cinders.

Former Gas Holder No. 2 contained NAPL, tar, and/or oil, supporting the conclusion in the *Phase II Area Investigation Report* (BBL, 2001) that NAPLs have migrated from this structure, through most of the unconsolidated overburden material along the southern portion of the Phase II Area (see Appendix E). Although Niagara Mohawk does not consider the removal of Former Gas Holder No. 2 to be an effective remedial option for the Phase II Area, it has been retained for detailed analysis at the request of the NYSDEC. Specifically, as discussed and agreed upon during a February 20, 2004 project conference call with the NYSDEC, removal of the holder contents and floor are evaluated in the detailed analysis presented in Section 7.

The NYSDEC also specifies removal of purifier wastes, identifying in its December 19, 2003 letter that the extent is limited, citing five test pits where this material was observed. The NYSDEC identifies the limited volume and presence within "feasible excavation reach" as the basis for requiring removal. As detailed in the Harza's *PSA* (Harza, 1999a), BBL's IRMI Report (BBL, 1999b), and BBL's *Phase II Area Investigation Report* (BBL, 2001), purifier wastes were observed in a number of additional test pits and borings, and therefore the extent is not as limited as identified in the NYSDEC's December 19, 2003 letter (Spellman, 2003d). For example, test pit TP-31 was not included in the NYSDEC's list of five test pits observed to contain purifier wastes. In this test pit, a layer of white ash material with blue and orange staining that was several feet thick (between 3 and 7.5 feet bgs) and approximately 60 feet long was observed at the western end, near monitoring well MW-6 located along the riverbank (see Figure 1). The maximum total cyanide concentrations in the Phase II Area were detected in soil samples collected during the installation of MW-6 at 2 to 4 bgs (280 parts per million [ppm]) and 12 to 14 feet bgs (360 ppm).

Removal of the purifier waste will not significantly satisfy the RAOs, including restoring groundwater quality to pre-release conditions, to the extent practicable based on the following considerations:

- The effects of total cyanide on groundwater were identified as limited. Moreover, studies have shown that greater than 98% of cyanide detected in groundwater at MGP sites is in a complex form with iron, which is much less toxic than free cyanide (Ghosh et al., 1999; ATSDR, 1997).

- Only two of the 47 soil samples collected in the Phase II Area had total cyanide concentrations greater than 100 ppm. As noted above, the two highest concentrations were detected in soil samples collected from the boring completed during the installation of monitoring well MW-6. Total cyanide was detected at a concentration of 280 ppm in the 2- to 4-foot interval from this well location, and 360 ppm in the 12- to 14-foot interval. The total cyanide concentrations were much lower in the deeper geologic units.

- The total cyanide concentration in groundwater collected during the most recent sampling event from the monitoring wells in the MW-6 cluster were all below the groundwater quality standard for cyanide.

- Dissolved cyanide is not impacting the Mohawk River under current, unremediated conditions.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC also identified that the contents of pipes greater than 6 inches in diameter be confirmed and removed if determined to be a source of NAPL (Spellman, 2003d). The full extent of the piping greater than 6 inches in diameter is unknown and likely considerable. During the investigation and IRM activities, a total of 15 pipes were observed to have diameters greater than 6 inches at locations distributed throughout the Phase II Area, excluding the area under the elevated State Route 30 bridge. In addition, 13 pipes with diameters equal to or less than 6 inches were also observed. The piping was observed to be above the winter low water table, was mostly undamaged, and observed to be intact.

Even if all or part of the volume of MGP-impacted materials (e.g., NAPL-containing soils, purifier wastes, and/or piping) located above the low winter water table were removed, potential vapors and odors would still be a consideration for any remedial plan. In addition, removing all or a part of the volume of MGP-impacted materials above the low winter water table would not eliminate the need for health and safety requirements for intrusive activities (institutional controls) due to the MGP-impacted materials remaining onsite. Therefore, addressing piping greater than 6 inches in diameter and purifier wastes are included in the detailed analysis (Section 7) in conjunction with the following removal scenarios:

- Removing MGP-impacted materials as required to support redevelopment of the Phase II Area of the Park and/or implementing other remedial components (e.g., installing an engineered cap across the Phase II Area); and

- Removing MGP-impacted materials above the low winter water table.

Implementability

In general, excavation is a proven process for the removal of MGP-impacted materials, structures, and piping, and is administratively feasible. The materials, equipment, and labor required for excavation activities are readily available. Excavating materials above the winter low water table in the Phase II Area is implementable. As identified above and previously agreed-upon by the NYSDEC and NYSDOT, removal would not be implementable for all areas of the Phase II Area due to stability issues associated with structures such as the State Route 30 bridge piers. During a December 2002 team meeting, the NYSDEC acknowledged that the bridge precludes excavation in the area of Former Gas Holder No. 1. In addition, in its December 19, 2003 letter to Niagara Mohawk, the NYSDEC did not request that removal be considered for this area.

REMOVAL SUMMARY

For the portion of the Phase II Area that is located under the elevated State Route 30 bridge, the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH agree that removal should not be retained for further consideration due to the presence of the bridge piers.

The relatively small portion of MGP-impacted materials above the winter low water table (less than 5% of the total volume of soil containing NAPL at the Phase II Area), including the NYSDEC's consideration of Former Gas Holder No. 2 as a source area, makes removal above this water table not significantly effective for the Phase II Area. Partial removal of MGP-impacted materials, as would be accomplished by removal of the materials above the water table, would not meet or facilitate meeting the RAOs, negate the need to consider potential vapor and odor issues, or eliminate the need for future health and safety requirements for intrusive activities. Removal of MGP-impacted materials, to the extent feasible, including Former Gas Holder No. 2, however, has been retained for detailed analysis at the request of the NYSDEC.

The following three removal scenarios are retained for further consideration for the Phase II Area, excluding the area under the elevated State Route 30 bridge:

- Removal of MGP-impacted materials as required to support redevelopment of the Phase II Area of the Park and/or implementation of other remedial components (e.g., installation of an engineered cap across the Phase II Area);

- Removal of the contents and bottom of Former Gas Holder No. 2; and
- Removal of MGP-impacted materials above the low winter water table (i.e., to the extent feasible).

6.2.1.6 Engineered Containment (Capping)

A multi-layer, engineered cap would extend over the entire Phase II Area, with boundaries to be determined during the remedial design/remedial action. The design of the cap depends (in part) on the City's redevelopment plans for the Phase II Area, and Niagara Mohawk will work with the City's design consultant to dovetail the cap design with the final design for the Park.

The key components of the engineered cap would likely be a gas venting layer, a low-permeability layer, and a protective layer. A passive gas venting layer would be used for control of nuisance odors and/or gases, and to allow for changes in soil gas volume below a low-permeability cap and within the limits of a barrier wall in response to fluctuations in the water table elevation which would be driven by changes in the Mohawk River elevation. The passive system could be replaced with an active system, if determined to be necessary in the future. A low-permeability layer prevents exposure to Site-related constituents by the general public/visitors to the Phase II Area, as well as mitigates potential odors and minimizes infiltration. A protective layer protects the low-permeability layer, provides further exposure prevention, and provides a base for revegetation (as needed). The details for the cap, including grading and surface water controls, will be developed during the remedial design/remedial action.

Long-term institutional controls, including periodic inspection and maintenance, would be required to maintain the engineered cap over time and restrict activities that may impact its integrity. As with the Phase I Area, the City would have responsibility for certain maintenance activities and certifications related to a cap in the Phase II Area. A legal agreement regarding the cap maintenance and monitoring activities would need to be executed. Such an agreement is not yet in-place for the Phase I Area.

Effectiveness

Capping is a proven remedial technology that would be effective over the long-term with proper monitoring and maintenance, but it would not reduce the toxicity, mobility, or volume of MGP-related constituents in the affected media via treatment. An engineered cap would prevent exposure to site-related constituents in soil and groundwater by the general public/visitors to the Phase II Area. Capping of the Phase II Area would not mitigate potential discharges of NAPL from the Phase II Area to the river, but would reduce infiltration. Capping would not eliminate the site-related source(s) of groundwater impacts and would not cause the restoration of groundwater quality to prerelease conditions.

Implementability

In general, engineered containment (capping) is a proven process for addressing MGP-impacted soil, is administratively feasible, and could be readily implemented. Capping has been successfully implemented at MGP sites in New York State, including the Phase I Area of the Site. The materials, equipment, and laborers required to construct an engineered cap are readily available. Niagara Mohawk will work with the City's design consultant to incorporate the final design for the Park in the Phase II Area with the cap design.

ENGINEERED CONTAINMENT SUMMARY

An engineered cap is an effective and implementable option that could be employed at the Phase II Area. While long-term O&M activities would be required to maintain the cap and verify its integrity, implementing these activities would be straightforward. Placing a cap over the entire Phase II Area has been retained for further consideration. An engineered cap is a component of the remedy for the Phase II Area that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH.

6.2.1.7 Source (NAPL) Control

Source control includes placing shoreline hydraulic control to control discharge of NAPL from the Phase II Area to the Mohawk River. One option is a barrier wall that mitigates potential LNAPL seeps and mitigates potential DNAPL migration into the riverbed. Other NAPL containment options include: hydraulic containment, changing the physical properties of the NAPL, density-based separation, and active or passive recovery of NAPL.

Hydraulic containment, whereby the hydraulic gradients are controlled by pumping groundwater to mitigate the potential offsite migration of NAPL, is not feasible for the following reasons:

- Due to the highly permeable sand-and-gravel unit, the pumping rate would be unreasonably high and control may not be achievable;
- The sand-and-gravel unit underlying the Phase II Area is hydraulically connected to the Mohawk River; and
- The seasonally strong gradients would affect pumping rates when the river is lowered and raised.

Changing the physical properties of the NAPL, via chemical oxidation, biodegradation, or thermal means, is not well demonstrated and would take an indeterminate period of time to render the NAPL immobile. In addition, density-based separation would not be effective because of the near neutral density of the NAPL present at the Site.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC stated that "where it is not feasible to remove contaminant source material by excavation, passive or active recovery must be used" (Spellman, 2003d). NAPL recovery in the Phase II Area would fulfill this requirement. Note that excavating MGP-impacted material is discussed in Subsection 6.2.1.5.

6.2.1.7.1 Shoreline Hydraulic Control

Hydraulic control of NAPL would be attained via placing a vertical hydraulic barrier wall around the Phase II Area. Two basic types of containment systems can mitigate NAPL migration: 1) solid barriers that contain both NAPL and groundwater; and 2) perforated barriers that contain NAPL, but allow groundwater to flow through. Solid walls contain NAPL and groundwater by restricting the lateral flow. Perforated (including funnel-and-gate walls) redirect the groundwater through specific openings that could contain media that absorbs NAPL and/or treats groundwater, while the solid sections mitigate NAPL migration. The barrier wall would have a permeability of less than 10^{-7} centimeters per second (cm/sec).

A perforated wall is not feasible at the Site due to the significantly large hydraulic gradients present at the Site; the increased flow through the wall during the lowering of the Mohawk River would overwhelm the NAPL retention media in the gates.

A conceptual-level 3-D groundwater flow model (MODFLOW) was developed to determine the effects of a barrier wall on hydraulic gradients in the Phase II Area, the potential for NAPL mobility resulting from these altered hydraulic gradients, and the hydraulic influences resulting from the annual raising and lowering of the river. The following four barrier wall scenarios were modeled:

- Along the river only, extending through the top third of the sand-and-gravel unit;
- Along the river only, extending to the base of the sand-and-gravel unit;
- Around three sides of the Phase II Area (the river and the eastern and western sides), extending to the base of the sand-and-gravel unit or the top of bedrock, whichever is shallower; and
- Around all four sides of the Phase II Area, extending to the base of the sand-and-gravel unit or to the top of bedrock, whichever is shallower.

A wall that extended to bedrock around the entire perimeter of the Phase II Area was not modeled because of technical impracticability issues associated with installing the wall due to the excessive (greater than 85 feet) and undetermined depth to bedrock at the western end of the Phase II Area along the river edge.

Based on the model, the two scenarios involving only walls along the river were not retained for further consideration; the horizontal gradients may drive NAPL around the western end of the wall in either scenario. In addition, the wall along the river extending through the top third of the sand-and-gravel unit is not deep enough to prevent vertical gradients from mobilizing LNAPL beneath the wall. Additional details regarding the gradients associated different barrier wall configurations are provided in Appendix A.

A wall that encompasses the east, south, and west sides of the Phase II Area and a wall that fully encompasses the area are retained for further consideration. The wall that fully encloses the area would minimize the entry of upgradient groundwater through the Phase II Area. The non-river sides would be advanced to the base of the sand-and-gravel unit or bedrock, whichever is encountered first. The location and depth of the river side wall will undergo detailed analysis in Section 7.

A wall extending to the bottom of the sand-and-gravel layer would provide groundwater relief, while providing protection of the human health and the environment. Additionally, based on the results of the MODFLOW groundwater model, installing this wall should not substantively change the water table contours in or around the Phase II Area, and therefore flooding of the ground surface is not anticipated.

In its December 19, 2003 letter, the NYSDEC stated that groundwater removal must be evaluated because potential infiltration from the north side of the Phase II Area would increase hydraulic pressure within any wall or cap system placed along the river; the removal would relieve hydraulic pressure against any wall or cap system placed along the river during the yearly draining of the canal (Spellman, 2003d). Based on the results of the MODFLOW groundwater modeling performed for the Site, hydraulic control of groundwater is not necessary if the wall is extended to the base of the sand-and-gravel unit rather than bedrock or clay. If the river side of the wall were installed to clay or bedrock, groundwater removal (and treatment/disposal) would likely be

necessary to manage groundwater build-up inside the barrier wall; however, given the lack of a continuous clay unit below the Site and an excessive (greater than 85 feet), and currently unknown, depth to bedrock in some areas of the proposed wall, installation of a barrier wall to clay or bedrock may not be possible. Subsection 6.2.1.8 discusses groundwater removal/treatment.

Groundwater modeling has shown that "increased hydraulic pressure" from the north side of the Phase II Area would not likely be a concern when the wall terminates at the base of the sand-and-gravel unit, if groundwater pump and treatment is not employed (the model also took into account potential discharge of groundwater from bedrock up into the Site). Calculated steady state conditions within the wall area are very similar to observed steady state conditions (at summer canal elevations). Installing the wall to the base of the sand-and-gravel unit would dampen gradients along the river edge and reduce the flux rate of groundwater to the river. Localized and very short duration (days) vertical gradients would occur (both upward and downward, depending on the direction of river elevation change) during annual river lowering/raising. These vertical gradients do not have a significant impact on NAPL migration under remediated conditions.

Based on the results of the modeling, the river side of the wall would extend to the bottom of the sand-and-gravel unit. The top of the wall would be at an elevation similar to western end of the existing terminal wall, and the area behind the wall would be backfilled to the Phase II Area grade. A discussion of the location of this wall and how it would also be an effective TMO for riverbed materials is provided in Subsection 6.2.3.

Effectiveness

Shoreline hydraulic containment would mitigate exposure to site-related constituents in soil and groundwater by the general public/visitors to the Phase II Area once construction of the wall (and associated engineered cap) is completed, and would mitigate potential discharges of NAPL from the Phase II Area to the river. This type of containment would not eliminate the site-related source(s) of groundwater impacts and would not cause the restoration of groundwater quality to prerelease conditions.

Shoreline hydraulic containment would not reduce the toxicity or volume of MGP-related constituents in the affected media. However, the mobility of NAPL would be impeded and the potential for discharge to the river mitigated.

Implementability

In general, shoreline hydraulic control is a proven technique for addressing MGP-impacted sites including NAPL containment, is administratively feasible, and is readily implemented. Barrier walls have been implemented at several other MGP sites in New York State. The materials, equipment, and laborers required to construct a barrier wall onsite are readily available. Proper geotechnical engineering design and construction quality assurance controls will be required for implementing a barrier wall. Care would be taken during the design phase to provide adequate clearance of the State Route 30 bridge pier. The existence of the NYSCC's navigation channel and the presence of the State Route 30 bridge pier must be considered when selecting the alignment of the barrier wall.

The effects of the location of the river-side portion barrier wall are discussed in Subsection 6.2.3.

Keying a barrier wall into a low-permeability layer (e.g., bedrock or clay) versus the bottom of the sand-and-gravel unit may present implementability issues, given the lack of a continuous clay layer and the locally

excessive depth to bedrock. Installing a barrier wall would be easiest in the fall/winter months when the Mohawk River pool elevation and recreational use is at a minimum.

With respect to administrative implementability, access to the river from the north shore would require CSX approval to cross the rail-line with materials and equipment. Access approval would also be required from the NYSDOT and NYSCC to construct access roads and equipment staging areas. Permits, approvals, and land use restrictions for wall locations would be required from the NYSDOT and NYSCC, as would a Section 404 permit from the United States Army Corps of Engineers (USACE). Access and permit approvals are considered achievable, but could take upwards of 1 year to obtain after remedy selection.

SHORELINE HYDRAULIC CONTROL SUMMARY

Containing NAPL via hydraulic containment, changing the physical properties of the NAPL, or implementing density-based separation would not be effective at the Phase II Area due to site-specific constraints. These constraints include the hydraulic connection between the sand-and-gravel unit and the near neutral density of the NAPL present at the Site.

A solid barrier wall that encompasses the east, south, and west sides of the Phase II Area and a wall that fully encompasses the area are retained for further consideration. The eastern, western, and northern sides would extend to the base of the sand-and-gravel unit or bedrock, whichever is encountered first.

A barrier wall is a component of the remedy for the Site that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH; however, the parties involved have not agreed upon the location and depth of the river side wall. In addition to the location of the river side wall discussed in this section (i.e., at the winter low water mark and extending to the base of the sand-and-gravel unit), the NYSDEC has requested that two additional wall locations be considered:

- A single wall installed at the top of bank and keyed into clay or bedrock; and
- A pair of walls – one installed at the top of bank and keyed into the sand-and-gravel unit, and the other installed at the low water line, driven or cut to the mud line, and keyed into clay or bedrock. A liner would be installed between the two walls.

A discussion of how the location of this wall would effect containment of riverbed materials is provided in Subsection 6.2.3.

6.2.1.7.2 NAPL Recovery

NAPL could be collected by vertical wells or collection trenches. A NAPL monitoring and removal program at the Phase II Area began in April 1999 using vertical monitoring wells; this program is ongoing. The recovered NAPL is sent offsite for treatment and disposal. Based on the total amount of NAPL recovered over a more than 4-year period and the decrease in the amount recovered each year (see Appendix C), a relatively limited volume of NAPL is anticipated to be recovered in the future.

Effectiveness

In general, NAPL recovery is a proven and effective process, is administratively feasible, and is readily implemented. As noted above, collection of NAPL via vertical wells has been occurring since 1999, thereby showing its feasibility at the Site. Over time, the removal of NAPL from the Phase II Area would reduce the Site-related sources of groundwater impacts, which, in turn, would help restore groundwater quality.

Implementability

NAPL recovery via wells has been successful at the Phase II Area since 1999; therefore, NAPL recovery via wells could be implemented at the Phase II Area.

Collecting NAPL via collection trenches would also be implementable for the Phase II Area with a downgradient barrier such as a barrier wall. Without some type of downgradient barrier, collecting NAPL via horizontal collection trenches is not implementable due to the strong fluctuations in hydraulic gradients at the Site. These fluctuations in gradients would prevent efficient collection of NAPL. A horizontal collection trench would need to be installed in combination with a barrier wall, and the trench would run parallel to the length of the wall. The expected limited amount of NAPL to be recovered in the future would not justify installing a collection trench.

NAPL RECOVERY SUMMARY

NAPL collection via wells, with offsite treatment of collected NAPL, has been retained for further consideration. NAPL recovery is a component of the remedy for the Phase II Area that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH.

6.2.1.8 Groundwater Control/Treatment

Groundwater control and treatment is not necessary at the Phase II Area unless needed to support implementation of another remedial component, for example, if a barrier wall is keyed into a low-permeability layer such as clay or bedrock. As discussed in Subsection 6.2.3, hydraulic control of groundwater, i.e., pumping and treating groundwater to prevent excessive mounding, may be necessary if a barrier wall is installed to a low-permeability layer.

The groundwater removed from behind the wall would need to be treated prior to discharge to a publicly owned treatment works (POTW) or the Mohawk River, or treated/disposed offsite. Several ex-situ, onsite groundwater treatment technologies are available, including ultraviolet (UV)/oxidation, chemical oxidation, carbon adsorption, air stripping, precipitation/coagulation/flocculation, dissolved-air flotation, oil/water separation, and filtration. These technologies (individually or in combination) may be necessary to treat groundwater. If needed, the exact groundwater treatment process would be determined during remedial design, along with details regarding the discharge.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC cites the potential for lenses of higher permeability to be present in bedrock on the north side of the Phase II Area (where the depth to bedrock is relatively shallow) as the basis for requiring groundwater removal behind the barrier wall (Spellman, 2003d). This is not substantiated by the results of the investigation activities, as summarized below.

- A sand-and-gravel lens was not observed while installing any of the four bedrock wells located along the north side of the Phase II Area, which is only approximately 500 feet long, equating to one well for approximately every 125 feet.

- Establishing the observed gradient between rock and the river prior to and after the canal lowering would not be possible if the rock has a high permeability as suggested by the NYSDEC.

- Higher conductivity lenses were also not observed at other locations where bedrock was penetrated at the Phase II Area. The NYSDEC's contention that a sand lens was observed at MW-1R is interpreted to be a boulder within the overburden materials rather than a sand lens in the bedrock (which is a geologically more plausible explanation).

- While not being direct evidence of the lack of localized higher conductivity lenses in the bedrock, the groundwater modeling completed for the Site (see Appendix A) utilized a hydraulic conductivity for the bedrock of 0.1 feet/day, and the model achieved excellent correlation with observed static and transient head measurements, indicating that the actual overall hydraulic conductivity of the bedrock at the Site is low.

Effectiveness

As previously noted, institutional controls, a barrier wall, and an engineered cap are remedial components that have been agreed to by the Volunteers, the City, and the NYSDEC. With institutional controls, Park users are not and would not be exposed to Site-related constituents in groundwater once construction of the Park is completed. Based on conservative estimates detailed in the *Phase II Area Investigation Report* (BBL, 2001), discharge of groundwater within the unconsolidated materials below the Phase II Area was shown to not adversely impact the Mohawk River surface water quality near and downstream of the Site. Groundwater discharge from these unconsolidated materials would be further reduced after installing a barrier wall and engineered cap.

Implementability

In general, groundwater control/treatment is a proven process for addressing MGP-impacted groundwater, is administratively feasible, and is readily implemented. Long-term O&M would be required.

Implementability of groundwater collection and treatment depends on the degree of hydraulic cut off achieved by the barrier wall and performance requirements. For example, if the performance requirement was defined as maintenance of inward hydraulic gradients, this requirement would not be practicable under times of rapidly dropping water levels in the river (i.e., after decrease in river flow associated with the waning of a storm event or the annual lowering of the river/canal at the end of boating season).

Groundwater removal for hydraulic control may be necessary if the river side wall were perfectly sealed against bedrock. The volume of groundwater to be removed ranges from an estimated 2,600 gallons per day (gpd) to 23,000 gpd depending on whether the river is at a high, static level or is dropping during the fall draw-down of the river.[2] Management of this groundwater would require above-grade support structures/equipment that would

[2] Because a barrier wall extending to the top of bedrock on all sides was not modeled, these volumes are estimated from the groundwater model in which the barrier wall extends to the base of the sand-and-gravel unit or the top of bedrock, whichever is shallower. The lower flow rate assumes static conditions with the river at the summer (high water) elevation and that the barrier wall extends around all four sides of the Phase II Area. The higher flow rate is an estimated maximum transient condition during Mohawk River drop with the barrier wall in place (either on four sides or around the western, southern, and eastern sides of the Phase II Area – the flow rates are the same for both conditions).

limit use of the Phase II Area as a Park. Space constraints would limit the practicability of onsite, long-term groundwater treatment of this volume of groundwater. The need for groundwater removal and the method for treating this water, if generated, would be selected during remedial design/remedial action.

GROUNDWATER CONTROL/TREATMENT SUMMARY

Groundwater control/treatment for remediation has not been retained for further consideration because it is not necessary for the Phase II Area. However, groundwater control/treatment for hydraulic control has been retained for further analysis if the river side of the barrier wall is keyed into bedrock or clay.

6.2.2 Summary of Retained TMOs – Phase II Area

To summarize, the following TMOs were retained for the Phase II Area:

1) Institutional controls;
2) Removal;
3) Engineered barrier (capping);
4) Physical barriers (i.e., barrier wall);
5) NAPL recovery; and
6) Groundwater control/treatment.

6.2.3 Mohawk River TMO Screening Evaluations

The NYSDEC-approved TMOs identified to address riverbed materials within the Mohawk River include:

1) Institutional controls;
2) In-situ treatment;
3) Removal;
4) In-situ containment; and
5) MNR.

The areas to be considered within the Mohawk River are described in Section 1 and shown on Figure 2.

Due to the annual raising and lowering of the Mohawk River and the associated net change in the river level between the summer and winter seasons at the Site (i.e., approximately 10 feet), implementation of active remedial alternatives is anticipated to occur during the winter season (i.e., between November and April), when the water is low. Implementing the selected remedial alternative should be more straightforward, safer, and potential human exposure more easily controlled during the winter when water depths are much lower (particularly for the TMOs that have an intrusive or potentially intrusive remedial component) and human use at and near the Site is minimal. Considering the overall project schedule, as presented in Niagara Mohawk's August 12, 2003 letter to the NYSDEC (Morgan, 2003e), construction activities associated with the selected remedial alternative would be targeted for completion during the fall or winter months of 2005/2006 when the Park and canal are not in use, to allow the construction of the Park in the Phase II Area as early as spring 2006.

6.2.3.1 Institutional Controls

Institutional controls are non-engineering measures intended to influence human activities in such a way as to minimize exposure to impacted riverbed materials. Typically institutional controls are used in conjunction with other remedial technologies and process options to achieve RAOs. Institutional controls include, but are not limited to, access restrictions, land use restrictions, and signage. For onsite impacted riverbed materials, institutional controls may include anchoring restrictions for watercraft associated with protecting an in-situ containment remedy (i.e., an engineered cap) or restrictions on groundwater use. Human exposure to riverbed materials from land is limited due to the relatively steep banks. While access by water is more difficult to control, signs could be placed along the waterways to discourage intentional human disturbance of the potentially impacted riverbed materials, and anchor restrictions could be put in place if needed to maintain an in-situ containment remedy.

Effectiveness

On their own, institutional controls would not achieve the RAOs which apply to the Mohawk River; however, human exposure to Site-related constituents in riverbed materials could be controlled to some extent through access and land use restrictions. Potential ecological exposure to Site-related constituents in riverbed materials would not be directly impacted, except possibly to some extent through anchoring restrictions (it is important to note that the ecological impacts associated with the annual raising and lowering of water levels in the Mohawk River are likely far greater than those related to bottom disturbance caused by an occasional anchor). Institutional controls would not reduce the potential toxicity, mobility, or volume of PAHs in riverbed materials beyond those reductions which have and will continue to occur naturally. Institutional controls are an effective component of a remedy at several other contaminated riverbed material sites.

Implementability

This process option would be both technically and administratively implementable; require minimal space, personnel, and equipment; and continue over the long term. Additionally, because minimal activities would be undertaken, there would be no Site issues to address regarding constructability, logistics, or access and the controls would not present a conflict with the planned future use of the Site. Implementing any access or land use restrictions would require prior approval by the affected property owner(s).

INSTITUTIONAL CONTROLS SUMMARY

Institutional controls would not, on their own, achieve the river-related RAOs; however, when used in conjunction with other TMOs, they would effectively contribute to overall achievement of the Site-wide goals. Institutional controls are retained for inclusion as a component of the proposed site-wide remedial alternatives. Institutional controls are a component of the remedy for the Mohawk River that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH.

6.2.3.2 In-Situ Treatment

Two in-situ treatment technologies were identified based on their assessment at other aquatic sites to remediate riverbed materials containing MGP-impacted materials: in-situ S/S and biological/chemical treatment. In-situ S/S would involve the in-situ injection/mixing of binders, such as cement or pozzolans, to alter the physical and/or chemical characteristics of the riverbed materials, physically or chemically binding the PAH-containing

riverbed materials, immobilizing them, and rendering the chemicals in the materials less prone to leaching and reducing exposure to human and ecological receptors.

In-situ biological/chemical treatment would involve the injection/mixing of microorganisms and/or chemicals such as oxygen and nitrogen into the riverbed materials to accelerate the PAH microbial degradation process.

Several common elements were noted during the evaluation of in-situ S/S and biological/chemical treatment effectiveness and implementability. To avoid repetition, the screening of both technologies is consolidated, with any unique characteristics specifically noted.

Effectiveness

S/S agents and biological enhancement products are likely available that could immobilize or reduce the concentration and mass of PAHs in the Mohawk River materials if the materials were first removed. However, no methods to implement either technology in-situ were identified that would reliably achieve the Mohawk River RAOs and reduce the toxicity, mobility, or volume of MGP-impacted materials present in the riverbed. Important facts considered when assessing in-situ treatment effectiveness included:

- Mohawk River Bottom Characteristics - The river bottom materials adjacent to the Phase II Area are primarily comprised of boulders, cobbles, and gravel. Injection/mixing of binding agents, microbes, and/or chemicals to treat the PAHs in the riverbed materials and effectively reduce ecological/human exposure is not considered feasible due to the presence of these larger-sized materials.

- Lack of Experience at Other Sites - In-situ S/S or chemical/biological treatment has not been successfully implemented full scale to address MGP-impacted materials in riverbeds. In the early 1990s, in-situ S/S of PAH-containing riverbed materials was attempted at the Manitowoc River in Wisconsin by lowering large steel cylinders into the riverbed materials and injecting/mixing a portland cement/fly ash slurry with a large hollow-stemmed Kelly bar. Several problems arose during the process, including release of oils and aqueous phase constituents to the overlying water column, a 3- to 4- foot rise in the riverbed elevation due to bulking and binding agent addition, and the riverbed materials remaining in a semi-solidified state. The Wisconsin Department of Natural Resources (WDNR) determined that the in-situ S/S process did little to treat the riverbed materials (Rehnolds, 1998).

  In-situ biological/chemical treatment of PAH-containing riverbed materials was attempted at Hamilton Harbour in Canada and a former MGP site in Salem, Massachusetts. At both sites, the riverbed materials were comprised primarily of sands and clays, and calcium nitrate was injected into the surficial materials by dragging a narrow-like injection device along the riverbed surface from a barge (Hamilton Harbour) or tractor (Salem). While a reduction in surficial PAH riverbed material concentrations were noted, treatment efficiency was difficult to monitor and accurately quantify (Rehnolds, 1998). Injection/mixing techniques like those utilized at the Hamilton Harbour and Salem sites could not be applied to the cobble material present in the Mohawk River.

Considering the issues identified above, in-situ treatment would not be an effective approach to achieving the river-related RAOs for the Mohawk River.

Implementability

Techniques for in-situ treatment of riverbed materials through enhanced biodegradation are in the early stages of development, and no reliable methods were identified that are commercially available. For any of the in-situ treatment technologies, bench-scale and/or pilot studies would be required to identify effective binding agents, microorganisms/nutrients, delivery systems, mixing methods, and/or surfactants/solvents/oxidants; this process could complicate approvals and would likely delay final implementation beyond the available timeframe (based on the planned expansion of the Park as early as spring 2006).

The presence of boulders, cobbles, gravel, and NAPL in the riverbed materials would likely greatly complicate implementation of any in-situ injection and/or mixing technology. A study of in-situ enhanced bioremediation of PAH-containing riverbed materials at a site in Salem, Massachusetts examined a calcium nitrate injection system that was based on an agricultural harrow being towed behind a tractor at low tide (Rehnolds, 1998). This type of system could not be used in the Mohawk River since the areas that are to be remediated that are exposed during the winter drawdown are covered with large cobbles and boulders and not amenable to harrowing. Further, significant portions of the areas to be remediated remain underwater even during the drawdown, eliminating the possibility of a tractor-based process.

Implementability of S/S would be further complicated by the fact that the binding agents would cause bulking of the riverbed materials, decreasing water depth. As a result, a removal step would likely be necessary to restore the appropriate depth (14 feet) in the navigation channel. This additional step would extend the schedule for the implementation, which could present a problem given the plans for expansion of the Park.

With respect to administrative implementability, access to the river from the north shore would require CSX approval to cross the rail-line with materials and equipment. Access approval would also be required from the NYSDOT and NYSCC to construct access roads and equipment staging areas. Permits and approvals would likely be required to inject/mix chemicals through the water column into the riverbed materials. The time required to complete bench/pilot studies, design the remedy, obtain access/permit approvals and complete remedial implementation (i.e., achieve the Mohawk River RAOs) if determined to be feasible would likely extend far beyond the current schedule for development/use of the Phase II Area.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC did not request that in-situ treatment be considered as a remedial alterative for the Mohawk River. Furthermore, it was agreed during the December 10, 2003 project meeting that in-situ technologies would not be retained for detailed analysis.

IN-SITU TREATMENT SUMMARY

While full-scale in-situ treatment approaches have been used at a limited number of sites with PAHs, no site data are available that demonstrate the long-term effectiveness of these technologies. In a report developed by Rehnolds (1998) on in-situ treatment technologies for riverbed materials, the lack of process control, combined with the inability to deliver the treatment agents to the riverbed materials, were identified as the major obstacles limiting the effectiveness and implementability of in-situ treatment. Success is highly site-specific, and a bench-scale and/or pilot study would be needed to identify effective binding agents, microorganisms/nutrients, delivery systems, mixing methods, and/or surfactants/solvents/oxidants for the riverbed materials present at the Site. In the Mohawk River, implementation would be greatly complicated by the presence and extent of boulders and cobbles, and the depth to some areas of the MGP-impacted materials (noted up to 36 feet). The timing involved in developing and implementing a bench-scale and/or pilot study is not consistent with the overall project schedule for future development of the Site.

For the technical and administrative reasons noted above, none of the in-situ treatment TMOs has been retained for further consideration. The Volunteers, City of Amsterdam, and NYSDEC/NYSDOH agree that in-situ treatment should not be retained.

6.2.3.3 Removal

Dredging is the representative remedial technology associated with the removal TMO. Three process options have been identified under dredging: hydraulic dredging, mechanical dredging in the wet, and mechanical dredging (excavation) in the dry. These three riverbed material removal process options are evaluated below. Although this issue will not be addressed in this RAR, once removed, the materials would be managed in accordance with appropriate rules and regulations.

As described in Section 4, two areas of the Mohawk River are being considered for remedial action: 1) an approximate 0.1-acre area at the eastern end of the terminal wall; and 2) the approximate 1-acre area in front (i.e., the river side) of the Phase II Area. The approximate 0.1-acre area is essentially an isolated deposit where MGP-related PAHs were detected in the top four feet of riverbed materials. This area is completely exposed during the winter season when the water is lowered. Removal of this area was discussed in the RADD, and is retained for detailed analysis in this report. In the approximate 1-acre area, NAPL, sheens, and PAHs were locally detected in surficial materials, and NAPL was observed in certain areas to depths up to 36 feet. The occurrence of NAPL is not continuous either laterally or vertically throughout the approximately 1-acre area.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC requested that Niagara Mohawk include removal of certain areas in the analysis of alternatives for the Mohawk River, including the following riverbed areas (Spellman, 2003d):

- The material between the high water edge and the low water edge, if a barrier wall is installed at the top of bank only (see Subsection 6.2.3.4.2);
- The portion of the 1-acre area outside of the low winter water mark; and
- For the approximate 0.1-acre area, sample points SD-11 and SD-12, based on the same reasoning that suggested removal for sample point T15-25 location.

In the 1-acre area below the low winter water mark, NAPL was observed at sampling location T7-50 from approximately 0.5 to 8 feet. Because this is the only location in the 1-acre area below the winter low water mark where NAPL was observed within the biologically active zone (0 to 2 feet), Niagara Mohawk proposes to remove riverbed materials around this location. In addition, removal of the riverbed materials between the winter low water mark and the outer bound of the 1-acre area (i.e., the southern boundary of this area) will be considered.

Niagara Mohawk does not agree with the NYSDEC regarding the removal requested near locations SD-11 and SD-12[3]. These locations were not retained in the 0.1-acre area for consideration due to the results of

[3]As noted in the March 14, 2003 letter from Niagara Mohawk that identified the areas to be addressed (Morgan, 2003c), Transect T15 had reported total PAH concentrations in the top 2 feet near the upper bounds of the range seen upstream of the Site (i.e., samples SD-11 and SD-12); however, subsequently collected co-located samples (T15-75 and T15-100) showed lower concentrations of total PAHs in

subsequently collected co-located samples (T15-75 and T15-100) that showed lower PAH concentrations. NYSDEC approved the boundary of the 0.1-acre area (Spellman, 2003b) that did not include locations SD-11 and SD-12. Removal near these locations has been retained for further consideration at the request of the NYSDEC.

In addition, removal may be a component of the alternative that includes installing an "impermeable cap" between the barrier walls located at the top of bank and at the low winter water level (see Subsection 6.2.3.4.2).

Many of the factors that impact the effectiveness and implementability of dredging apply to these process options. To avoid repetition, one overarching evaluation is presented after the brief descriptions of each dredging approach, and considerations unique to each dredging technology are identified as appropriate.

Hydraulic Dredging

Hydraulic dredging uses a pump to create a vacuum at the dredgehead to remove and transport riverbed materials in a riverbed material/water slurry. The dredged material is usually pumped through a pipeline to a settling lagoon(s) or tank(s) on land. Environmental dredging using hydraulic dredges typically produces slurries in the range of 3% to 8% solids by wet weight (General Electric Company [GE], 2000). While various types of dredgehead configurations exist, the cutterhead is the most common. The cutterhead applies mechanical force to dislodge the riverbed materials for subsequent removal by the dredge pump. After removal, the riverbed materials would need to be dewatered, and the resulting water would have to be treated to meet relevant standards before being discharged back into the environment.

Mechanical Dredging (Wet)

Mechanical dredging removes riverbed materials by applying direct mechanical force to dislodge and contain the material. The dredged material is then lifted mechanically through the water column, where it is placed onto a barge or land-based vehicles for transport to a dewatering facility. The clamshell bucket is the most common mechanical dredge used in the wet for environmental applications. Although some water is entrained with the riverbed materials during mechanical excavation (wet), the water volume is considerably less than that generated during hydraulic dredging.

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the upper 2 feet of riverbed materials and no sheens were historically observed. Therefore, the proposed 0.1-acre area was defined as being encompassed by a straight line from the end of terminal wall due east to land, a line that coincides with the winter low water mark and the canal boundary. The NYSDEC approved the areas to be considered (Spellman, 2003b) including this delineation of the 0.1-acre area.

Furthermore, diver surveys and sampling of the riverbed in this location during the summer of 2003 found 1 to 4 inches of silt covering a bottom of 3-inch cobbles. In some locations, the 3-inch cobbles could be seen at the riverbed surface. Simulations of typical river flows during summer (navigation) season suggest that this is a possible depositional area during the summer season. However, simulations of higher flow events during the winter (non-navigation) season suggest that the higher flows can re-suspend fine-grained materials in this location. Overall, this would indicate that fine-grained materials are transient in the SD-11, SD-12, T15-75, and T15-100 locations. Fine-grained materials deposit during the summer season and are subsequently re-suspended during higher flows that occur during the winter season.

Review of flow records from continuously monitoring USGS streamflow gaging stations on the Mohawk River indicate two higher flow events occurred between collection of the SD-series samples in November 1999 and T15 sampling in June 2001. To further assess the observation of the transient nature of the fine-grained materials, BBL simulated the high flow events that occurred between the sampling events to evaluate the shear stresses in this area and the potential for re-suspension. The results of this simulation are provided in Appendix D.

Mechanical Dredging (Dry Excavation)

Mechanical excavation of riverbed materials in the dry would require diverting the river around the removal areas. The removal areas are typically segregated into manageable work cells by installing a water diversion/ containment structure (i.e., engineering controls/hydraulic modifications). After installing the structure, a work cell is dewatered. In general, the impounded river water within the work area is initially pumped over the water diversion/containment structure back into the flowing portions of the river. Initial dewatering of work areas and discharge of untreated water to the flowing portion of the river is often performed via a pump suspended above the bottom of the river. When the depth of water in a work area approaches the riverbed materials, water may be subject to additional handling and treatment, prior to discharge.

After completing the activities noted above, riverbed material would be removed in a phased approach. To maintain each area in as dewatered state as possible, incoming water is continuously extracted with pumps. Once excavation activities reach an appropriate depth, one or more sumps are constructed along the sides of the sheeting as needed to direct water to the sumps. After installing a sump(s), removal activities are performed under "dry" conditions (i.e., not through a standing water column) with standard earth-moving equipment.

Effectiveness

Both hydraulic and mechanical dredging are effective means of removing riverbed materials from waterways. These process options have been employed at several sites, including MGP sites, across the country with varying degrees of success. From a general perspective, several factors associated with environmental dredging need to be considered and addressed. The physical mixing action of the dredge stirs up riverbed materials, releasing both suspended solids and dissolved constituents to the water column. To reduce the impacts of downstream transport, environmental dredging areas are typically isolated from the rest of the waterway by engineering controls such as cofferdams (e.g., temporary sheetpile enclosures, Jersey barriers, porta-dams, or earthen berms), silt curtains, or other water diversion/containment barriers. If riverbed materials migrate outside the removal area, resettlement of those materials over a larger surface area in the river is possible. Even with appropriate controls, careful operations, and repeat dredging passes over the target area, experience has shown that some riverbed material is left behind after dredging; in some cases, concentrations of the constituents of concern may be higher in the residual riverbed materials than they were in the surficial riverbed materials prior to dredging. Achieving protective cleanup concentrations in riverbed materials via removal is further complicated when NAPL is present. Excavation in the dry helps to address these issues, and the greater control of excavation depths is possible with the water removed. Any dredging method would result in the temporary destruction of the benthos and habitat in the targeted area.

Effectiveness would also be impacted by site-specific issues. The presence of boulders, cobbles, and gravel on and in the riverbed would likely necessitate using mechanical dredges at least initially, even if hydraulic dredging is the selected option, as these materials would prevent the deployment and optimal operation of a hydraulic dredge. If a water-tight clamshell bucket is used to mechanically dredge in the wet, boulders, cobbles, and other debris can prevent the bucket from closing completely, and the removed riverbed materials can empty out of the bucket as it is lifted through the water column. Riverbed material removal is further complicated when NAPL is present in the material to be excavated. When riverbed material removal processes are employed, NAPL is mobilized to the overlying water column and the riverbed surface due to riverbed disturbance and increased hydraulic gradients (dry excavation), resulting in mobilization/dispersion of NAPL at/to the riverbed surface which can prevent achievement of established cleanup goals. At several NAPL-containing aquatic sites where cleanup goals could not be achieved by removal, a containment component to the remedy (i.e., cap installation post-dredging) was required. With NAPL present at depths up to 36 feet in the

riverbed materials within the Site, achievement of residual riverbed PAH concentrations comparable to background via removal alone is not considered feasible.

Achieving a post-removal performance specification of 4 ppm in the top 2 feet of riverbed material may require cap placement. Given the presence of elevated PAHs in background riverbed material from other sources, long-term attainment of 4 ppm would not be possible. The existence of ongoing background PAH sources from stormwater outfalls and runoff, particularly in the mudflat upstream of the State Route 30 bridge, was discussed in the *Mohawk River Investigation Summary Report* (BBL, 2002). Background inputs of PAHs, which were found at concentrations ranging up to 84 ppm in mudflat sediment, are expected to continue into the future, upstream of the Site. As a result, the 4 ppm total PAH concentration is a likely unattainable performance standard for surficial riverbed materials in the Mohawk River, regardless of the ultimate remedy. Note that the NYSDEC states in its own MGP remediation strategy that 4 ppm is a screening value and may be used as an endpoint to delineate the extent of sediment contamination, but that it is not a remedial action objective (NYSDEC, date unknown).

Removal of MGP-impacted riverbed materials would reduce the volume of MGP-related constituents in the river. In addition, removal would help reduce human and fish and wildlife exposure to Mohawk riverbed materials containing Site-related constituents.

Implementability

The potential depth to MGP-impacted materials is the most significant barrier to implementing complete removal of impacted riverbed material. No continuous confining unit is present between the NAPL contained in the shallow riverbed and the NAPL in the lower riverbed; therefore, once removal begins, riverbed excavation depths in excess of 36 feet would likely have to be achieved before all the MGP-impacted materials were removed. Hydraulic dredging and mechanical dredging in the wet are not feasible methods for achieving such depths at the Site. If dry excavation were attempted, sheetpile walls would be necessary to keep the work area dry and stabilize the sides of the removal area, and hydraulic control within the sheetpile wall enclosure (if possible) would generate significant quantities of water requiring storage and/or treatment. No underlying confining unit is present onsite at a reasonable depth to key in a vertical containment wall and support in-place dewatering. Removal in the wet to such depths would also require an extensive braced-wall sheetpile system, and the dispersion of NAPL to the water column within the system during removal would be expected to greatly complicate effective cleanup/restoration.

Although removal of all NAPL-impacted riverbed materials is not feasible, removal of smaller areas (e.g., the 0.1-acre area to be considered and areas of focused removal) and removal to feasible depths (e.g., the top 4 feet in the 0.1-acre area, the top 2 feet to meet the performance specification) are both implementable.

Because there is no underlying confining unit present at a reasonable depth at the Site to key in a vertical containment wall and support in-place dewatering, removal of areas below the low winter water mark would need to be performed in-the-wet. Removal in-the-wet would suspend PAH-bound solids and possibly release NAPL (if mobile NAPL is present in the subsurface) to the surface water and surficial riverbed materials within the containment cell, making it difficult to achieve reduced PAH concentrations in the surficial riverbed material. In addition, using shore-based equipment alone may not be possible, complicating the implementability of removal in these areas.

Upon removal from the river, riverbed materials would be transferred to a dewatering area to allow remaining free liquids to gravity drain from the materials and be collected for treatment. Appropriate precautions would

need to be taken (e.g., installing an impermeable geomembrane material, additional erosion and sedimentation controls) to minimize the potential for the removed materials to contact a "clean" area. In addition, free liquids released from the staged materials would also be kept from contacting "clean" areas. Issues relating to dewatering that would need to be addressed include determining water treatment capacity, identifying appropriate treatment process units that would effectively meet any applicable discharge requirements, and designing a functional water collection/transfer system. The potentially significant volume of water generated during hydraulic dredging and the space necessary for dewatering activities for these process options present significant implementability concerns, as space is limited in the Phase II Area.

Other implementability concerns are as follows:

- The presence of large riprap, boulders, and cobbles would make it difficult if not impossible to deploy a hydraulic dredge.

- Low water levels in the winter season may limit using barges to access some of the removal areas. While some mechanical dredging could be performed from land with a long reach excavator, the lack of access would likely be problematic.

- With respect to administrative implementability, locations of access roads, staging areas, and space for materials handling and processing would have to be selected considering constructability, logistics, and access issues. The limited availability of upland areas could be problematic.

- Any removal in the navigation channel would have to be approved by the NYSCC, and any activities within a certain distance of the State Route 30 bridge piers would have to be approved by the NYSDOT.

- Securing local, state, and federal approvals and necessary permits is feasible, but could extend implementation beyond the available timeframe.

- Removed materials would either have to be treated onsite (which could be problematic given the space constraints and the potential quantity of material requiring treatment) or transported to an offsite treatment and disposal facility. Offsite transportation increases the possibility of human exposure to MGP-impacted materials and work-related accidents, including traffic accidents.

- Working in the winter, the "flashiness" of surface water velocities and water depth, ice formation/movement, and cold temperatures would pose construction-related challenges for removal work in the river.

REMOVAL SUMMARY

The presence of debris, boulders, cobbles, and gravel in the riverbed materials may pose challenges with dredge equipment. In addition, a number of technical issues associated with the removal of NAPL at depths of approximately 36 feet could present significant technical issues. Given the Site conditions noted above and the limitations associated with environmental dredging/excavation, achieving the river-related RAOs with a dredging/excavation remedy alone in the 1-acre area to be considered is not considered feasible.

The removal of limited, focused areas and/or removal to a feasible depth in this area has been retained for further consideration, as follows:

- Removal in the dry using mechanical equipment for the 0.1-acre area and for the area between the top of bank and the low winter water mark as part of a barrier wall alternative; and

- Removal in the wet using mechanical equipment for near sampling locations SD-11 and SD-12, near sampling location T7-50, and the portion of the 1-acre area below the low winter water mark.

Due to the presence of large riprap, boulders, and cobbles extending far below the riverbed surface, combined with the potentially significant volume of water that would be generated, hydraulic dredging has not been retained for further consideration.

Removal of riverbed material is a component of the remedy for the Mohawk River that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH. The extent and delineation of areas to be removed will be included in the detailed analysis presented in Section 7.

6.2.3.4 In-Situ Containment

Constructing an engineered cap and installing a barrier wall are the representative remedial technologies options associated with the in-situ containment TMO. Engineered capping would involve placing single or multiple layers of select materials over targeted riverbed materials to bring about chemical isolation and erosion control (i.e., physical stability), while a barrier wall could be constructed to isolate impacted riverbed materials and mitigate scouring and downstream transport.

6.2.3.4.1 Engineered Capping

Cap materials may be placed in-the-wet or in-the-dry using land-based and/or barge-mounted equipment. Determining the appropriate cap thickness depends on the physical and chemical properties of the riverbed materials (e.g., the presence/absence of NAPL), cap material type, hydrodynamic conditions, the need for/extent of any bioturbation protection, the bearing capacity of the riverbed materials, and the potential for cap consolidation. The objective of an engineered cap would be to isolate targeted riverbed materials from the environment and reduce human and ecological exposure to the riverbed materials. Caps may be placed with or without prior removal of riverbed materials; however, maintaining the required depth for the navigation channel may require removal of riverbed materials prior to cap placement.

Placing a cap alters the principle pathways for PAH transport and interaction with the overlying water column. The physical presence of the cap acts as a barrier, preventing direct human and ecological contact with PAH-containing riverbed materials. In addition, the presence of an engineered cap provides a buffer between the riverbed materials and hydrodynamic forces within the channel, reducing the potential for erosion and transport of the PAH-containing riverbed materials. Depending on the specific properties of the PAH compounds and the cap material, the transport of PAHs from the riverbed materials to the water column through the cap could be effectively controlled by increasing the transport path and sorption-related retardation. An additional benefit is the potential for natural processes to degrade the PAH compounds during the extended sequestration.

In a river system, a multi-component cap may be most appropriate. Typically, a cap in a flowing river environment consists of an isolation layer, armor layer, and depending on the stability of adjacent materials, one or more "filter" layers. The chemical isolation provided by the cap depends on the cap's ability to contain or

adsorb PAHs from the adjacent pore water. In general, the organic carbon in the materials used for permeable capping provides a sorbent that binds organic constituents in pore water and retards the movement of PAHs through the cap. The most controllable design parameter is usually the thickness of the isolation layer, which could be designed to account for the additive thicknesses associated with long-term isolation, short-term consolidation, mixing during placement, and bioturbation.

Soil caps have been used at other sites to mitigate exposure to PAH and other chemical constituents containing riverbed materials either as a stand-alone remedy or combined with other remedial alternatives. While a granular soil cap could be designed to effectively isolate dissolved constituent phases (i.e., suitable for non-NAPL areas), a different capping media may be required to contain and/or treat mobile NAPL if present in the riverbed materials. An engineered cap over NAPL-impacted riverbed materials would need increased sorptive capacity (if chemical isolation is sought) and/or low permeability to be effective. An array of sorptive materials have been considered/applied at sites containing mobile NAPL, ranging from natural material (e.g., peat) to manufactured products (e.g., activated carbon or other specialized geosorbents). For low-permeability materials such as geomembranes (e.g., HDPE liner), AquaBlok™ (a proprietary mixture including bentonite-coated gravel), or concrete (as suggested by the NYSDEC), vertical controls (e.g., a barrier wall, which is discussed below) may be required to prevent the potential lateral migration of NAPL beneath the cap.

Within a cap, "filter" layers may be included. The filter layer may be incorporated to provide stability between different material layers (at the cap/riverbed material interface or cap/armor interface) of very different particle sizes. A layer of intermediate sized materials or a geotextile could be used for this purpose. Filter layers might also be considered for other specific purposes. Examples would include geotextile to reduce cap/riverbed material mixing caused by cap placement and/or bioturbation.

A cap cannot function successfully if it does not remain in place. For physical stability, an engineered cap may include additional layers of armor material to withstand hydrodynamic/physical forces that may occur (e.g., episodic high flow velocities, wind-induced waves, ice scour, and navigational-induced disturbances). The primary role of the armor layer is to enhance the long-term durability of the isolation layer which it protects. Each category of hydrodynamic disturbance could be evaluated to determine the maximum potential shear stress that could be induced, and the armor layer size and thickness can then be designed based on the magnitude of the worst case prediction. Most often, stone (e.g., riprap) is used due to cost considerations, but application of other erosion control technologies such as synthetic liners and concrete mats are also possible.

As part of one of the barrier wall remedies to be analyzed in this RAR, the NYSDEC has requested installing an impermeable cap between two barrier walls (see Subsection 6.2.3.4.2).

Effectiveness

A properly designed and constructed engineered cap can effectively reduce the potential for human and ecological exposure to MGP-impacted materials in the riverbed, resulting in achievement of the river-related RAOs. Cap effectiveness would be directly dependent upon thorough characterization of the NAPL presence/absence of mobile NAPL. The cap would be designed to reduce the potential upward mobility of dissolved-phase PAHs and mobile NAPL, if any is currently present below the river. Cap placement would result in temporary destruction of the benthos and habitat present in the capping area. Engineering controls could be implemented (e.g., silt-curtains, signs, fencing) to effectively minimize exposure to humans and the surrounding environment during cap placement.

A thorough understanding of the Site hydrodynamics, and mobile NAPL extent, mass, and flux rates would be required to design the capping system. Given the uncertainties associated with determining the presence of mobile NAPL (in contrast to residual NAPL) in the riverbed materials, the currently available data suggest that a very thick sorbtive layer would be necessary to restrict the potential vertical migration of NAPL and ensure effectiveness. Constructing a low-permeability cap would likely require vertical cutoff walls as a capping component to prevent potential lateral migration of NAPL beneath the cap. The ability to design, construct, and maintain a seal between the vertical walls and the low-permeability cap would be complicated by Site-specific considerations, and hence, this option may not be entirely effective in mitigating potential NAPL discharge to the river. Long-term effectiveness would be dictated by the conservativeness of the cap design, and evaluated through a long-term monitoring program.

Implementability

The material, equipment, and laborers required to construct an engineered cap at the Site should be readily available. Caps designed to mitigate exposure to organic chemicals (e.g., PAHs, polychlorinated biphenyls [PCBs]) and NAPL-containing riverbed materials were approved and successfully constructed at other aquatic sites. To maintain required depths within the NYSCC's navigation channel and/or minimize changes in river velocities and flood flow elevations, removal of riverbed materials in certain portions of the 1-acre area to be considered would be required prior to cap placement. If capping with a sorbtive cap media were used, the anticipated thickness of the sorbtive layer necessary to restrict NAPL movement based on the current site understanding could necessitate the removal of a significant quantity of riverbed material. Additional delineation of NAPL presence/extent in the riverbed material would be necessary to support the design. While an impermeable liner could be constructed, difficulties installing and sealing the liner to vertically installed barriers associated with the Phase II Area would be expected. The cap would be easiest to construct in the fall/winter months, when the Mohawk River pool elevation and recreational use is at a minimum. Cap construction would need to be performed in coordination with any upland construction activities to address access needs as well as to tie-in the cap with any upland remedial structures.

With respect to administrative implementability, access to the Mohawk River from the north shore would require CSX approval to cross the rail-line with materials and equipment. Access approval would also be required from the NYSDOT and NYSCC to construct access roads and equipment staging areas. Permits, approvals, and land use restrictions for cap placement would be required from the NYSCC and NYS Office of General Services, as would a Section 404 permit for fill placement in a navigable water body from the USACE. Access and permit approvals are considered achievable, but could take upwards of 1 year to obtain following remedy selection.

A capping system would likely require an O&M plan to be implemented to verify that the cap materials remain in place and are functioning as designed. Periodic maintenance may be necessary to replace eroded materials or repair disturbed areas. Due to the high river velocities in the area, the maintenance component of this option could be significant. In addition, installing a cap between two barrier walls, as requested by the NYSDEC, would involve maintaining the seams between the cap and both walls to mitigate loss of NAPL which may accumulate below the capping system.

6.2.3.4.2 Barrier Wall

A barrier wall is a physical barrier remedial technology that could be used to restrict the lateral flow of Site-related constituents and isolate MGP-impacted materials. Barrier walls are driven into the ground or riverbed

from the surface using standard construction equipment in an effort, if properly sealed joints are used, to create a watertight barrier. Installing solid barrier walls is fairly straightforward, but could be complicated by the presence of subsurface obstructions such as debris and boulders.

As discussed in Subsection 6.2.1.7.1, a barrier wall along the river side of the Phase II Area has been retained to mitigate potential discharge of NAPL from the Phase II Area to the river. To effectively eliminate potential human and ecological exposure to riverbed materials between the high and low water lines, the wall could be placed along the non-navigation (winter) season water surface elevation of 246 feet. This alignment would also effectively contain the soil containing NAPL located between the top of bank and winter season low water elevation (see Appendix E). This alignment would be modified on the western end to avoid the State Route 30 bridge pier, and would parallel the navigation channel on the eastern end to maximize the containment of MGP-impacted materials within the approximately 1-acre area to be considered (see Figure 2). The area behind the wall would be backfilled to the approximate Phase II Area grade. This approach would permit expansion of the Park by approximately 45% (0.8 acres). In addition to this location option for the river side wall, the NYSDEC has requested that two additional wall locations be considered:

- A single wall installed at the top of bank and keyed into clay or bedrock; and

- A pair of walls – one installed at the top of bank and keyed into the sand-and-gravel unit, and the other installed at the low water line, driven or cut to the mud line, and keyed into clay or bedrock.

The location of the river side of the wall will be analyzed in detail in Section 7.

For the wall locations requested by the NYSDEC, additional TMOs are involved. For the single wall installed at the top of the bank, the NYSDEC also requested that the material between the high water edge and the low water edge be removed to a feasible depth. Removal is discussed in Subsection 6.2.3.3. For the pair of walls, the NYSDEC also requested the placement of an impermeable cap between the walls. Capping is discussed earlier in this subsection.

Effectiveness

Barrier walls are a proven in-situ containment strategy and have been successfully demonstrated at full-scale at a variety of sites across the country with a variety of constituents. As detailed in Appendices A and B and summarized in Section 5, a barrier wall installed to the base of the sand-and-gravel unit would mitigate the potential for NAPL discharge from the Phase II Area to the river.

Installing a barrier wall at the low winter water mark would isolate and contain MGP-impacted riverbed materials without infringing on the navigation channel. Placing a wall only at the top of bank would, of course, not contain any impacted material outside (south) of the barrier wall. As detailed in Appendix E, installing a wall along the low winter water mark would contain over 70% more soil containing NAPL, compared to a wall installed at the top of bank. The subsurface NAPL are in a shallower and a deeper layer, and the distance between these layers increase at a distance from the Phase II Area shoreline. A primary benefit of placing a barrier wall at the low winter water mark as opposed to along the shoreline (e.g., top of bank) is that the upper NAPL layer would be contained and the lower NAPL layer would remain isolated at depth. Both human and ecological exposure to impacted riverbed materials would be effectively mitigated, achieving the river-based RAOs. While some MGP-impacted materials would be present outside a barrier wall placed at the low winter water mark, once the potential source(s) of NAPL and site-related PAHs in the Phase II Area are addressed, natural recovery of the areas outside the wall should proceed on a faster time frame because there would not be a

potential on-going source of these materials. The effectiveness of the barrier wall option, which includes installing a wall at the top of bank and one at the low water mark with an impermeable cap in between, would be dictated/limited by the seals between the vertical barrier walls and the lateral cap between them.

Implementability

Barrier walls are a proven technique for NAPL containment and isolating PAH-impacted riverbed materials, and no insurmountable barriers have been identified that would preclude implementing this option at the Site. Further, the materials, equipment, and laborers required to construct a barrier wall at the Site should be readily available. Care would be taken during the design phase to provide adequate clearance of the State Route 30 bridge pier. The existence of the NYSCC's navigation channel and the presence of the State Route 30 bridge pier must be considered when selecting the alignment of the barrier wall.

The effects of placing a barrier wall at the low winter water mark and backfilling to the approximate existing Phase II Area grade must be considered regarding the stage and flows in the Mohawk River. Specifically, reductions in the cross-sectional area of the river could raise river stages and increase flow velocities during flood events. In the stretch of the river adjacent to the Phase II Area, the banks are generally steep between the low water and navigation season elevations, with the grade less steep above top of bank. Based on a review of the river cross-sections in this area, substantial impacts on river stage and flow velocities would not be expected due to the presence of a barrier wall at the low winter water mark. To confirm this, a hydraulic assessment was performed to evaluate the effects on the river stage and velocities with the location of the river side barrier wall. Simulations of the flows in the river with and without the barrier wall were performed with RMA2. RMA2 is a two-dimensional hydrodynamic computer code used to simulate water levels, flow velocities, and shear stresses on the river bottom. Simulations were performed for a range of flow conditions to determine the effects the location of the barrier wall would have on river stage, velocities, and bed shear stress in the area. Details of this assessment were presented as Attachment 1 to Niagara Mohawk's September 12, 2003 letter to the NYSDEC (Morgan, 2003f).

To evaluate the potential impacts to the flood stage by construction of a barrier within the Mohawk River, steady-state simulations were conducted of the 100-year flood with and without the barrier wall. The 100-year flood magnitude for the Mohawk River, North Chuctanunda Creek, and South Chuctanunda Creek were determined from the Flood Insurance Study for the City of Amsterdam. To conservatively estimate the maximum 100-year flood elevations, the flood was assumed to occur during navigation (summer) season in the Mohawk River. Steady-state simulations were performed using RMA2 with and without the barrier and the results were compared. The results indicated that there is minimal impact to the 100-year flood elevations (maximum increase in water surface elevation of 0.1 foot due to the presence of the wall). In addition, the simulations did not indicate significant increases in velocities and scour potential due to the presence of the barrier wall. The results of this analysis are presented in Appendix D.

Installation would be performed in conjunction with any upland construction activities to address access needs and to link the barrier wall along the river to the wall around the Phase II Area, if constructed.

IN-SITU CONTAINMENT SUMMARY

As discussed above, both engineered caps and barrier walls have been effectively implemented at several sites with PAH- and NAPL-containing riverbed materials. Both approaches are potentially effective, implementable options that could be employed to isolate PAH- and NAPL-containing riverbed materials. While long-term

O&M activities would be required to verify and maintain cap integrity, these activities should not be excessively complicated.

A sorbtive cap would require additional data first be collected to better delineate the presence/extent of NAPL in the riverbed materials adjacent to the Phase II Area. Due to time constraints and other considerations, a sorbtive cap has not been retained for further consideration.

At the request of the NYSDEC, an impermeable cap between the walls placed at the top of bank and the low winter water mark has been retained for further consideration. Dredging/excavation may be necessary prior to placing the cap materials to maintain stream bathymetry/flow as well as to maintain appropriate water depths in the NYSCC's navigation channel.

Capping after removal of riverbed materials has also been retained for further consideration. Installing a cap after removal would help ensure that the remediated area continues to meet the performance specifications in the long term.

Since installing a barrier wall is compatible with the potential remedy for the Phase II Area, this process option has been retained for inclusion as a component of the proposed site-wide remedial alternative. Three options for placing the wall, including two recommended by the NYSDEC, are analyzed in detail in Section 7.

6.2.3.5 Monitored Natural Recovery

MNR includes several processes. In its *Contaminated Sediment Management Strategy*, the USEPA states that natural attenuation may include "natural processes that can reduce or degrade the concentration of contaminants in the environment including biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation or destruction of contaminants, and the deposition of clean sediments to diminish risks associated with the site" (USEPA, 1998a). In the NYSDEC's Region 8 Citizen's Glossary of Environmental Terms, natural attenuation is defined as "relying on natural (physical, chemical, or biological) processes to reduce mass, toxicity, mobility, volume or concentration of compounds."

Riverbed and surface water systems have a considerable inherent capacity to recover from either natural or human disturbances. The rate and extent of such recovery would likely be linked to an Phase II Area source (NAPL) control activity, designed to mitigate any ongoing discharge of site-related PAHs to the river. For site-related PAH constituents, physical-chemical processes achieve reductions in constituent mass, mobility, and bioavailability through mechanisms such as burial, sorption, volatilization, dissolution, advection, and dispersion. Chemical transformation or biodegradation can also be important mechanisms for reducing the toxicity and mass of PAH constituents when Site conditions are favorable (Pastorok et al., 2000; USEPA-OSWER, 1999). In most cases, there is evidence that PAHs degrade to compounds that are less toxic to environmental or human receptors (USEPA-ORD, 1999), although only a portion of NAPL residues may completely mineralize. Several of the more effective (and better understood) natural attenuation processes are further described below.

- **Physical processes** promote natural attenuation, primarily in riverbed materials, through several mechanisms. Advection/dispersion and burial are purely physical processes that reduce risk by lessening the concentration of PAHs at points of exposure, such as in the biologically active surficial riverbed material layer. *Advection* refers to the movement of dissolved PAHs in flowing water, while *dispersion* describes the spreading of the dissolved contaminants along the direction of the flow as well as away from the flow.

PAHs sorbed to resuspended fine-grained riverbed materials may also be removed by advection and dispersion. *Burial* by natural deposition of cleaner riverbed materials is another purely physical process that occurs in areas of sedimentation. When PAH sources have been contained, removed, or otherwise controlled, cleaner sediments depositing on impacted riverbed materials mix with and effectively reduce constituent concentrations at the surface. Ongoing deposition continuously reduces constituent concentrations at the point of exposure, which is at or near the riverbed materials surface for most receptors.

- **Physical-chemical weathering** alters compositions and concentrations of PAHs in surficial riverbed materials through dissolution, evaporation, sorption, and photo-oxidation. In *dissolution*, the different PAH constituents dissolve into interstitial and overlying water as a function of their solubility, depleting the concentrations of the more soluble PAHs. In intertidal areas that are sometimes directly exposed to air, *evaporation* reduces concentrations of the more volatile PAHs. Evaporation, or *volatilization*, is not a significant process in subsurface riverbed materials, or surficial riverbed materials that remain submerged. Generally, the more soluble PAHs are also the more volatile, thus dissolution and evaporation produce similar losses.

  Sorption refers to the physical and chemical binding of constituents to soil/riverbed material particles. As tar residues weather, the more persistent components, such as the 4-, 5-, and 6-ringed PAHs, become sequestered in the riverbed material phase (Pastorok et al., 2000; Neff et al., 2001) through chemical sorption. Physical-chemical weathering processes reduce risk through depletion of the more bioavailable components of tar residues and sequestering of the less bioavailable components through sorption, reducing their bioavailability even further. *Photo-oxidation* is a purely chemical process that uses light energy and oxygen to transform constituents to different chemicals. Although this chemical mechanism is well understood, its importance in natural attenuation of PAHs in riverbed materials is not well documented.

- **Biological degradation processes** complement physical-chemical processes and are generally considered the primary mechanism degrading the weathering-resistant fraction of tar residues. For example, physical-chemical weathering rapidly depletes low-molecular-weight PAHs such as naphthalene (a 2-ringed PAH). Physical-chemical weathering also depletes 3-ringed and higher-molecular-weight PAHs, but over longer periods of time (Brenner et al., 2002). Microbial degradation further depletes persistent PAHs, with 2- and 3-ringed PAHs being more amenable to biodegradation than 4-, 5-, and 6-ringed structures. In order for microbial degradation to be viable, certain conditions must exist, including the presence of hydrocarbon-utilizing microorganisms, electron acceptors (oxygen, nitrate, sulfate, iron), nutrients, suitable hydrocarbon substrate, and other conditions favorable to microbial growth (Pastorok et al., 2000).

  Although rates of biodegradation are typically driven by nutrient availability, the mechanism of degradation is determined by the redox conditions of the riverbed material and the nature of the microbiological community (Atlas et al., 1981). Some mineralization of PAHs to carbon dioxide (CO_2) results from microbial degradation, but typically to less than 50 percent (Atlas et al., 1981). Although both aerobic and anaerobic degradation could beneficially transform hydrocarbons, some products (*trans*-diols) of aerobic PAH degradation by fungi and other eukaryotic microorganisms are also toxic; yet, in general, the products (*cis*-diols) of PAH degradation by bacteria are not toxic (Pastorok et al., 2000).

Reductions in PAH mass and bioavailability in surficial riverbed material via naturally occurring physical-chemical process is a well recognized and documented phenomenon. To achieve maximum reductions naturally, any significant ongoing discharges (i.e., sources) of PAHs to the surficial riverbed material must first be mitigated. Source control of NAPL will be included in the selected alternative for the Phase II Area.

NYSDEC's *Technical Guidance for Screening Contaminated Sediment* (NYSDEC, 1999a) states that "once the source of contaminants to sediments is terminated, the length of time a particular area of sediments remain contaminated will depend on the persistence of the chemicals, and the site-specific characteristics of the sediment such as: rate of sedimentation; resuspension; and biological and chemical degradation." The guidance goes on to note that factors such as volume/location/areal extent of the sediment exceeding the criteria, contaminant persistence, cleanup criteria uncertainty, and accessibility should all be factors in considering the need for, extent, and method of remediation.

In a USEPA Directive titled *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (USEPA, 2002), the USEPA recommends that when selecting and planning a response, sources should be controlled early and an iterative approach to remedy evaluation/selection should be adopted. As noted in this Directive: "In some cases, it may be appropriate to take an interim action to control a source, or remove or cap a hot spot, followed by a period of monitoring in order to evaluate the effectiveness of these interim actions before addressing less contaminated areas."

Effectiveness

PAHs and NAPL-related constituents are good candidates for natural attenuation, and over time the riverbed materials will recover. Site specific information indicate that there are notably lesser concentrations of 2- and 3-ringed PAHs relative to benzo(a)pyrene (a recalcitrant internal indicator) in MGP-related residues in shallow riverbed materials and there is an increasing extent of weathering/degradation in residues further from the Site, where migration from the Site appears to be less of a factor than mixing of MGP-related residues with ongoing background sources of PAHs. When coupled with periodic monitoring of the riverbed material, this approach is an effective means of tracking the rate and extent at which ongoing natural attenuation is achieving both the river and site-wide RAOs.

MNR has been employed at other MGP-impacted sites. Long-term monitoring data could be used to evaluate trends and make predictions regarding future conditions. MNR alone is not expected to result in achievement of the river or groundwater-related RAOs; however, MNR could be an effective remedial component if linked with a source (NAPL) control technology as natural attenuation processes are always at work and will reduce the potential toxicity, mobility, and volume of PAHs in riverbed materials over time. When used in conjunction with an active remedial approach designed to contain/control MGP-related constituents (e.g., barrier wall), MNR could be particularly effective.

The extent of any toxicity, mobility, and volume reduction due to MNR would be determined through long-term monitoring, however; under current, unremediated conditions, the current chemical evidence shows that the fine-grained surficial materials in the river exhibit significant weathering characteristics and/or characteristics indicating mixing with fine-grained materials from upstream of the site (that contain non-MGP related PAH constituents). This information suggest that MNR is ongoing at the site and would continue (if not accelerate) under remediated conditions. Also note that based on existing data, the average PAH concentration for the upper 2 feet of riverbed materials is 8.3 ppm, which is well within the background range (up to 84 ppm).

Implementability

Similar to the techniques that have been used during previous investigations, riverbed material and other samples could be collected at the Site and analyzed in a laboratory, and field observations may be made and documented quite readily. The appropriately certified laboratories and trained technicians are available to perform these tasks, and any necessary approvals could be easily secured. MNR is a component of remedies at

most sites and is both technically and administratively implementable. Additionally, because minimal activities would be undertaken, there would be no Site limitations regarding constructability, logistics, or access involved in implementing this TMO.

MONITORED NATURAL RECOVERY SUMMARY

Monitoring is effective for documenting Site conditions over time to confirm the progress of ongoing natural attenuation at the Site, and is easily implementable at a relatively low cost. MNR has been retained for inclusion as a component of one or more proposed area-specific remedial alternatives.

6.2.4 Summary of Retained TMOs – Mohawk River

In summary, the following TMOs were retained for the Mohawk River:

1) Institutional controls;
2) Removal;
3) Engineered capping;
4) Physical barriers (i.e., barrier wall); and
5) MNR.

6.3 Identification of Selected Remedial Alternatives for Analysis

This subsection utilizes the TMOs retained after screening to form the remedial alternatives that will undergo detailed analysis in Section 7. A summary of both the site-wide and area-specific alternatives is provided.

6.3.1 Site-Wide Remedial Alternatives

Institutional controls and a barrier wall are the two site-wide remedial alternatives retained for detailed analysis. Both are briefly discussed below.

6.3.1.1 Institutional Controls

Institutional controls are a component of the remedy for the Site that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH.

6.3.1.2 Barrier Wall

A barrier wall is a component of the remedy for the Site that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH. A solid barrier wall would be placed around at least the east, south, and west sides of the Phase II Area. A determination regarding the necessity of a wall along the northern boundary of the Phase II Area will be developed during the remedial design.

Three options for the location and configuration of the river side of the wall (the south wall) will be analyzed in detail in Section 7. All three of these alternatives include NAPL recovery behind the river side and eastern side of the wall. The three potential locations to be analyzed, including the two proposed by the NYSDEC in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d), include:

- Wall Alternative A - The river side wall would be installed at the winter low-water line, installed to the base of sand-and-gravel unit or bedrock, whichever is encountered first, and backfilled to meet Phase II Area grade.

- Wall Alternative B - The river side wall would be installed at the top of bank, and into clay or to the top of bedrock. Sediments, as defined by the NYSDEC, would be removed to the extent feasible; and NYSDEC-specified performance specifications would be satisfied. Hydraulic control of groundwater would be provided, if necessary. The NYSDEC proposed this alternative in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d).

- Wall Alternative C - The river side wall would be two walls: one wall installed at top of bank and keyed into the sand-and-gravel unit, with a second wall installed at the low water line, driven or cut to the mud line, and keyed into clay or bedrock. An impermeable cap would be provided between the walls, and NYSDEC-specified performance specifications would be satisfied. Hydraulic control of groundwater would be provided, if necessary. Removing the riverbed materials before placing the cap may also be required to maintain required water depths. The NYSDEC proposed this alternative in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d).

The non-river-side walls (i.e., west, east, and north, if installed) would be installed to the base of the sand-and-gravel unit or bedrock, whichever is encountered first.

6.3.2 Area-Specific Remedial Alternatives

Remedial alternatives were developed for four specific areas of the Site, as follows:

- Area 1 - Upland Area under State Route 30 Bridge;

- Area 2 - Upland Phase II Area, excluding Area 1;

- Area 3 - Mohawk River between Low Winter Water Level and Outer Bound of 1-Acre "Area for Consideration;" and

- Area 4 - Eastern 0.1-Acre "Area for Consideration" (East of the Terminal Wall).

These four areas are based on the geographic boundaries presented by the NYSDEC in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d). The alternatives developed for each of these areas are briefly discussed in the following subsections.

6.3.2.1 Area 1 - Upland Area under State Route 30 Bridge

For the approximate 0.3-acre upland area under the elevated State Route 30 bridge, the alternative identified for detailed analysis includes institutional controls, the barrier wall, an engineered cap, and additional NAPL recovery. Institutional controls, the wall, and a cap are components of the remedy for Area 1 that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH. The NYSDEC suggested the additional NAPL recovery in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d).

6.3.2.2 Area 2 - Upland Phase II Area, excluding Area 1

Three alternatives have been retained for detailed analysis regarding the approximate 1.8-acre Area 2 - the Upland Phase II Area, excluding Area 1. The Volunteers, City of Amsterdam, and NYSDEC/NYSDOH have agreed to institutional controls, the barrier wall, and an engineered cap as components of the remedy for Area 2. In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC requested the removal of MGP-impacted materials, where feasible to do so (Spellman, 2003d). The following alternatives have been retained for this area:

- **Alternative 2A** - Alternative 2A consists of institutional controls, the barrier wall, an engineered cap, and removal of MGP-impacted materials (e.g., MGP wastes, structures, and piping), as required to install the engineered cap and construct the Park.

- **Alternative 2B** - Alternative 2B consists of institutional controls, the barrier wall, an engineered cap, removal of the contents and bottom of Former Gas Holder No. 2, and removal of MGP-impacted materials (e.g., MGP wastes, structures, and piping), as required to install the cap and construct the Park.

- **Alternative 2C** - Alternative 2C consists of institutional controls, the barrier wall, an engineered cap, and removal of MGP-impacted materials (e.g., MGP wastes, structures, and piping) to the extent feasible (i.e., above the low winter water table).

6.3.2.3 Area 3 - Mohawk River between Low Winter Water Level and Outer Bound of 1-Acre "Area for Consideration"

The area between the top of bank and low winter water level in the Mohawk River will be addressed in the evaluation of the barrier wall under site-wide alternatives. Presented below are the three alternatives that have been retained for detailed analysis for the area of riverbed material between the low winter water level and the outer bound of the approximate 1-acre "area for consideration:"

- **Alternative 3A** - MNR.

- **Alternative 3B** – MNR, with the addition of removing a defined volume of material at transect sampling location T7-50. Following removal, restoration would consist of placing sand and armor layers to an elevation that maintains an appropriate navigable water depth.

- **Alternative 3C** - Removal of riverbed materials within this area, satisfy NYSDEC's sediment performance specification, and monitoring. The NYSDEC requested this alternative in its December 19, 2003 letter to

Niagara Mohawk. Following removal of the material, restoration would consist of placing sand and armor layers to restore to existing grade or to an elevation that maintains an appropriate navigable water depth.

6.3.2.4 Area 4 - Eastern 0.1-Acre "Area for Consideration" (East of the Terminal Wall)

Two alternatives have been retained for detailed analysis to address the 0.1-acre area located east of the terminal wall, as follows:

- **Alternative 4A** - Removal of the upper 4 feet of riverbed materials in this area. Following removal, restoration would consist of placing a sand layer to restore to existing grade.

- **Alternative 4B** - Removal of the upper 4 feet of riverbed materials in the 0.1-acre area, and removal of a defined volume(s) at (or encompassing) locations SD-11 and SD-12. Satisfy NYSDEC's sediment performance specification. The NYSDEC recommended this alternative in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d). Following removal, restoration would consist of placing a sand layer to restore to existing grade or to an elevation that maintains an appropriate navigable water depth.

The removal of the upper 4 feet of riverbed materials in the 0.1-acre area is a component of the remedy for the Mohawk River that was agreed upon by the Volunteers, City of Amsterdam, and NYSDEC/NYSDOH. This removal was discussed in the NYSDEC's letter to Niagara Mohawk dated December 19, 2003.

7. Detailed and Comparative Analysis of Remedial Alternatives

7.1 General

In this section, the Site-wide and area-specific remedial alternatives introduced in Section 6 are described in detail and evaluated with respect to the National Contingency Plan (NCP) criteria specified by the NYSDEC in TAGM No. 4030 (which incorporates the NCP by reference) (NYSDEC, 1990). These criteria are also consistent with factors required by the VCA (NYSDEC, 1999b) and set forth in 6NYCRR Part 375-1.10(c), with the exception (absence) of community acceptance. The NYSDEC will complete the assessment of community acceptance after issuing a notice in the *Environmental Notice Bulletin* regarding the public's opportunity to submit comments on the proposed remedy for the Site. Niagara Mohawk has and will continue to work with the City to facilitate Park development.

In addition to the detailed analysis of each of the remedial alternatives, a comparative analysis of the remedial alternatives developed for each targeted area is provided, except for Area 1, where only one alternative was identified. The Site-wide alternatives are considered first, followed by an assessment of the alternatives developed for each of the four specific areas identified in Section 4. The comparative analysis identifies the advantages and disadvantages of each alternative relative to one another and with respect to the seven NYSDEC/NCP criteria. The results of the comparative analyses will be used as a basis for recommending a remedy for the Site.

7.2 Description of the Evaluation Criteria

The detailed evaluation of remedial alternatives presented in this section consists of an assessment of each of the remedial alternatives (both Site-wide and area-specific), which were approved by the NYSDEC in a September 9, 2003 letter to Niagara Mohawk (Spellman, 2003c), against the following seven criteria:

- Compliance with standards, criteria, and guidance (SCGs);
- Overall protection of human health and the environment;
- Short-term effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Implementability; and
- Cost.

Each of these criteria is described below.

7.2.1 Compliance with SCGs

This evaluation criterion evaluates the ability of each remedial alternative to comply with SCGs. "Standards and Criteria" are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance. "Guidance" refers to non-

promulgated criteria, advisories, and/or guidance that are not legal requirements and do not have the same status as "standards and criteria;" however, remedial programs should be designed with consideration given to guidance that, based on professional judgment, is determined to be applicable to the project (6NYCRR 375-1.10[c][1][ii]).

SCGs are categorized into the following three NYSDEC-recommended classifications:

- *Chemical-Specific SCGs* - These SCGs are usually health- or risk-based numerical values or methodologies which, when applied to Site-specific conditions, result in the establishment of numerical values for each constituent of concern. These values establish the acceptable amount or concentration of constituents that may be found in, or discharged to, the ambient environment.

- *Action-Specific SCGs* - These SCGs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and Site cleanup.

- *Location-Specific SCGs* - These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

7.2.2 Overall Protection of Human Health and the Environment

This evaluation criterion considers whether the alternative provides adequate protection of human health and the environment. This evaluation relies on the assessments conducted for other evaluation criteria, including long-term and short-term effectiveness, and compliance with SCGs.

7.2.3 Short-Term Effectiveness

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

- Potential short-term impacts to which the community may be exposed during implementation of the alternative;

- Potential impacts to workers during implementation of the remedial actions and the effectiveness and reliability of protective measures;

- Potential environmental impacts of the remedial actions during implementation and the effectiveness of mitigation measures; and

- Amount of time until protection is achieved. The timeframe discussed within each alternative reflects the timeframe for implementing that alternative alone, and does not consider the implementation timeframe for the overall Site remedy. The overall Site remedy timeframe is discussed in Section 8.

7.2.4 Long-Term Effectiveness and Permanence

The evaluation of each remedial alternative relative to long-term effectiveness and permanence considers the risks that may remain following implementation of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness and permanence:

- Environmental impacts from untreated waste or treatment residuals remaining at the completion of the implementation of the remedial alternative;
- The adequacy and reliability of controls (if any) that will be used to manage treatment residuals or remaining untreated waste; and
- The remedial alternative's ability to meet the RAOs established in Section 3.

7.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the degree to which remedial actions will permanently and significantly reduce the toxicity, mobility, or volume of MGP-related constituents present within the Site media through treatment. The evaluation focuses on the following factors:

- The treatment process and the amount of materials to be treated;
- The treatment process's anticipated ability to reduce the toxicity, mobility, or volume of MGP-related constituents of interest;
- The nature and quantity of treatment residuals that will remain after treatment;
- The relative amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled; and
- The degree to which the treatment is irreversible.

The definition of this criterion at 6NYCRR Part 375-1.10(c)(5) indicates that New York State prefers consideration of options that result in destruction first, followed by separation/treatment, then solidification/chemical fixation, and finally control and isolation. While this preferred hierarchy will be considered, Site-specific factors will also be assessed and the results combined with the results of the evaluations against the other six criteria to arrive at the most appropriate remedial approach for the Site from among the feasible options.

7.2.6 Implementability

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

- **Technical Feasibility** - This factor refers to the relative ease of implementing or completing the remedial alternative based on Site-specific constraints. In addition, the remedial alternative's constructability and operational reliability are considered, as well as the ability to monitor the effectiveness of the remedial alternative.

- **Administrative Feasibility** - This factor refers to the feasibility of acquiring any necessary approvals and permits, including consideration of the time required to obtain the approvals and permits.

7.2.7 Cost

This criterion refers to the total cost to implement each remedial alternative. The total cost represents the sum of the direct capital costs (materials, equipment, and labor), indirect capital costs (engineering, licenses or permits, and contingency allowances), and O&M costs. O&M costs may include operating labor, energy, chemicals, and sampling and analysis. These costs, which are developed to allow the comparison of the remedial alternatives, are estimated with expected accuracies of -30 to +50%, in accordance with the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988). A 25% contingency factor is included to cover unforeseen costs incurred during implementation. Present worth costs are calculated for alternatives expected to last more than 2 years. In accordance with USEPA guidance (OSWER Directive 9355.3-20), a 7% discount rate (before taxes and after inflation) is used to determine the present worth factor (USEPA-OSWER, 1993).

7.3 Site-Wide Alternatives

The Site-wide alternatives include institutional controls and a subsurface barrier wall. As detailed in Section 5, institutional controls are a requirement of the VCA (Paragraph XI) and include prohibiting the Site from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting the use of Site groundwater without treatment.

The purpose of the subsurface barrier wall would be to mitigate, to the extent practicable, potential discharges of NAPL from the Phase II Area to the Mohawk River and support achievement of the RAOs. Based on a number of project meetings and correspondence between the NYSDEC, the Volunteers, and the City a subsurface barrier wall is generally agreed-upon as a viable and effective remedial component. The three potential barrier wall alternatives identified for the Site are summarized in the table below.

Alternative	Summary
Alternative A	• Installation of a barrier wall along the approximate Mohawk River low-water line and to the base of the sand-and-gravel layer or bedrock (whichever is encountered first). • Backfill to the Phase II Area grade (final grade to be determined in conjunction with the City and the City's design team with regard to the requirements for the Phase II Area of the Park). • NAPL collection behind the wall. • Niagara Mohawk identified this option in the RADD (Morgan, 2003g).

Alternative	Summary
Alternative B	• Installation of a barrier wall at the top of Mohawk River bank and keyed into bedrock or clay unit. • Removal of bank and riverbed materials between the low water line and the top of bank to the extent feasible. • Backfill to existing grade. • NAPL collection behind the wall. • The NYSDEC identified this alternative and Alternative C in its December 19, 2003 letter to Niagara Mohawk and requested both options be subject to detailed evaluation (Spellman, 2003d).
Alternative C	• Installation of a barrier wall at the top of the Mohawk River bank. • Installation of a second barrier wall at the approximate Mohawk River low-water line, cut or driven to the mudline, and keyed into bedrock. • Removal of riverbed and river bank materials between the two walls for cap installation. • Construction and maintenance of a low-permeability cap between the walls. • NAPL collection behind the barrier wall at the top of the bank.

A long-term monitoring program would be implemented as part of the selected Site-wide alternative. While specific elements of the program would be established during detailed design, the program would generally include annual visual inspections of the area to verify the continued integrity and effectiveness of the remedy to the extent possible. Any issues identified during the visual inspections would be addressed as appropriate.

Implementation of the selected Site-wide alternative would have to be coordinated with the remedial actions for the Phase II Area and Mohawk River. Limited space is available to stage equipment and materials; therefore, actions across the various areas of the Site would likely have to proceed sequentially rather than concurrently.

The focus of this section is to evaluate and compare the three subsurface barrier wall alternatives using the seven NYSDEC/NCP criteria to identify the most appropriate option based on technical, scientific, and regulatory requirements. Following selection, that subsurface barrier wall option will then be carried through as a remedial component of the area-specific alternatives for the Phase II Area and Mohawk River, which are analyzed in detail in Subsections 7.4 through 7.7.

Presented below is a detailed analysis of the three subsurface barrier wall alternatives designed to mitigate, to the extent practicable, potential discharges of NAPL from the Phase II Area to the Mohawk River and support achievement of the RAOs.

7.3.1 Site-Wide Alternative A - Placement of a Barrier Wall at Low-Water Line, Backfill to Phase II Area Grade, and NAPL Collection

Alternative A consists of placement of an approximately 595-foot long barrier wall adjacent to the Phase II Area at the approximate winter low-water line (i.e., elevation 246 feet above mean seal level [amsl], referenced to NYSCC datum), with the wall extending vertically from the base of the sand-and-gravel unit to the approximate surface elevation of the Phase II Area. The low water line wall would be connected to a perimeter barrier wall proposed to be installed, at grade, around the eastern, western, and potential northern boundaries of the Phase II Area. The barrier wall along these boundaries would be installed to the sand-and-gravel unit or bedrock, whichever is encountered first. Once installed, the shoreline wall would be supported with tie-back anchors and the area behind the wall backfilled to the grade of the Phase II Area. The backfill would either be clean fill brought in from offsite or some combination of clean fill and materials excavated as part of the

alternative for Area 2 (see Section 7.5). If a portion of the materials excavated from Area 2 are observed to not contain NAPL, then they could be used behind the wall as appropriate. Final decisions regarding the backfill materials would be made during detailed design. Plan and cross-sectional depictions of Alternative A are presented on Figures 10A and 10B, respectively. NAPL monitoring collection wells would be installed proximate to the interior southern and eastern sides of the barrier wall.

Construction of Alternative A would be performed during the winter months using conventional land-based equipment. It is assumed that portions of the NYSDOT property located along the shoreline would be used to stage equipment and materials. The wall would be tied in with other upland and/or river remedy components. Silt curtains or other erosion control devices would be installed in the river to mitigate the potential for downstream migration of materials disturbed during construction. Daily water column monitoring for turbidity would be performed to monitor the effectiveness of the silt curtains. Once construction of the wall is complete, an aquatic habitat restoration project would be implemented, as needed, to replace habitat lost between the low- and high-water lines due to barrier wall construction along the Phase II Area shoreline.

After the NYSDEC has approved completion of the remedial construction activities, and in accordance with the VCA (NYSDEC, 1999b), a *Maintenance and Monitoring Plan* would be developed describing the long-term activities to be implemented. Specific to this area, the plan would: 1) detail the long-term monitoring program to be implemented to verify the continued integrity and effectiveness of the remedy; and 2) describe the NAPL monitoring and removal program to be implemented using newly installed and existing wells in the Phase II Area.

7.3.1.1 Compliance with SCGs

Chemical-Specific SCGs

The only chemical-specific SCGs applicable to the area between the high and low water lines are those related to groundwater and surface water associated with the goal to restore groundwater quality to pre-release conditions to the extent practicable. Attainment of New York State Groundwater Standards beneath this area is technically impracticable, due in part to the widespread presence of NAPL below the water table and the thickness of the saturated zone. Groundwater beneath this area is not, however, used as a potable source, and conservative calculations presented in the Phase II Area Investigation Report document that dissolved phase groundwater discharge is not impacting surface water in the Mohawk River. New York State Surface Water Standards are currently being met, and implementation of Alternative A is not expected to alter that situation.

Action-Specific SCGs

Action-specific SCGs that would apply to this alternative include general health and safety requirements and general requirements for: managing, treating, and disposing of wastes; installing the barrier wall; and implementing the NAPL monitoring and collection program.

This alternative would need to comply with Occupational Safety and Health Administration (OSHA) requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1910, 1926, and 1904. Before initiating field activities, a project-specific *Health and Safety Plan* (HASP) would be developed to incorporate these SCGs, as well as other appropriate requirements. The HASP would be subject to NYSDEC/NYSDOH approval and would be complied with during remedial activities. The HASP would incorporate, as appropriate, the requirements of NYSDEC TAGM No. 4031 which

provides monitoring requirements, action levels, and procedures for addressing fugitive dust associated with inactive hazardous waste site operations (NYSDEC, 1989). In addition, a *Community Air Monitoring Plan* would be developed and implemented in accordance with the most current version of the NYSDOH's *Community Air Monitoring Plan.*

New York State regulations regarding the identification and listing of hazardous wastes outlined in 6NYCRR Part 371, and the Universal Treatment Standards (UTSs) and Land Disposal Restriction (LDRs) listed in 6NYCRR Part 376 are potentially applicable standards for waste materials generated during implementation of this alternative. Because MGP wastes resulted from historical operations that ended before the passage of the Resource Conservation and Recovery Act (RCRA), MGP-impacted material is only considered hazardous waste in New York State if it is removed (generated) and exhibits a characteristic of a hazardous waste (6NYCRR Part 371). If the MGP-impacted material only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste management requirements (6NYCRR Parts 370 through 374 and 376) when destined for thermal treatment in accordance with the requirements set forth in NYSDEC's TAGM No. 4061, *Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants* (NYSDEC, 2002). If MGP-related hazardous wastes are destined for land disposal in New York State, the state hazardous waste regulations apply, including LDRs and the alternative LDR treatment standards for soil. These potentially applicable SCGs would be achieved by completing appropriate characterization and profiling of the excavated materials prior to offsite transportation and treatment/disposal, in accordance with applicable rules and regulations at a properly permitted facility.

United States Department of Transportation (USDOT) and disposal facility requirements for packaging, labeling, manifesting, transporting and disposing regulated materials would also be applicable to this alternative. Compliance with these SCGs would be achieved by using licensed and properly permitted waste transporters and treatment/disposal facilities.

Finally, compliance with the substantive requirements of the NYSDEC (Division of Water) General Permit (#GP-02-01) for Stormwater Discharges Associated with Construction Activity under State Pollutant Discharge Elimination System (SPDES) may be required, including development and implementation of a *Stormwater Pollution Prevention Plan* (SWPPP). These requirements and any associated plan(s) would be identified and developed during the remedial design.

Location-Specific SCGs

A review of the relevant Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map indicates that a portion of the Phase II Area is within the 100-year floodplain, and a smaller portion is within the 500-year floodplain. Because of this, applicable local, state, and federal requirements related to activities performed in a floodplain will be incorporated into the remedial design/remedial action.

As detailed in Appendix D, to evaluate the potential impacts to the flood stage by construction of a barrier within the Mohawk River, steady-state simulations were conducted of the 100-year flood with and without the barrier wall. The 100-year flood magnitudes for the Mohawk River, North Chuctanunda Creek, and South Chuctanunda Creek were determined from the Flood Insurance Study for the City of Amsterdam. To conservatively estimate the maximum 100-year flood elevations, the flood was assumed to occur during navigation (summer) season in the Mohawk River. Steady-state simulations were performed using RMA2 with and without the barrier wall and the results were compared. The results indicated that there are minimal impacts to the 100-year flood elevations (maximum increase in water surface elevation of 0.1 foot due to the presence of

the wall). In addition, the simulations did not indicate significant increases in velocities and scour potential due to the presence of the barrier wall.

Remedial activities would be conducted in accordance with applicable local building/construction codes and ordinances. Local SCGs (if any) would be determined during the remedial design/remedial action.

The Cultural Resources Survey, conducted as part of the Phase II Area Investigation, concluded that there are no resources of cultural and/or historical significance that will be impacted by remedial implementation.

Additional location-specific SCGs that apply to this alternative are associated with discharge of dredge or fill materials, modification of waterways, and obstruction/alteration of navigable waters. As such, the Clean Water Act (CWA Section 404 [33 USC § 1344]), as well as the NYSDEC's Use and Protection of Waters Program (6NYCRR Part 608) and the regulatory programs of the NYSCC and (USACE) (e.g., Nationwide Permit Program) are potentially applicable location-specific SCGs. Compliance with these SCGs would be achieved (in general) by meeting the substantive requirements of any required permits, and by implementing a design that would minimize disturbance to the Mohawk River and maintain the navigation channel. Permitting issues are further discussed under Implementability (Section 7.3.1.6).

7.3.1.2 Overall Protection of Human Health and the Environment

Implementing Alternative A would effectively eliminate potential human or fish/wildlife exposure to NAPL located between the high and low water lines. Placing the barrier wall at the low water line would effectively contain: 1) the entire Phase II Area; 2) the majority of the riverbed area thought to contain LNAPL; and 3) the NAPL-containing soil in the subsurface below the entire Phase II Area down to the low water line.

Based on the results of the MODFLOW groundwater model (Appendix A) and the NAPL mobility assessment (Appendix B), installing the barrier wall to the sand-and-gravel unit is expected to be highly effective at mitigating the potential for NAPL discharge to the Mohawk River, while providing groundwater relief beneath the wall. Groundwater discharged up into this area from the bedrock and produced by recharge (assumed to be 1 inch per year through the cap) will gradually migrate beneath the wall, but as discussed in the *Phase II Area Investigation Report* (BBL, 2001), the reduced groundwater discharge to the river associated with this remedy will further reduce the already acceptable dissolved-phase loading to the river.

Backfilling of the area between the low water line and the top of the bank would eliminate the potential for future human or fish/wildlife exposure to riverbank materials containing potentially elevated concentrations of Site-related PAH constituents.

7.3.1.3 Short-Term Effectiveness

No short-term impacts to the community are anticipated from implementing Alternative A, with the exception of temporarily increased truck traffic during the hauling of equipment and clean backfill (an estimated 12,5000 cy, if no onsite materials generated during implementation of other Site remedial activities are used as backfill) to the Site. The quantity of backfill may be significantly reduced during design, if soils generated during grading of the Phase II Area are placed behind the wall. Adherence to common health and safety practices defined in a project-specific HASP should provide for appropriate worker protection during the barrier wall installation and backfilling construction activities.

With regard to the environment, the habitat provided by the riverbank materials, boulders, and debris present between the low water line and the top of the Phase II Area riverbank will be lost as a result of barrier wall placement and backfilling. The habitat between the high- and low-water lines is of questionable quality due to the annual lowering/raising of the river-water elevation, the lack of submerged vegetation, the nature of the subsurface materials (riprap and/or an armor layer), and environmental impacts related to discharges from the nearby upstream storm sewer. Performing a habitat restoration program in a nearby reach of the river would likely provide higher quality, less transient habitat to compensate for expected losses would be would occur if this remedy were implemented. Placing silt curtains and/or conventional erosion control devices should adequately contain Site-related materials disturbed during installation of the barrier wall, if not compromised by high surface-water velocities or ice build-up/movement in the Mohawk River.

Implementation of Alternative A is expected to be completed in one fall/winter construction season.

7.3.1.4 Long-Term Effectiveness and Permanence

Implementing Alternative A would effectively mitigate long-term risks associated with potential exposure to NAPL and/or elevated Site-related PAHs in the riverbed materials present between the high and low water lines of the Mohawk River within the Site. This alternative would also be highly effective at mitigating the potential for NAPL discharge to the Mohawk River.

Barrier walls have been designed and installed to effectively contain NAPL at other sites. Collection and treatment/disposal of NAPL that accumulates behind the wall over time would reduce the mass of MGP-related constituents. A long-term monitoring program would be implemented to verify that the wall effectively mitigates the discharge of NAPL to the surficial riverbed materials outside the barrier wall. When implemented in conjunction with other area-specific remedial alternatives, this alternative would contribute to attainment of the RAOs established for the Phase II Area and Mohawk River.

7.3.1.5 Reduction in Toxicity, Mobility or Volume through Treatment

Containment and passive collection of NAPL from behind the barrier wall would reduce the mobility and volume of NAPL in the materials below the Phase II Area, down to the low water line, including the area between the high- and low-water lines over time. Based on calculations of NAPL mass presented in Appendix E, approximately 70% more soil containing NAPL would be contained by placing the barrier wall at the low water line (as opposed to the top-of-bank).

Once NAPL is collected from NAPL collection wells, the NAPL will be sent offsite for blending/thermal treatment or incineration (i.e., irreversible treatment). Additionally, the barrier wall would be designed to mitigate the potential for NAPL discharge from the Phase II Area to the river, thereby decreasing the potential contribution of Site-related PAHs to surficial riverbed materials outside of the proposed wall location.

7.3.1.6 Implementability

The equipment, manpower and materials needed to implement Alternative A are readily available. NAPL barrier walls and NAPL collection systems have been successfully constructed and monitored at other sites. While working under cold winter and ice flow conditions may at times lead to delays, conducting the shoreline barrier wall installation and backfilling activities while the river water elevation is drawn down should simplify implementation. The potential exists for subsurface cobbles/boulders present beneath the Site to interfere with conventional sheetpile wall construction techniques and extend implementation time. Therefore, a pre-design investigation would be conducted along/near the proposed alignment of the barrier wall to obtain geotechnical and other data necessary for the design. Using these data, as well as existing data, the most appropriate barrier wall type(s) and installation techniques would be determined during detailed design. Additionally during the design, the presence of utilities and other structures along/near the barrier wall alignment would need to be addressed. For example, the 30-inch diameter storm sewer outfall located near the western end of the terminal wall would need to be addressed. Welded boots or impermeable collars could potentially be used in areas of existing discharge pipes. These types of details would be determined during the remedial design.

From an administrative perspective, the NYSDOT and NYSCC, owners of the Phase II Area and Mohawk River property, respectively, have provided their written concurrence of Alternative A (Morgan, 2003g). Recognizing the public benefits to expanding the Park, the City of Amsterdam has also expressed its support of this alternative and has developed a conceptual plan to use the expanded Park area, including the additional boat docking space that would be created along the barrier wall adjacent to the Phase II Area (see Figure 11, prepared by The Saratoga Associates).

Because this alternative would entail filling in a waterway and loss of habitat, permit approval (or compliance with the substantive requirements) would be required from the USACE and NYSDEC who have joint jurisdiction over the project. The permitting process, including review/comment and final approval could take up to a year. With specific regard to applicable NYSDEC regulations, 6NYCRR Part 608 establishes a procedure for projects like Alternative A, to be evaluated and approved through issuance of a permit. As described in Section Part 608.8, Standards, "The basis for the issuance or modification of a permit will be a determination that the proposal is in the public interest in that:

(a) The proposal is reasonable and necessary;

(b) The proposal will not endanger the health, safety, or welfare of the people of the State of New York; and

(c) The proposal will not cause unreasonable, uncontrolled, or unnecessary damage to the natural resources of the state, including soil, forests, water, fish, shellfish, crustaceans, and aquatic and land-related environment."

Alternative A appears to meet all the above criteria, and as previously described, already is supported by the City of Amsterdam, the NYSDOT, and the NYSCC. While there would be damage to the natural resources existing between the high and low water marks, the habitat in this area is of questionable quality and could be replaced through restoration in a nearby reach of the River that would likely result in habitat of higher quality.

7.3.1.7 Cost

The estimated costs associated with Alternative A are presented in Table 3. The total estimated capital cost for implementation of Alternative A is $6,000,000. Annual O&M costs for this alternative are estimated to be $50,000. The total estimated 30-year present worth cost associated with implementing Alternative A is $6,600,000.

Assumptions related to the costs are described in Table 3.

7.3.2 Site-Wide Alternative B – Placement of Barrier Wall at Top of Mohawk River Bank, Removal of Bank Materials, Backfill Area to Existing Grade

The objective of Alternative B is to construct a barrier wall along the top of the Phase II Area bank, and remove impacted river bank and riverbed materials to the extent feasible to support long-term protection of the upper 2 feet of riverbank/bed following restoration. This alternative was developed and analyzed at the request of the NYSDEC. Alternative B consists of placing an approximately 525-foot long barrier wall at the top of the south shore bank of the Phase II Area. The wall would extend down and be keyed into bedrock to mitigate potential NAPL discharge from the Phase II Area to areas outside of the barrier wall, and be cut off at the top-of-bank grade elevation (i.e., approximately 266 feet amsl). The top-of-bank wall would be connected to a perimeter barrier wall, driven to bedrock around the boundaries of the Phase II Area and cut off at grade elevation. A groundwater pump and treat system would likely be needed to address groundwater mounding within the fully enclosing barrier wall system.

Once installed, the top-of-bank wall would be supported with tie back anchors, and another temporary sheetpile wall would be driven at the winter low-water line. The up and downstream ends of the temporary wall would be connected to the top-of-bank wall to allow riverbank/bed excavation and mitigate the potential for offsite transport of material disturbed during removal. The sheetpile enclosure would be designed to minimize the potential for overtopping of the wall due to natural fluctuations in the Mohawk River surface water elevation. Silt curtains would also be installed in the river for additional control/protection and sorbent material (e.g., oil booms) may also be installed in the river to mitigate the spreading of potential sheens/oils on the water surface which may be generated during removal activities.

For purposes of this RAR analysis, it was assumed that excavation of riverbank/bed materials within the contained area would occur to an elevation of 234 feet amsl (chosen to correspond with the excavation depth proposed for the "focused" removal of NAPL-impacted riverbed materials at sample location T-7-50; see Alternative 3B in Subsection 7.6.2 for details), or an excavation depth ranging from 30 to 35 feet from the top-of-bank. If achievable, an estimated 29,200 cy of riverbank/bed materials would be excavated. Excavation would occur in-the-wet using a combination of land- and possibly barge-based earth-moving equipment, depending on the construction sequence and approach. The actual approach would be identified during design.

Stabilizing the wet riverbed materials after removal would be performed at a land-based processing facility by mechanically mixing a stabilizing agent (e.g., lime, portland cement) to facilitate offsite transportation of the materials for treatment/disposal. For cost estimating purposes, it was assumed that 90% of the materials generated under this alternative would be non-hazardous and subject to treatment at ESMI's LTTD facility in Fort Edward, New York. The remaining 10% of materials generated under this alternative are assumed to be RCRA-regulated and subject to landfill disposal at Chemical Waste Management's (CWM's) facility in Model City, New York. It has also been assumed that water generated during the construction activities would be

treated in the permanent onsite pump and treat system designed to address groundwater mounding that is predicted to occur within the Phase II containment area after the barrier walls are keyed into the bedrock, and subsequently discharged to the Mohawk River. Actual methods/processes/facilities for handling removed riverbed materials, water generated during removal, and selection of final disposal facilities would be determined during remedial design based on pricing/availability and profile of the dredged riverbed materials. All materials would be disposed in accordance with applicable rules and regulations.

Once excavation is completed, the area would be backfilled to original grade with a combination of common fill and scour protective riprap on the riverbank/bed surface, and the temporary sheetpile wall would be removed, washed, and transported offsite for potential reuse by the Contractor. The common fill could be a mixture of fill brought in from offsite and materials excavated as part of the alternative for Area 2 (see Section 7.5), if some portion of those materials are observed to not contain NAPL. Final decisions regarding the backfill materials would be made during detailed design. Plan view and cross-sectional depictions of Alternative B are presented on Figures 12A and 12B, respectively.

Although unlikely, an attempt would be made to complete construction of Alternative B in one winter construction season. The barrier wall would be tied in with other upland and/or river remedy components.

A long-term O&M Plan and a monitoring program would be developed for the groundwater pump and treat system to control the water level elevation within the Phase II Area. This plan would also detail the long-term monitoring program to be implemented to verify the continued integrity and effectiveness of the remedy; and describe the NAPL monitoring and removal program to be implemented using newly installed and existing wells at the Phase II Area.

7.3.2.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are the same as those addressed under Site-wide Alternative A. In addition, the NYSDEC has indicated that a performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may apply. This guidance value is presented in the NYSDEC's *Technical Guidance for Screening Contaminated Sediments* (1999). While the 4 ppm is a guidance value that should be considered, a number of qualifiers cited in the guidance document limit the extent to which 4 ppm should be applied. For example:

- NYSDEC's guidance states that "it is not necessary in all cases and at all times to achieve these criteria through remediation efforts." And further, "to view sediment criteria in a one-dimensional, go/no go context is to miss potential opportunities for resource utilization through appropriately identified and managed risk." Based on these statements, alternatives should not be rejected out-of-hand simply because the criterion cannot be met. At this Site in particular, the overall benefit of the options selected for each of the remedial areas should be considered along with the RAOs, which for the River in particular are designed to prevent exposure to levels of Site-related constituents above background concentrations, not to achieve a 4 ppm PAH target.

- The NYSDEC states that "the uncertainty about the criteria" should be considered when making remedial decisions. The level of confidence associated with the total PAH criterion is "low," according to the table included in the guidance. Further, the study from which the 4 ppm value was drawn does not establish causality between 4 ppm PAH and negative impacts on benthic communities. Instead, 4 ppm is set as the

level below which no negative impacts would be expected – an important difference. In addition, the study did not account for the possible impacts of other contaminants; therefore, it is impossible to definitively link exposure to total PAHs as the reason for observed impacts at levels above 4 ppm PAH.

- The guidance states that "for non-polar organic contaminants [like PAHs], exceedence of sediment criteria based on aquatic life chronic toxicity by a factor of 50 in a significantly large area indicates that biota are probably impaired, and to achieve restoration of the ecosystem will require remediation of organic contaminants present." Area-wide average PAH concentrations at the Site do not exceed 200 ppm; therefore, remediation should not be considered a foregone conclusion to meet this SGC.

- The study cited in the guidance from which the 4 ppm criteria were drawn was carried out in a marine environment, not in a freshwater system like the Mohawk River.

Action-Specific SCGs

The action-specific SCGs discussed under Site-wide Alternative A (Subsection 7.3.1.1) are applicable to this alternative.

Location-Specific SCGs

The location-specific SCGs discussed in Subsection 7.3.1.1 are applicable to this alternative. Under Site-wide Alternative B, no additional filling of the Mohawk River would be performed and the Park area would not be expanded; however, excavation and filling below the mean high water level would occur, so permits from USACE and NYSDEC (or compliance with substantive requirements) would likely be required. Permitting issues are further discussed under Implementability (see Section 7.3.2.6).

7.3.2.2 Overall Protection of Human Health and the Environment

Construction of a barrier wall keyed into the underlying bedrock (in conjunction with NAPL collection and groundwater pump and treat within the barrier wall) should effectively reduce the potential for future human or fish/wildlife exposure to NAPL which may be migrating from the Phase II Area to the Mohawk River. Extensive removal of riverbank/bed materials with backfilling/ restoration would eliminate the potential for exposure to elevated Site-related PAH concentrations in the surficial riverbank/bed materials in the near term. However, the potential for future recontamination of and subsequent exposure to the restored materials via upward migration of deep residual LNAPL present beneath the elevated area cannot be ruled out. As noted in boring MW-6S/M/D/R, NAPL was encountered at the top of the bank at depths far below those which could be practically excavated, if present at similar elevations beneath the riverbank/bed. As discussed in Appendix B, however, after mitigating potential active NAPL discharge from below the Phase II Area with the installation of a barrier wall (if there is in fact an active current discharge), potentially mobile NAPL below the riverbank and outside of the wall, would be expected to be driven to residual saturation. Additionally, keying the wall into bedrock (as opposed to keying the barrier wall into the silty sand unit below the sand-and-gravel) is expected to somewhat reduce the vertical gradients immediately outside of the barrier wall (when compared to a wall keyed into the silty sand), which would prolong the length of time needed to drive the NAPL to a residual saturation.

7.3.2.3 Short-Term Effectiveness

If Alternative B were implemented, the greatest risk posed to the community would likely relate to increased truck traffic (e.g., highway accidents, potential for spillage, inherent risks crossing the high speed rail line) during construction. For soil handling alone, an estimated 4,900 truck trips would be required to transport PAH-containing material (an estimated 29,200 cy) from the Site and deliver clean backfill to the Site. The quantity of backfill may be significantly reduced during design, if soils generated during grading of the Phase II Area are reused as backfill.

Potential risk of exposure and injury to onsite workers exist, primarily associated with the deep excavation of NAPL-containing riverbank/bed material. Potential hazards associated with working over water during potentially severe winter conditions, operating heavy construction equipment adjacent to a deep, structurally supported open excavation and inhalation/dermal exposure to coal-tar NAPL would all need to be addressed in a project-specific HASP.

Construction of a clean cover (i.e., less than 4 ppm PAHs in the upper 2 feet of the backfill/cap, which is a performance specification required by the NYSDEC) near the low water line may be difficult to attain because of the likely presence of NAPL and elevated residual PAH concentration in the water column of the excavation area during backfilling of the excavation.

With regard to the environment, the habitat and any biota residing in the riverbank/bed material would be destroyed during excavation. Following restoration, the excavated area is expected to become re-inhabited. Placing booms or silt curtains around the temporary sheetpile wall should adequately contain a potential release of any Site-related material, if not compromised by high surface water velocities or ice build-up/movement in the Mohawk River. There is a potential for short-term compliance issues with New York State Surface Water Standards.

Completion of Alternative B in one fall/winter construction season may be difficult to achieve, especially if harsh winter conditions persist or excavation rates are low. Such concerns would need to be considered and addressed during design (e.g., conduct excavation of the riverbank/bed in a series of cells, rather than as one large excavation area, to allow work to be performed over two construction seasons).

7.3.2.4 Long-Term Effectiveness and Permanence

A significant volume of riverbank/bed material containing NAPL and/or Site-related PAHs would be removed if Alternative B were implemented. Because of the volume of NAPL-containing soil remaining in place below the excavation area, the long-term effectiveness and permanence of this alternative is somewhat, uncertain. As noted previously, NAPL is present beneath the Phase II Area riverbank at depths far below what can be feasibly excavated (see Figure 8). Implementing Alternative B would not mitigate the potential for lateral and/or vertical migration of unexcavated NAPL to the surface outside of the barrier wall; however, as indicated above, NAPL in this area with the potential to be mobilized is expected to eventually be driven to residual saturation. Constructing a clean cover near the river's edge (i.e., achievement and maintenance of less than 4 ppm PAHs in the upper 2 feet of the backfill/cap, which is a performance specification required by the NYSDEC) would be complicated by the presence of NAPL and elevated residual PAH concentrations expected to be present in the water column of the excavation area and following excavation. Long-term compliance with the 4 ppm total PAH concentration in the upper 2-foot interval is not expected to be achievable due to the downstream

migration of PAHs from non-MGP related sources (e.g., the storm sewer outfall located immediately upstream of the Site).

The barrier wall would effectively mitigate the potential discharge of NAPL from the Phase II Area to the Mohawk River. The groundwater pump and treat system would likely need to be operated and maintained in perpetuity to prevent the water table from rising to unacceptable levels within the Phase II Area. Watertight barrier walls have been designed and installed to effectively contain NAPL at other sites. Passive collection and treatment/disposal of any NAPL that accumulates behind the wall over time would reduce the mass of MGP-related constituents.

When implemented in conjunction with other area-specific remedial alternatives, Alternative B would contribute to the near-term attainment of the majority of the RAOs established for the Phase II Area and Mohawk River. The potential exists for future recontamination of surficial riverbed material through the upward migration of LNAPL, if present, beneath the Alternative B excavation area at levels above saturation, which could preclude long-term attainment of the Mohawk River RAOs.

7.3.2.5 Reduction in Toxicity, Mobility or Volume through Treatment

Containment and passive collection of NAPL from behind the barrier wall would reduce the mobility and volume of NAPL in the Phase II Area materials over time. Once collected, the NAPL would be sent offsite for blending/thermal treatment or incineration (i.e., irreversible treatment). Treatment of any PAHs captured in the groundwater pump and treat system (the mass of PAHs expected to be collected via pump and treat is, however, expected to be small because of the low solubility of these constituents) would further reduce the mass of PAHs in the Phase II Area materials over time.

Excavating an estimated 29,200 cy of PAH- and NAPL-containing riverbank/bed materials would significantly reduce the volume and mobility of MGP-related material present. Treating the excavated material before disposal (if necessary) would reduce toxicity.

7.3.2.6 Implementability

The equipment, manpower and materials needs to implement Alternative B are readily available. NAPL barrier walls, NAPL excavation and NAPL collection systems have been successfully constructed and monitored at other sites. However, a number of Site-specific constraints could greatly impact the constructability and operational reliability of Alternative B; the following constraints must be considered:

- The upper 15 feet of bedrock in the Phase II Area is characterized as moderately to highly fractured gray/limestone. To key a barrier wall into the moderately fractured limestone bedrock along the top of the bank would require sheeting to depths greater than 65 feet bgs. It may not be possible to drive sheeting to these depths and obtain an adequate key in the bedrock.

  As noted under Alternative A, the potential exists for subsurface cobbles/boulders present beneath the Site to interfere with conventional barrier wall construction techniques. As such, a pre-design investigation would be conducted and the most appropriate barrier wall type(s) and installation techniques would be determined during detailed design.

- With the wall advanced to the bedrock, groundwater mounding within the limits of the wall would be expected. Groundwater extraction would be required to mitigate possible flooding of the Phase II Area, if the leakage rate out of the containment area was less than the combined groundwater infiltration from the bedrock and recharge through the surface cap (estimated to be 1 inch per year). While this scenario was not modeled, the estimated flux of groundwater out of the containment area for Site-wide Alternative A (with the walls to the base of the sand-and-gravel unit, or bedrock, which ever is shallower) was estimated to range from 2,600 to 23,000 gpd (primarily dependent on the stage of the river). Under this alternative, the fluctuations in river level are not expected to significantly impact the water levels within the containment area, therefore, the long term average groundwater pumping rate will likely be closer to 2,600 gpd rather than the upper limit. The space required to construct and operate such a system could somewhat limit future use of the property as a park by the City.

- Excavation to an elevation of 234 feet amsl, or approximately 10 feet bgs along the outer temporary sheetpile wall (i.e., 234 feet amsl) would result in a vertical face of upwards of 35 feet along the outside of the barrier wall.

- The NYSDOT may not allow excavation to 234 feet amsl near the western end of the Site, due to the proximity of the State Route 30 bridge pier.

- Excavation of riverbank/bed material would be complicated by the presence of large boulders/debris, shoring structures likely required the Phase II Area bank, and changing river/weather conditions during the winter months.

- Subsurface NAPL would be mobilized in the excavation area during excavation. The presence of NAPL in the excavation area would greatly complicate and slowdown the production of both the wet excavation and backfilling activities.

- Constructing a clean cover (i.e., less than 4 ppm PAHs in the upper 2 feet of the restored surface, a performance specification required by the NYSDEC) would be difficult to achieve in portions of the excavation where the cover would likely be placed into water containing NAPL and/or elevated PAH concentrations.

- The 4 ppm PAH performance standard would likely be unattainable in the future, due to the existence of ongoing sources of PAHs from non-MGP related sources (here defined as background PAH sources, or simply "background") from storm sewer outfalls and runoff. As discussed in the *Mohawk River Investigation Summary Report* (BBL, 2002), background PAH concentrations up to 80.9 ppm were found in riverbed material, immediately upstream of the Site.

From an administrative perspective, the NYSDOT and NYSCC, owners of the Phase II Area and river property, would need to provide their written concurrence of Alternative B, and accept certain future and use restrictions. Alternative B would not be compatible with the City of Amsterdam's most current rendition of the Park expansion (see Figure 11).

Because this alternative would entail filling in a waterway (for restoration purposes) and loss of habitat, permit (or compliance with the substantive requirements) approval would be required from the USACE and NYSDEC, who have joint jurisdiction over the project. The permitting process, including review/comment and final approval could take up to a year. As described in the implementability discussion under Site-wide Alternative A, 6NYCRR Part 608 provides a process for issuing permits for projects that involve altering or filling a

waterway. The elements of this alternative do not appear to be in conflict with the issues that are considered during permit review.

7.3.2.7 Cost

The estimated costs associated with Alternative B are presented in Table 4. The total estimated capital cost for implementation of Alternative B is $20,800,000. Annual O&M costs for this alternative are estimated to be $130,000. The total estimated 30-year present worth cost associated with implementation of Alternative B is $22,400,000.

The primary elements of the cost associated with implementation of Alternative B include:

- mobilization/demobilization;
- traffic control and Site security;
- temporary sheetpile at the low water mark;
- installation of the barrier wall at the high water mark;
- removal, dewatering, transport, and disposal of approximately 29,200 cy of riverbed materials;
- placement of backfill/cap materials to existing grade; and
- construction of the pump and treat system.

Assumptions related to the costs are described in Table 4.

7.3.3 Site-Wide Alternative C – Placement of Barrier Walls at Top of Mohawk River Bank and at Low-Water Line, Removal of Bank Materials, Construct Cap, and Backfill to Existing Grade

The objective of Alternative C is to construct a barrier wall at the approximate winter low water line (i.e., elevation 246 feet amsl), remove impacted riverbank and riverbed materials, and construct a subgrade impermeable cap that provides long-term protection of the upper 2 feet of riverbank/bed following restoration. Alternative C consists of placement of an approximately 595-foot-long barrier wall at the approximate winter low water line, adjacent to the south shore bank of the Phase II Area. The wall would extend down and be keyed into bedrock to mitigate potential NAPL discharge from the Phase II Area to areas outside of the barrier wall, and would ultimately be cut off at or just below grade for tie-in with a subgrade cap. The low water line wall would be connected to a Phase II Area perimeter barrier wall, driven to bedrock along the western, northern, and eastern sides of the Phase II Area and ultimately cut off at grade elevation. During construction, sheetpiling in and along the Mohawk River bed and banks would be set at an elevation designed to minimize the potential for overtopping and support excavation. A groundwater pump and treat system would be needed to prevent mounding within the fully enclosing barrier wall system.

A second barrier wall would be constructed along the top of the Phase II Area bank, and tied into the eastern and western perimeter walls. The objectives of the top-of-bank wall would be to:

1) Prevent future potential migration of NAPL from the Phase II Area to the banks of river adjacent to the Site;

2) Stabilize the upland area of the Phase II Area during excavation of riverbank/bed materials present between the two walls; and

3) Provide an upland vertical barrier to which the subgrade impermeable cap is tied.

For purposes of this RAR analysis, it was assumed that the top-of-bank wall would consist of 60 foot-long sheets, driven to grade and supported with tie-back anchors.

Once all the barrier walls are in place and the groundwater pump and treat system was operational, excavation of the riverbank/bed material would begin. Excavation would be performed within the area bounded by the low waterline and top-of-bank barrier walls, to a depth of elevation 243 feet amsl. This would result in an estimated excavation volume of approximately 17,000 cy of material. Much of the riverbank material would be excavated in-the-dry using conventional earth moving equipment staged on the Phase II Area. Excavating the riverbank/bed material below the water table would occur in-the-wet using land based equipment, possibly augmented by barge-based earth moving equipment as appropriate/needed. Silt curtains and booms would be placed in the Mohawk River around the perimeter of the work area to provide additional protection against work-related releases of NAPL/sheens to the Mohawk River.

Similar to Alternative B, stabilizing the wet riverbed materials after removal would be performed at the land-based processing facility by mechanically mixing a stabilizing agent (e.g., lime, portland cement) to facilitate offsite transportation of the materials for treatment/disposal. For cost estimating purposes, it was assumed that 90% of the materials generated under this alternative would be non-hazardous and subject to treatment at ESMI's LTTD facility in Fort Edward, New York. The remaining 10% of materials generated under this alternative are assumed to be RCRA-regulated and subject to landfill disposal at CWM's facility in Model City, New York. It was also assumed that water generated during the construction activities would be treated in the permanent 2,600-gpd pump-and-treat system designed to address groundwater mounding predicted to occur within the containment area of the Phase II Area after the barrier walls are keyed into the bedrock, and subsequently discharged to the Mohawk River. Actual methods/processes/facilities for handling removed riverbed materials, water generated during removal, and selection of final disposal facilities would be determined during remedial design based on pricing/availability and profile of the dredged riverbed materials. All materials would be disposed in accordance with applicable rules and regulations.

Once excavation is completed, an impermeable cap would be constructed in the base of the excavation and tied to the upper and lower barrier walls. The impermeable cap would consist of 6 inches of sand placed below and 2 feet above a high-density polyethylene (HDPE) liner, overlain by geotextile and a 1.5-foot thick layer of armor stone. The liner would be tied to the barrier walls through placement of bentonite around the HDPE edges where they contact the wall.

Once the 3-foot cap is in place, the area would be backfilled to original grade with a combination of common fill and placement of a geotextile beneath a scour protective riprap on the riverbank/bed surface. The common fill could be a mixture of fill brought in from offsite and materials excavated as part of the alternative for Area 2 (see Section 7.5), if some portion of those materials are observed to not contain NAPL. Final decisions regarding the backfill materials would be made during detailed design. Plan view and cross-sectional depictions of Alternative B are presented on Figures 13A and 13B, respectively. Monitoring would assess whether NAPL was being properly contained and if possible, the integrity of the seals between the horizontal cap and the two barrier walls.

An attempt would be made to complete construction of Alternative C in one winter construction season. Once constructed, NAPL monitoring/collection wells would be installed along the south bank behind the top-of-bank source barrier wall and a program implemented to remove NAPL that collects behind the wall. See concerns above for Alternative B regarding these wells. Perimeter monitoring wells would be installed in the Phase II Area around the outside of the barrier wall and a long-term monitoring program would be implemented to assess the effectiveness of the wall in mitigating the potential for NAPL migration to the river. A long-term O&M Plan and a monitoring program would be developed for the groundwater pump and treat system to control the water level elevation within the Phase II Area.

7.3.3.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs are addressed under Site-wide Alternative B.

Action-Specific SCGs

The action-specific SCGs discussed under Site-wide Alternative A (Subsection 7.3.1.1) are applicable to this alternative.

Location-Specific SCGs

The location-specific SCGs discussed in Subsection 7.3.1.1 are applicable to this alternative. Under Site-wide Alternative C, no additional filling of the Mohawk River would be performed and the Park area would not be expanded; however, excavation below the mean high water level would occur, and a subaqueous cap would be installed between two barrier walls (one located at the low waterline), requiring approvals/permits from the NYSDEC, NYSCC, and USACE. Permitting issues are further discussed under Implementability (Section 7.3.3.6).

7.3.3.2 Overall Protection of Human Health and the Environment

Removing the riverbank/bed materials, along with cap construction and backfilling/restoration, would eliminate the potential for exposure to elevated Site-related PAH concentrations in the surficial riverbank/bed materials in the near term. While the cap and containment system should effectively reduce the potential for future human or fish/wildlife exposure to Site-related PAHs, some concern exists regarding the ability to design, construct, and maintain an effective seal between the cap liner and sheetpile barrier walls. With the NAPL collection system located upgradient of the top-of-bank barrier wall, LNAPL present beneath the cap would likely accumulate in the sand layer immediately beneath the HDPE liner overtime (with no means of collection/removal). If not properly sealed, humans and fish/wildlife may be exposed to NAPL if they were to migrate upward through the cap to the restored riverbank/bed materials.

7.3.3.3 Short-Term Effectiveness

Similar to Alternative B, if Alternative C were implemented, the greatest risk posed to the community would likely relate to increased truck traffic (e.g., highway accidents, potential for spillage, inherent risks crossing the high speed commuter railing) during construction. For soil handling alone, an estimated 3,060 truck trips would be required to transport PAH-containing material (an estimated 19,400 cy) from the Site and deliver clean backfill to the Site. The quantity of backfill may be significantly reduced during design, if soils generated during grading of the Phase II Area are reused as backfill.

Potential risk of exposure and injury to onsite workers exists, primarily associated with the excavation of impacted material. Potential hazards associated with working over water during potentially severe winter conditions, operating heavy construction equipment adjacent to a structurally supported open excavation, and inhalation/dermal exposure to coal-tar NAPL would need to be addressed in a project-specific HASP.

With regard to the environment, the habitat and any biota residing in the riverbank/bed material would be destroyed during excavation. Following restoration, the excavated area is expected to become re-inhabited. Placement of booms or silt curtains around the temporary sheetpile wall and excavation barge should adequately contain a release of any Site-related material, if not compromised by high surface water velocities or ice build-up/movement in the Mohawk River. There is a potential for short-term compliance issues with New York State Surface Water Standards.

Completion of Alternative C in one fall/winter construction season may be difficult to achieve, especially if harsh winter conditions persist or excavation rates are low. Such concerns would need to be considered and addressed during design.

7.3.3.4 Long-Term Effectiveness and Permanence

While a clean layer of riverbank/bed materials would be placed over the excavation area following cap and barrier wall construction, the long-term effectiveness and permanence of this alternative is uncertain. Based on the results of previous subsurface investigative activities, some volume of mobile LNAPL would be present beneath the cap, following construction. Given the presence of LNAPL, and challenges anticipated constructing and monitoring the submerged seal between the barrier wall and the HDPE liner, the potential for long term releases of NAPL to the restored riverbed/bank material exists.

When implemented in conjunction with other area-specific remedial alternatives, Alternative C would contribute to the near-term attainment of the majority of the RAOs established for the Phase II Area and Mohawk River. The potential exists for future recontamination of surficial riverbed material through the upward migration of NAPL present beneath the Alternative C cap, which could preclude long-term attainment of the Mohawk River RAOs.

7.3.3.5 Reduction in Toxicity, Mobility or Volume through Treatment

Containment and passive collection of NAPL from behind the top-of-bank wall would reduce the mobility and volume of NAPL in the Phase II Area materials over time. Once collected, the collected NAPL would be sent offsite for blending/thermal treatment or incineration (i.e., irreversible treatment). Treatment of any PAHs

captured in the groundwater pump and treat system would further reduce the volume of PAHs in the Phase II Area materials over time.

Constructing a cap and barrier at the winter low water line would reduce the mobility of NAPL present beneath the Phase II Area riverbank. Excavating an estimated 17,300 cy of PAH- and NAPL-containing riverbank/bed materials would reduce the volume of MGP-related materials present. Treating the excavated material prior to disposal (if necessary) would reduce toxicity.

7.3.3.6 Implementability

The equipment, manpower and materials needs to implement Alternative C are readily available. NAPL barrier walls, NAPL excavation and NAPL collection systems have been successfully constructed and monitored at other sites. However, a number of Site-specific constraints could greatly impact the constructability and operational reliability of Alternative C; the following constraints must be considered:

- The upper 15 feet of bedrock in the Phase II Area is characterized as moderately to highly fractured gray/ limestone. To key the lower barrier wall into the moderately fractured limestone bedrock may require sheeting to depths exceeding 100 feet bgs at the western end of low water line (see Figure 13B). It may not be possible to drive sheeting to these depths and/or obtain an adequate key in the bedrock.

  As noted under Alternative A, the potential exists for subsurface cobbles/boulders present beneath the Site to interfere with conventional barrier wall construction techniques. As such, a variety of barrier wall types and installation techniques would be evaluated during design.

- With the wall advanced to bedrock, groundwater mounding within the limits of the wall would be expected. Groundwater extraction would be required to mitigate possible flooding of the Phase II Area, if the leakage rate out of the containment area was less than the combined groundwater infiltration from the bedrock and recharge through the surface cap (estimated to be 1 inch per year). While this scenario was not modeled, the estimated flux of groundwater out of the containment area for Site-Wide Alternative A (with the walls to the base of the sand-and-gravel unit, or bedrock, which ever is shallower) was estimated to range from 2,600 to 23,000 gpd (primarily dependent on the stage of the river). Under this alternative, the fluctuations in river level are not expected to significantly impact to water levels within the containment area, therefore, the long term average groundwater pumping rate will likely be closer to 2,600 gpd rather than the upper limit. The space required to construct and operate such a system could somewhat limit future use of the property as a park by the City.

- Excavation to 10 feet bgs along the outer barrier wall (i.e., 243 feet amsl) would result in a vertical face of upwards of 25 feet along the outside of the upper barrier wall.

- The NYSDOT may not allow excavation to 243 feet amsl near the western end of the Site, due to the proximity of the State Route 30 bridge pier.

- Excavating the riverbank/bed material would be complicated by the presence of large boulders/debris, shoring structures likely required the Phase II Area bank, and changing river/weather conditions during the winter months.

- NAPL present on the excavated materials would be mixed with the water during wet excavation procedures. The presence of this NAPL-water mixture in the excavation area would complicate cap construction.

- Constructing a clean cover (i.e., less than 4 ppm PAHs in the upper 2 feet of the restored surface, a performance specification required by the NYSDEC) would be difficult to achieve in portions of the excavation where the cover would likely be placed into water containing NAPL and/or elevated PAH concentrations.

- The 4 ppm PAH performance standard would likely be unattainable in the future, due to the existence of ongoing background PAH sources with concentrations of total PAHs of up to 80.9 ppm.

From an administrative perspective, the NYSDOT and NYSCC, owners of the Phase II Area and Mohawk River property, would need to provide their written concurrence of Alternative C, and accept certain future and use restrictions. The NYSCC has expressed concerns regarding the effectiveness and potential long-term O&M requirements associated with Alternative C. Alternative C would not be compatible with the City of Amsterdam's most current rendition of the Park expansion (see Figure 11).

Because this alternative would entail filling in a waterway and loss of habitat, permit (or compliance with substantive permit requirements) approval would be required from the USACE and NYSDEC who have joint jurisdiction over the project. The permitting process, including review/comment and final approval could take up to a year. As described in the implementability discussion under Site-wide Alternative A, 6NYCRR Part 608 provides a process for issuing permits for projects that involve altering or filling a waterway. The elements of this alternative do not appear to be in conflict with the issues that are considered during permit review.

7.3.3.7 Cost

The estimated cost associated with Alternative C is presented in Table 5. The total estimated capital cost for implementation of Alternative C is $17,500,000. Annual O&M costs for this alternative are estimated to be $140,000. The total estimated 30-year present worth cost associated with implementation of Alternative C is $19,200,000.

The primary elements of the cost associated with implementation of Alternative C include:

- mobilization/demobilization;
- traffic control and Site security;
- installation of barrier walls at both the low and high water marks;
- removal, dewatering, transport, and disposal of approximately 17,000 cy of riverbed materials; and
- construction of a pump and treat system.

Assumptions related to the costs are described in Table 5.

7.3.4 Comparative Analysis of Site-Wide Alternatives

Three Site-wide remedial alternatives were identified and evaluated to mitigate, to the extent practicable, potential discharges of NAPL from the Phase II Area to the Mohawk River and support achievement of the

RAOs. The three Site-wide alternatives consist of different subsurface barrier wall configurations, constructed around the perimeter of the Phase II Area and at varying locations along the Mohawk Riverbank. The three potential barrier wall configurations developed and evaluated for the Phase II Area are summarized in the table below.

Alternative	Summary
Alternative A	• Placing a barrier wall at the low water line and around the Phase II Area perimeter, extending vertically from the base of the sand-and-gravel layer or bedrock to Phase II Area grade. • Backfilling behind the barrier wall. • NAPL collection.
Alternative B	• Placing a barrier wall at the top of the Mohawk riverbank and around the Phase II Area perimeter, extending vertically from the bedrock or clay unit to Phase II Area grade. • Removing riverbank/bed material containing NAPL and Site-related PAHs present between the low water line and the top of bank to 234 feet amsl. • Backfilling to existing grade. • NAPL collection.
Alternative C	• Placing a barrier wall at the low water line and around the Phase II Area perimeter, extending vertically from the bedrock or clay unit to existing Phase II Area and riverbank/bed grade. • Placing a second wall along the top of the Mohawk riverbank, extending vertically from the sand-and-gravel unit to the existing Phase II Area grade. • Removing riverbank/bed material containing NAPL and Site-related PAHs present between the low water line and the top of bank barrier walls to 243 feet amsl. • Placing a low-permeability cap between the walls. • NAPL collection behind the top of bank barrier wall.

A comparative analysis of the three Site-wide remedial alternatives is provided below using the seven NYSDEC/NCP evaluation criteria.

7.3.4.1 Compliance with SCGs

Each of the three Site-wide alternatives would be expected to be compliant with applicable NYSDEC, NYSCC, and USACE requirements by meeting the substantive requirements of any required permits, and implementing a design that would minimize disturbance to the Mohawk River and maintain the navigation channel. All the alternatives include filling in a portion of the River or excavating below the mean high water level; therefore, all would be subject to USACE and NYSDEC permitting requirements. Further, all would result in some permanent habitat loss, although since the alterations proposed in Alternative A are the most extreme, it may be the most difficult (administratively) to implement.

NYSDEC's 4 ppm PAH performance specification for the top 2 feet of riverbed materials may apply to Alternatives B and C (it would not apply to Alternative A, since the resulting area would no longer be in the river environment). If the 4 ppm specification does apply, it is unlikely that implementation of either Alternative B or C would result in long-term achievement of this criterion. Finally, none of the alternatives would be expected to achieve New York State Groundwater Standards beneath the area; however, New York State Surface Water Standards are currently being met and are expected to be maintained over the long term.

7.3.4.2 Overall Protection of Human Health and the Environment

Alternative A is expected to provide a higher degree of human health and environmental protection than Alternatives B and C. Implementing Alternative A would effectively eliminate potential human or fish/wildlife exposure to NAPL potentially migrating or currently present in the riverbed materials located between the high and low water lines, through low water wall placement and burial beneath up to 20 feet of backfill. Alternative B provides comparable short-term protection through extensive riverbank/bed removal and backfilling; however, approximately 70% more soil containing NAPL would be contained by placing the barrier wall at the low water line (Alternative A), as opposed to the top of bank. With Alternative B, there is no assurance that deeper NAPL present beneath the riverbank can be removed, or that future lateral migration or upward movement of NAPL left outside the barrier wall would be mitigated. Some concern exists regarding the ability to design an effective seal between the cap liner and barrier walls proposed with Alternative C, with a potential for future human or fish/wildlife exposure to Site-related PAHs that may migrate upward through the cap to the restored riverbank/bed materials.

7.3.4.3 Short-Term Effectiveness

Alternative B poses the greatest risk to the community, with an estimated 4,900 truck trips through the streets of Amsterdam required to transport over 29,200 cy of NAPL/PAH-containing material from the Site and deliver 29,200 cy of clean backfill to the Site. For both Alternatives B and C, air monitoring/emission control measures may be required during excavation for odor control and to minimize community exposure to PAHs through inhalation.

Potential risks of exposure and injury to onsite workers are also greatest for Alternative B, primarily during the deep excavation of NAPL-containing riverbank/bed material. For both Alternatives B and C, potential hazards associated with working over water during potentially severe winter conditions, operating heavy construction equipment adjacent to deep open excavations, and inhalation/dermal exposure to coal-tar NAPL would need to be addressed in project-specific HASPs.

With regard to the environment, the habitat and any biota residing in the riverbank/bed material would be destroyed during implementation of each of the three alternatives. Alternatives B and C run the greatest risk of offsite releases of NAPL- and PAH-containing solids to the Mohawk River during implementation of the proposed riverbed excavation activities, which could lead to short-term compliance issues with New York State Surface Water Standards. Once constructed, the existing riverbank/bed habitat would be restored in place with Alternatives B and C. Because the habitat along the river bank would be lost with Alternative A, mitigative habitat restoration elsewhere in the Mohawk River would be required.

Implementing Alternative B would take, by far, the longest, possibly requiring more than one fall/winter construction season to implement, especially if significant weather-related delays are encountered.

7.3.4.4 Long-Term Effectiveness and Permanence

Alternative A is expected to provide the highest degree of long-term protection of the three barrier wall configurations considered. While a significant volume of NAPL-containing riverbank/bed material would be removed with Alternative B, long-term effectiveness and permanence are somewhat uncertain due to the

potential for future migration of NAPL that cannot be feasibly excavated. With Alternative C, long-term effectiveness and permanence are the least certain, due to the difficulties anticipated both constructing and monitoring the subaqueous seal between the barrier walls and the HDPE liner.

With Alternative A, placing the barrier wall at the low water line is considered a more permanent and reliable means to contain NAPL-containing soils below the Phase II Area and riverbank/bed. While soil excavation is not a remedy component, NAPL collection from the riverbank/bed materials is a viable option with Alternative A, to reduce the mass of MGP-related constituents and the potential for future NAPL releases to the surficial riverbed materials located outside the wall.

Implementing each of the Site-wide alternatives is expected to contribute toward attainment of the RAOs established for the Phase II Area and Mohawk River in the near term. For reasons noted above, the ability of Alternatives B and C to support long-term attainment of the RAOs is somewhat uncertain.

7.3.4.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Through excavation and offsite treatment/disposal of more than 29,000 in-situ cy of NAPL- and PAH-containing riverbank/bed material (35,000 ex-situ cy with bulking factor), Alternative B would remove and treat (reduce toxicity) the largest volume of NAPL/PAHs from the Site. Through placing barrier walls and a cap (Alternative C), each alternative would reduce the future mobility of NAPL present beneath the Phase II Area, as well as support reduction in PAH volume through NAPL collection. By placing the barrier wall at the low water line, Alternative A has the potential to collect more NAPL remaining beneath the Phase II Area and riverbank/bed following remedy implementation (approximately 70% more NAPL-containing soil would be contained by placing the barrier wall at the low water line, as opposed to the top of bank).

7.3.4.6 Implementability

The equipment, manpower, and material needs to implement each alternative are readily available. However, Alternatives B and C are considered much more difficult to implement. With each alternative, barrier wall installation may be complicated by the presence of subsurface cobbles/boulders, requiring use of non-conventional construction techniques, which may lead to extended implementation times. Barrier wall construction is further complicated by the greater required embedment depths and the desire to key into fractured bedrock or clay unit with Alternatives B and C. A number of other Site-specific constraints that could greatly impact the constructability and operational reliability of Alternatives B and C include:

- Riverbank/bed materials would be excavated to depths of 25 to 35 feet below the top of the riverbank;
- Excavation activities would be complicated by the presence of large boulders/debris and shoring structures likely required to support the barrier walls, NAPL mobilized in the excavation area, and changing river/weather conditions during the winter months; and
- Constructing a clean cover (i.e., less than 4 ppm PAHs in the upper 2 feet of the restored surface, a performance specification required by the NYSDEC) would be difficult to achieve in portions of the excavation where the cover must be placed into water likely containing NAPL and/or elevated PAH concentrations (i.e., dewatering of the excavation area is not considered technically feasible).

From an administrative perspective, the NYSDOT and NYSCC, owners of the Phase II Area and river property respectively, have provided their written concurrence of Alternative A. Recognizing the public and potential economic benefits to expanding the Park, the City has also expressed its support of Alternative A and has developed a conceptual plan to use the expanded Park area, including the additional boat docking space that would be created along the barrier wall adjacent to the Phase II Area. Since Alternative A requires filling in a portion of a waterway and would result in some permanent habitat loss, permit approval by the USACE and NYSDEC is required, making Alternative A the most difficult (administratively) to implement. The permitting process for each alternative, including review/comment and final approval, could take up to a year.

7.3.4.7 Cost

A comparison of costs among the three Site-wide alternatives is presented in the table below.

Remedial Alternative	Estimated Capital Costs (Rounded)	Estimated Annual O&M Costs (Rounded)	Estimated Present Worth of O&M Costs (Rounded)	Estimated Total Cost (Rounded)
Site-Wide Alternative A	$6,000,000	$50,000	$620,000	$6,600,000
Site-Wide Alternative B	$20,800,000	$130,000	$1,600,000	$22,400,000
Site-Wide Alternative C	$17,500,000	$140,000	$1,700,000	$19,200,000

Based on the above comparative analysis, Site-wide Alternative A has been selected as the alternative to carry forward in combination with the area-specific alternatives.

7.4 Area 1 Alternative - Upland Area under State Route 30 Bridge - Institutional Controls, Barrier Wall, Engineered Cap, and Additional NAPL Recovery Wells

7.4.1 Technical Description

For the approximate 0.3-acre upland area under the elevated State Route 30 bridge, the remedial alternative includes the following components:

- Institutional controls;
- A barrier wall, with NAPL collection behind the wall;
- Additional NAPL recovery wells near and downgradient of Former Gas Holder No. 1; and
- A multi-layered engineered cap across the area.

Institutional controls and a barrier wall (with NAPL collection) are components of the Site-wide Alternatives discussed in Subsection 7.3. Institutional controls are a requirement of the VCA (NYSDEC, 1999b) and therefore, the purpose of the analysis of the Site-wide alternatives was to determine the appropriate barrier wall

option. Based on the detailed and comparative analysis performed on the three potential barrier wall alternatives using the NYSDEC/NCP criteria, the most appropriate barrier wall alternative was determined to be Alternative A: a barrier wall with the southern wall located along the approximate Mohawk River winter low-water line and installed to the base of the sand-and-gravel layer or bedrock, whichever is encountered first. A technical description of this barrier wall and the NAPL recovery to be conducted proximate to the interior side(s) is provided in Subsection 7.3.1.

The remedial components specific to this area are: additional NAPL recovery wells near and downgradient of Former Gas Holder No. 1 and a multi-layered engineered cap across this area. These components were accepted by the NYSDEC in its December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d). In that letter, the NYSDEC also requested placement of a recovery well inside this former gas holder. Based on the investigation data, however, the presence of recoverable NAPL in this holder is questionable.

As detailed in the *Phase II Area Investigation Report* (BBL, 2001) and depicted in Appendix E (3-D data visualization model), this holder contains considerable coarse material (e.g., bricks, cobbles, metal debris, etc.) and NAPL was not observed during installation of the one soil boring and three test pits completed within this holder. Additionally, NAPL was generally not observed in the fill materials downgradient of this holder. Although the holder walls appear to be relatively impermeable, the holder bottom (assumed to be located at approximately 19.8 feet bgs) appears to have possibly been penetrated by some of the footing piles for the State Route 30 bridge constructed between 1968 and 1972. The holder bottom also appears to have a reasonable degree of hydraulic communication with the underlying sand-and-gravel unit, and accordingly the bottom several feet of the holder contents likely saturate and drain seasonally, in response to changes in the river level, and correspondingly, the water levels in the underlying sand-and-gravel unit.

While the presence of recoverable NAPL inside the holder is questionable, potentially recoverable NAPL may be present in the silt and sand-and-gravel units that are downgradient and near this former gas holder, as depicted on the figures shown in Appendix E and evidenced by the NAPL recovered from the MW-6 monitoring well cluster. This monitoring well cluster, the closest well cluster to Former Gas Holder No. 1, is located approximately 60 feet downgradient of the holder (Figure 1). To date, approximately 6.5 gallons of LNAPL have been recovered from this well cluster (MW-6S 5 gallons, screened in the silt and sand-and-gravel units and MW-6M 1.5 gallons, screened in the sand-and-gravel unit) since commencing the NAPL removal program in April 1999. Appendix C provides a summary of the NAPL monitoring data obtained since 1999.

To address the NYSDEC's request for NAPL recovery in this area, a NAPL recovery well(s) screened in the silt and sand-and-gravel units downgradient of and/or near this holder outside of the holder would be installed. The actual location and screened interval for any additional NAPL recovery wells would be determined during design/remedial action. If a recovery well(s) is placed within Former Gas Holder No. 1, it would not be advanced through the bottom of the holder.

For RAR cost estimating purposes, one additional monitoring well, screened in the silt and sand-and-gravel units, has been assumed. This additional well would be constructed of 2-inch PVC and incorporated into the ongoing NAPL recovery program, which includes monitoring and removal of NAPL that may be present in existing monitoring well cluster MW-6

The other component of the remedy for this area is the engineered cap. The key components (from bottom to top) of the engineered cap to be installed across this area are summarized below.

- Gas venting layer, with vapor controls (if needed) to: 1) control nuisance odors and/or gases; and 2) allow for changes in soil gas volume below a low-permeability cap and within the limits of a barrier wall in response to fluctuations in the water table elevation which would be driven by changes in the Mohawk River elevation.

- Low-permeability layer to prevent exposure to MGP-impacted materials by the general public/visitors to the Phase II Area, mitigate potential odors, and minimize infiltration.

- Subsurface drainage layer to appropriately manage drainage and minimize infiltration.

- Protective layer over the subsurface drainage/low-permeability layer. This layer will also provide additional protection against potential exposure to MGP-impacted materials and provide a base for revegetation (as needed).

- Stormwater control system to appropriately manage stormwater in the area and across the cap.

The details of the cap, including evaluating the need for vapor controls/treatment, would be determined during the remedial design. One of the design criteria for the cap would likely be to reduce infiltration in the Phase II Area to approximately 1 inch per year, consistent with the conclusions of the numerical groundwater modeling effort (see Appendix A). Cap details, including (for example) final grade and surface water controls, would depend, in part, on the City's redevelopment plans for the Phase II Area. Niagara Mohawk has and will continue to work with the City's design consultant team to dovetail the cap design with the final design of the Park. Cap construction and installation details would also be coordinated and determined with the NYSDOT. As part of or prior to the cap design, a detailed topographic and property boundary survey would be conducted.

Installing and maintaining a cap is a common remedial component that has been implemented at hundreds of sites, including other MGP sites and, for example, landfills. As part of the cap installation activities for the Phase II Area, removal of soil would likely be required to maintain appropriate grade elevations. The maximum depth of removal would likely be limited to the approximate thickness of the cap, and as such the excavation would be relatively straightforward and simple. For RAR cost estimating purposes, the volume of material to be removed is estimated to be approximately 1,500 cy, assuming an approximate 3-foot thick cap and a final cap grade that is more or less consistent with existing grade. The volume of material to be removed depends on the final cap and park redevelopment details that will be determined during the remedial design.

Excavated materials would be disposed offsite or potentially used as onsite backfill in deeper areas of the Site, in conjunction with another remedial component(s). For cost estimating purposes, it is conservatively assumed that: 1) the entire volume of removed material would be treated/disposed offsite; and 2) it would be composed of soil and debris (e.g., rubble and piping) requiring potentially different treatment/disposal options. Actual disposal facilities to be used would be determined during remedial design/remedial action process based on current pricing and availability, and the profiles of the materials for disposal. All waste materials generated as a result of implementing this alternative (e.g., drill cuttings, personal protective equipment [PPE], recovered NAPL, etc.) would be treated/disposed offsite in accordance with applicable rules and regulations.

After the NYSDEC has approved completion of the remedial construction activities, and in accordance with the VCA (NYSDEC, 1999b), a *Maintenance and Monitoring Plan* would be developed describing the activities to be implemented. Specific to this area, the plan would detail an inspection and maintenance program for maintaining the integrity of the engineered cap and describe the NAPL monitoring and removal program to be implemented using newly installed and existing wells at the Phase II Area. Institutional controls would also be

implemented to facilitate maintaining the integrity of a remedy and associated engineering controls, and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities on the Phase II Area of health and safety considerations associated with MGP-impacted materials.

Provided below is the detailed analysis focusing on the area-specific remedial components (engineered cap and additional NAPL recovery) for Area 1, as described above. The detailed analysis for the barrier wall is presented in Subsection 7.3.1, and institutional controls are a requirement of the VCA (NYSDEC, 1999b).

7.4.2 Compliance with SCGs

Chemical-Specific SCGs

Under this alternative, potential human health risks associated with MGP-impacted materials would be effectively reduced/eliminated through the combined remedial components. MGP-impacted materials would, however, remain in Area 1 and as such, NYSDEC TAGM No. 4046 cleanup objectives and NYS Groundwater Quality Standards (6NYCRR Part 703) would not be attained throughout the Phase II Area. As detailed in Subsection 6.2.1.5, removal to meet TAGM No. 4046 soil cleanup objectives (NYSDEC, 1994) is technically impracticable. Attainment of NYS Groundwater Standards beneath the Phase II Area is also technically impracticable due, in part, to the widespread presence of NAPL below the water table and the thickness of the saturated zone. Groundwater beneath the Phase II Area is not, however, used as a potable source and conservative calculations presented in the *Phase II Area Investigation Report* (BBL, 2001) document that dissolved phase groundwater discharge is not impacting the Mohawk River.

Action-Specific SCGs

Action-specific SCGs that may apply to this alternative include general health and safety requirements and general requirements for the management, treatment, and disposal of wastes, as applicable to installing the cap and barrier wall; excavating, handling, and offsite treatment/disposal of the MGP-impacted materials; and monitoring for and managing NAPL and associated wastes generated during NAPL collection activities.

This alternative would need to comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1910, 1926, and 1904. Before initiating field activities, a project-specific HASP would be developed to incorporate these SCGs, as well as other appropriate requirements. The HASP would be subject to NYSDEC/NYSDOH approval and would be complied with during remedial activities. The HASP would incorporate, as appropriate, the requirements of NYSDEC TAGM No. 4031 which provides monitoring requirements, action levels, and procedures for addressing fugitive dust associated with inactive hazardous waste site operations (NYSDEC, 1989). In addition, a *Community Air Monitoring Plan* would be developed and implemented in accordance with the most current version of the NYSDOH's *Community Air Monitoring Plan*.

As discussed in Subsection 7.3.1.1, New York State regulations regarding the identification and listing of hazardous wastes outlined in 6NYCRR Part 371, and the UTSs and LDRs listed in 6NYCRR Part 376 are potentially applicable standards for waste materials generated during implementation of this alternative. Because MGP wastes resulted from historical operations that ended before the passage of RCRA, MGP-impacted material is only considered hazardous waste in New York State if it is removed (generated) and exhibits a characteristic of a hazardous waste (6NYCRR Part 371). If the MGP-impacted material only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste

management requirements (6NYCRR Parts 370 through 374 and 376) when destined for thermal treatment in accordance with the requirements set forth in NYSDEC's TAGM No. 4061, *Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants* (NYSDEC, 2002). If MGP-related hazardous wastes are destined for land disposal in New York State, the state hazardous waste regulations apply, including LDRs and the alternative LDR treatment standards for soil. These potentially applicable SCGs would be achieved by completing appropriate characterization and profiling of the excavated materials prior to offsite transportation and treatment/disposal, in accordance with applicable rules and regulations at a properly permitted facility.

USDOT and disposal facility requirements for packaging, labeling, manifesting, transporting and disposing regulated materials would also be applicable to this alternative. Compliance with these SCGs would be achieved by using licensed and properly permitted waste transporters and treatment/disposal facilities.

Finally, compliance with the substantive requirements of the NYSDEC (Division of Water) General Permit (#GP-02-01) for Stormwater Discharges Associated with Construction Activity under SPDES may be required, including development and implementation of a SWPPP. These requirements and any associated plan(s) would be identified and developed during the remedial design.

Location-Specific SCGs

A review of the relevant FEMA Flood Insurance Rate Map indicates that a portion of the Phase II Area is within the 100-year floodplain, and a smaller portion is within the 500-year floodplain. Therefore, applicable local, state, and federal requirements related to activities performed in a floodplain will be incorporated into the remedial design/remedial action.

Remedial activities would be conducted in accordance with applicable local building/construction codes and ordinances. Local SCGs (if any) would be determined during the remedial design/remedial action.

The Cultural Resources Survey, conducted as part of the Phase II Area Investigation, concluded that there are no resources of cultural and/or historical significance that will be impacted by remedial implementation.

7.4.3 Overall Protection of Human Health and the Environment

This alternative would provide for overall protection of human health and environment by reducing the mobility of MGP constituents, isolating the MGP-impacted soils, and significantly reducing (or eliminating) the potential for human exposure. Implementing the remedial components for Upland Area 1, in combination the components for Site-wide Alternative A, would effectively achieve the following RAOs:

- Eliminate, to the extent practicable, discharges of NAPL from the Phase II Area to the Mohawk River;
- Eliminate and/or control the Site-related source(s) of groundwater impacts to the extent practicable; and
- Prevent exposure to Phase II Area-related constituents in soil and groundwater by the general public/visitors to the Phase II Area once construction of the Park is completed.

The remaining RAO applicable to the Phase II Area is restoring groundwater to prerelease conditions, to the extent practicable. As previously discussed, restoring groundwater to prerelease conditions cannot practicably

be attained given: 1) the considerable depth of MGP impacts; and 2) the vast majority of soil containing NAPL is below the water table and extends beyond the riverbank. This alternative would, however, mitigate future impacts to groundwater by reducing: 1) the volume of water (in the form of precipitation, surface water run-on, or groundwater flow) which is transported through the impacted soil to the water table; and 2) the amount of NAPL onsite. MGP-impacted materials would remain in-place, but would be addressed by implementing institutional controls and a monitoring and maintenance program for the engineered cap and NAPL recovery program.

7.4.4 Short-Term Effectiveness

Implementing this alternative may result in potential exposure of onsite remedial construction workers to the MGP-related constituents present in onsite soil and groundwater by the following mechanisms:

- Ingestion or dermal contact with MGP-impacted soil, groundwater, and/or NAPL; and
- Inhalation of MGP-impacted dust and/or inhalation of volatilized organic vapors.

Potential exposure of onsite workers to MGP-related constituents during remedial construction would be mitigated by using PPE, as specified in a Site-specific HASP that will be developed during the remedial design. Air monitoring would be performed while implementing this alternative to determine the need (if any) for additional controls (e.g., using water sprays to suppress dust, modifying the rate of construction activities) to maintain dust or volatilized organic vapor levels within acceptable levels, as specified in the Site-specific HASP. The HASP would also address requirements associated with personnel working outdoors, including during the winter in potentially subfreezing temperatures.

Access to the Phase II Area during the remedial activities will be restricted. The Phase II Area is currently fenced and will remain fenced during the remedial construction activities. Potential short-term risks to the community during remedial construction would also be mitigated by providing (as necessary) onsite security personnel, implementing a community air monitoring plan, and performing the remedial activities during the winter months when the Park is not in use. Additionally, traffic associated with implementing this remedial alternative would be relatively minimal and traffic-control measures would be implemented if necessary. An onsite CSX representative would be used to facilitate crossing of the adjacent railroad tracks during remedy implementation.

The remedial construction activities for this approximate 0.3-acre area are relatively limited. Capping of this area would be expected to be completed within several weeks, but would not be completed as a "stand-alone" remedy. Installation of the cap underneath the State Route 30 bridge would be completed in conjunction with installation of the cap on the remaining portion of the Phase II Area. Implementation of the remedial construction activities for the Phase II Area would also be coordinated with the Site-wide components (barrier wall) and area-specific components for the Mohawk River, as well as the Park redevelopment activities (as appropriate).

7.4.5 Long-Term Effectiveness and Permanence

Implementing this alternative would permanently remove NAPL from the Phase II Area. This alternative would also prevent exposure to Site-related constituents through institutional controls and by providing a physical barrier from the impacted materials. This alternative would mitigate future impacts to groundwater by reducing the volume of water (in the form of precipitation, surface water run-on, or groundwater flow), which is transported through the impacted soil to the water table and by reducing, over time, the amount of NAPL onsite.

Engineered caps have been proven effective over the long-term at numerous sites. Long-term cap monitoring and maintenance, along with institutional controls, would be required for this alternative to remain effective and reliable. The cap monitoring and maintenance activities, as well as details for the NAPL recovery program, would be set forth in the monitoring and maintenance plan to be developed and implemented in accordance with the VCA (NYSDEC, 1999b).

In the event that breaching or disturbing the cap is necessary, due to (for example) future subsurface Park excavation activities, the NYSDEC/NYSDOH would be notified and an approved HASP would used, consistent with requirements set forth in Paragraph XI of the VCA for Phase I Area of the Park (NYSDEC, 1999b). The cap would need to be appropriately restored, in accordance with details that would be determined during development of the long-term maintenance and monitoring program. Because the cap and associated storm water controls would be constructed of readily available materials, repair activities and/or replacement of damaged portions of the cap (if necessary) would be expected to be relatively straightforward to accomplish.

7.4.6 Reduction of Toxicity, Mobility, or Volume through Treatment

Removal of NAPL would reduce the mobility and volume of NAPL present within Area 1, while offsite treatment would reduce the toxicity of NAPL. Additionally, the mobility, volume and toxicity of any MGP-impacted materials removed during construction would be reduced if treated at an offsite commercial facility such as ESMI.

Impacted soil would remain in-place; therefore, the volume, toxicity, or mobility of MGP-related constituents in the affected media would not be reduced through treatment. The mobility of the remaining MGP-impacted materials would be reduced by the engineered cap and subsurface barrier wall.

7.4.7 Implementability

The area-specific components of this alternative are administratively and technically feasible, and relatively easy to be implemented. The equipment, materials, and labor necessary for installing this alternative are readily available for use. Materials and techniques used to install caps are proven and well-developed. Niagara Mohawk will work with the City's design consultant to incorporate the final design for the Park with the cap design. As noted above, cap installation in this area would be completed in conjunction with installation of the cap for the remaining portion of the Phase II Area. Implementation of these remedial activities would also be coordinated with the Site-wide components and area-specific components for the Mohawk River, as well as the Park redevelopment activities. Potential implementability issues would generally be anticipated to be associated with the relatively tight construction schedule (fall 2005/winter 2006), space limitations, and weather/field conditions during implementation.

7.4.8 Cost

The estimated 30-year present worth cost of this alternative is $770,000, with a total estimated capital cost of approximately $681,000 and estimated annual operation and maintenance costs of $7,000. A detailed breakdown of the estimated cost and a listing of corresponding notes/assumptions are presented in Table 6.

The primary elements of the cost associated with implementation of the Area 1 alternative include:

- removal, transport, and disposal of existing soil and debris necessary to support installation of the cap and Park redevelopment (assumed to be approximately 1,500 cy); and
- installation of a cap across Area 1.

7.5 Area 2 - Upland Phase II Area, Excluding Area 1

The following three alternatives have been identified for detailed analysis regarding the approximate 1.8-acre Area 2 - the Upland Phase II Area, excluding Area 1.

- **Alternative 2A** – Alternative 2A consists of the common components for this area and removal of MGP-impacted materials (e.g., MGP wastes, structures, and piping), as required for installing the engineered cap and constructing the Park.

- **Alternative 2B** – Alternative 2B is the same as Alternative 2A, and also includes removing the contents and floor of Former Gas Holder No. 2.

- **Alternative 2C** – Alternative 2C consists of the common components and removal of MGP-impacted materials above the low winter water table.

The Volunteers, City, and NYSDEC have agreed to institutional controls, the barrier wall (with NAPL collection behind the wall), and a multi-layered engineered cap as remedial components for this area. In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC requested the removal of MGP-impacted materials, where feasible to do so (Spellman, 2003d). Accordingly, the only difference between the three alternatives for Area 2 is the amount of MGP materials that would be removed.

As noted previously, institutional controls and a barrier wall are components of Site-wide Alternative A, which is described in Subsection 7.3.1. The engineered cap would be the same as that described above for the area beneath the State Route 30 bridge (i.e., the cap across these areas would be contiguous). These components are collectively referred to herein as "common components." Provided below is a summary of the three alternatives identified for this area, followed by the detailed analysis which focuses on the removal of MGP materials.

7.5.1 Alternative 2A - Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials as Required

7.5.1.1 Technical Description

This remedial alternative is, for all intents and purposes, the same as that described in Subsection 7.4.1 for the area beneath the State Route 30 bridge, except under this alternative, the cap covers the remaining (and larger) portion of the Phase II Area. The engineered cap for these two areas comprising the Phase II Area will be same and contiguous. The material to be removed from these areas would be that which is necessary for installing the cap or Park development. The details for the Phase II Area of the Park have not yet been determined, and as such the volume of material to be removed and the details of the engineered cap and/or potential Park structures that will cover this area will be determined during the remedial design. As previously noted, Niagara Mohawk has and will continue to work with the City's design consultant to dovetail the cap design with the final design of the Park.

Excavation, handling, and offsite disposal of the MGP materials during cap installation would be performed as described under the Area 1 alternative. For RAR cost estimating purposes, the volume of material to be removed/replaced is estimated to be 8,700 cy, based on an area of approximately 1.8 acres with an average removal depth and cap placement thickness of 3 feet, resulting in a final grade that is more or less consistent with existing grade. The volume of material to be removed would be dependent on the final cap and park redevelopment details that would be determined during the remedial design.

Excavated materials would be disposed offsite or potentially used as onsite backfill in deeper areas of the Site, in conjunction with another remedial component(s). For RAR cost estimating purposes (and consistent with the Area 1 remedial alternative), it is conservatively assumed that: 1) the entire volume of removed material would be treated/disposed offsite; and 2) it would be composed of soil and debris requiring potentially different treatment/disposal options. Actual disposal facilities to be used would be determined during remedial design/remedial action process based on current pricing and availability, and the profiles of the materials for disposal. All waste materials generated as a result of implementing this alternative (e.g., drill cuttings, PPE, recovered NAPL, etc.) would be treated/disposed offsite in accordance with applicable rules and regulations.

Underground piping and/or utilities present within the excavation area, would be appropriately addressed (e.g., support, deactivate, disconnect, reroute, and/or repair). For example, the onsite stormwater system piping, the water line that traverses the Phase II Area from east to west, and two existing catch basins (CB-6 and CB-8) may need to be addressed during the remedial construction activities.

After the NYSDEC has approved completion of the remedial construction activities, and in accordance with the VCA (NYSDEC, 1999b), a *Maintenance and Monitoring Plan* would be developed as described in Subsection 7.4.1. This plan will address monitoring and maintenance activities for the cap and NAPL monitoring and recovery program. Institutional controls would also be implemented as previously described.

7.5.1.2 Compliance with SCGs

The evaluation of compliance with SCGs presented in Subsection 7.4.2 for Area 1 is applicable to this alternative because the remedial components are the same.

7.5.1.3 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment and meet the RAOs established for the Phase II Area. For details, please refer to the discussion presented in Subsection 7.4.3.

7.5.1.4 Short-Term Effectiveness

The short-term effectiveness discussion provided for the Area 1 alternative (Subsection 7.4.4) is also applicable to this alternative, with additional short-term considerations related to the larger area to be capped. Those considerations generally include the additional length of time required to complete the remedial construction activities (assumed to be several months) and the additional volume of MGP-impacted materials to be managed (assumed to be approximately 8,700 cy). These additional considerations would, however, be managed using the same measures discussed in Subsection 7.4.4 for the Area 1 alternative, including (but not necessarily limited to) the following measures:

- Complying with a Site-specific HASP and a NYSDEC-approved RWP;
- Providing (as necessary) onsite security personnel;
- Implementing a *Community Air Monitoring Plan*;
- Performing the remedial activities during the winter months when the Park is not in use;
- Implementing traffic-control measures (as appropriate); and
- Using an onsite CSX representative (as necessary) to facilitate crossing of the adjacent railroad tracks during remedy implementation.

As identified previously, implementation of the remedial construction activities for the Phase II Area would be coordinated with the Site-wide components (barrier wall) and area-specific components for the Mohawk River. These activities would be targeted for completion during the fall/winter months of 2005/2006. Construction activities in the winter tend take longer than if implemented during other times of the year.

7.5.1.5 Long-Term Effectiveness and Permanence

The evaluation of long-term effectiveness and permanence presented in Subsection 7.4.5 for Area 1 is applicable to this alternative because the remedial components are the same.

7.5.1.6 Reduction of Toxicity, Mobility, and Volume through Treatment

The evaluation of this criterion presented in Subsection 7.4.6 for Area 1 is applicable to this alternative.

7.5.1.7 Implementability

The evaluation of implementability presented in Subsection 7.4.7 for Area 1 is applicable to this alternative. Potential implementability issues (if any) would be associated with the following considerations:

- The combined remedial construction activities for the Site are targeted for completion during a relatively short-time frame (fall 2005/winter 2006).
- Limited available space is available to conduct the remedial construction and associated support activities.
- Completing construction activities during the winter presents certain difficulties.

7.5.1.8 Cost

The estimated costs and a listing of corresponding notes/assumptions associated with Alternative 2A are presented in Table 7. The total estimated capital cost for implementing this alternative is $4,400,000, assuming installation in the winter. Annual O&M costs are estimated to be approximately $38,000. The total estimated 30-year present worth cost associated with implementing Alternative 2A is $4,900,000.

The primary elements of the cost associated with implementation of Alternative 2A include:

- mobilization/demobilization;
- excavation, transport, and disposal of existing soil/debris necessary to support installation of the cap and Park development (assumed to be approximately 8,700 cy); and
- installation of a cap across Area 2.

7.5.2 Alternative 2B - Institutional Controls, Barrier Wall, Engineered Cap, Removal of Contents and Bottom of Former Gas Holder No. 2, and Removal of MGP Materials as Required

7.5.2.1 Technical Description

This remedial alternative is the same as Alternative 2A, with the additional component of removing the contents and floor of Former Gas Holder No. 2. As such, the technical description and evaluation presented in the previous subsection apply to this alternative, and the focus of this evaluation is the additional remedial component of removing the contents and floor of Former Gas Holder No. 2.

As detailed in Section 6, Niagara Mohawk does not consider the removal of this holder to be an effective remedial option for the Phase II Area. While it is clear that NAPL has migrated from this structure (see Appendix E), it is not clear that the holder represents a significant ongoing source or that material directly below the holder floor is significantly impacted. "Free product" was observed in the bottom 1.5 feet of the holder only[4], and this volume of NAPL-containing soil totals less than 500 cy (less than 2% of the volume of material

[4] One soil boring (SB-11) and two test pits (TP-1 and TP-33) were completed in Former Gas Holder No. 2. "Free product" and wood chips were observed only in the bottom 1.5 feet of the soil boring (12 to 13.5 feet bgs), which was installed to refusal (assumed bottom of

above the low winter water table). The bottom of Former Gas Holder No. 2 is believed to be approximately 13.5 feet bgs (based on SB-11 from the Harza PSA (Harza, 1999a) and, accordingly, does not penetrate the silt, which likely limits the potential vertical movement of water below the holder. Nevertheless, this alternative will include removing the contents of Former Gas Holder No. 2, as well as the holder bottom, as discussed and agreed-upon during a February 20, 2004 project conference call. As further agreed during that call, this alternative will not include additional excavation of the holder walls or outside of the holder walls. Niagara Mohawk transmitted, via a March 3, 2004 email, a key point summary of that conference call to the Project Team Members, who concurred with the information and conclusions presented therein.

The remainder of the contents of Former Gas Holder No. 2 (the contents below the top 3 feet to be removed for cap installation) is estimated to be approximately 3,100 cy, with an additional estimated 600 cy associated with the holder floor. As with Alternative 2A, this alternative also includes removing MGP materials as required to install the engineered cap and support development of the Park, which is estimated for the purposes of this RAR to be approximately 8,700 cy. The total volume of materials to be removed as part of this alternative is estimated to be approximately 12,700 cy.

The excavation and holder floor removal activities would generally be conducted using conventional construction equipment (e.g., excavator, hoe-ram, etc.). As identified above, this alternative would not include removing the sidewalls of the holder, only the holder floor which is likely several feet thick. Removal of the entire floor may not be feasible given the depth and limits of the excavation.

Water (if any) that enters the excavation would be collected if necessary to facilitate the removal activities, and would be subsequently treated/disposed in accordance with applicable rules and regulations. During the remedial construction activities appropriate erosion and sedimentation control measures would be implemented and maintained. These control measures would likely consist of hay bales and silt fence.

Excavated materials would be disposed offsite or potentially used as onsite backfill in deeper areas of the Site. Excavated materials observed to contain NAPL or tars (e.g., the bottom 1.5 feet of the contents within Former Gas Holder No. 2) could not be used for onsite deeper backfill, and would require offsite treatment/disposal. For RAR cost estimating purposes (and consistent with the other Phase II Area remedial alternatives), it is conservatively assumed that: 1) the entire volume of removed material would be treated/disposed offsite; and 2) it would be composed of soil and debris requiring potentially different treatment/disposal options. Actual disposal facilities to be used would be determined during remedial design/remedial action process based on current pricing and availability, and the profiles of the materials for disposal. All waste materials generated as a result of implementing this alternative (e.g., drill cuttings, PPE, recovered NAPL, etc.) would be treated/disposed offsite in accordance with applicable rules and regulations.

7.5.2.2 Compliance with SCGs

The same SCGs are applicable to Alternative 2B as those described under the Area 1 alternative (see Subsection 7.4.2).

the holder). The two test pits installed in this holder (TP-1 and TP-33) were excavated to approximately 9 feet bgs: TP-33 had brown oil droplets at 8 feet bgs, and TP-1 did not contain NAPL, tar, or oil. Considerable debris was observed in this holder, including: bricks, slate tile, glass, gravel, slag, and cinders.

7.5.2.3 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment and meet the RAOs established for the Phase II Area. For details, please refer to the discussion presented in Subsection 7.4.3. Removal of the floor and/or the contents of Former Gas Holder No. 2 would not, however, provide an additional measure of protection beyond that provided by the barrier wall, engineered cap, NAPL recovery, and institutional controls.

7.5.2.4 Short-Term Effectiveness

The short-term effectiveness discussion provided for Alternative 2A is also applicable to this alternative, with the additional short-term considerations related to the excavation and materials management activities required to remove the contents and floor of Former Has Holder No. 2. These additional short-term considerations would, however, be expected to be effectively managed using the same measures discussed in Subsection 7.5.1.4 for Alternative 2A.

7.5.2.5 Long-Term Effectiveness and Permanence

The evaluation of long-term effectiveness and permanence presented in Subsection 7.4.5 for the Area 1 alternative is applicable to this alternative, with the addition of permanently removing the larger rubble/debris and contents of Former Gas Holder No. 2 observed to contain NAPL or tars.

7.5.2.6 Reduction of Toxicity, Mobility, and Volume through Treatment

The evaluation of this criterion presented in Subsection 7.4.6 for the Area 1 alternative is applicable to this alternative.

7.5.2.7 Implementability

The evaluation of implementability presented in Subsection 7.5.1.7 for Alternative 2A is applicable to this alternative. As identified in that subsection, potential implementability issues (if any) would generally be anticipated to be associated with scheduling and space limitations for completing the remedial construction activities for the Site.

Implementation of the remedial construction activities for the Phase II Area would be coordinated with the Site-wide components (barrier wall) and area-specific components for the Mohawk River. These activities would be targeted for completion during the fall/winter months of 2005/2006. Construction activities in the winter tend to take longer than if implemented during other times of the year. Coordinating a number of remedial activities in a relatively limited space and under a tight schedule, combined with the difficulties associated with construction in the winter, will pose some implementability challenges.

7.5.2.8 Cost

The estimated costs and a listing of corresponding notes/assumptions associated with Alternative 2B are presented in Table 8. The total estimated capital cost for implementing this alternative is $6,000,000, with an estimated $1.6 million associated with removal of the contents ($1.25 million) and floor ($0.35 million) from Former Gas Holder No. 2. Annual O&M costs are estimated to be $38,000. The total estimated 30-year present worth cost associated with implementing Alternative 2B is $6,500,000.

The primary elements of the cost associated with implementation of Alternative 2B include:

- mobilization/demobilization;
- excavation, transport, and disposal of existing soil/debris necessary to support installation of the cap and Park redevelopment (assumed to be approximately 8,700 cy);
- installation of a cap across Area 2; and
- removal, transport, and disposal of Former Gas Holder No. 2 contents and floor, along with a 1-foot buffer of soil beneath the holder (estimated to be approximately 4,000 cy).

7.5.3 Alternative 2C - Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials to the Extent Feasible

7.5.3.1 Technical Description

This remedial alternative is the same as Alternative 2A, with the additional component of removing MGP materials from this area to the extent feasible (i.e., above the winter low water table) to address comments presented in the NYSDEC's December 19, 2003 letter to Niagara Mohawk (Spellman, 2003d). The focus of the detailed analysis for this alternative is the additional remedial component of removing the material above the winter low water table. The technical description and evaluation presented in Subsection 7.5.1.1 generally applies to the other components of this remedial alternative.

The volume of material in this portion of the Phase II Area and above the winter low water table is estimated to be approximately 22,000 cy. Although removal of this material would likely remove the majority of the purifier wastes and MGP-related structures and associated piping, it would only remove approximately 5% of the NAPL-containing soil below the Phase II Area based on the results of the 3-D data visualization model (see Appendix E). Nevertheless, this removal scenario has been developed into a remedial alternative pursuant to the NYSDEC's request.

Excavation, handling, and offsite disposal of the MGP materials would generally be performed as described under the Alternative 2B, with additional considerations due to the large volume of material that would be excavated and the considerable excavation depths (to approximately 20 feet bgs in some areas). Due to the estimated depth of excavation, proximity of the Mohawk River, and the presence of structures, shoring and/or sheeting of certain portions of the excavations would be necessary. Buffer zones and/or other requirements for excavating near adjacent structures (e.g., bridge piers, storm water system) would be determined during the remedial design.

Although the excavation would be completed above the winter water table, water may enter the excavation. Water that does enter the excavation would be collected (as necessary) to facilitate completing the excavation activities, and then treated/disposed in accordance with applicable rules and regulations. The appropriate treatment and/or disposal option for water (if any) generated as a result of implementing this alternative would be determined during the remedial design/remedial action and would be dependent upon several considerations, including estimated volume of water to be generated, concentrations of constituents of interest in the water, and costs for offsite treatment and/or disposal at a properly permitted facility.

Excavated materials would be disposed offsite or potentially used as onsite backfill in deeper areas of the Site. Excavated materials observed to contain NAPL or tars (e.g., the bottom 1.5 feet of the contents within Former Gas Holder No. 2) could not be used for onsite deeper backfill, and would require offsite treatment/disposal. For RAR cost estimating purposes (and consistent with the other Phase II Area remedial alternatives), it is conservatively assumed that: 1) the entire volume of removed material would be treated/disposed offsite; and 2) it would be composed of soil and debris requiring potentially different treatment/disposal options. Actual disposal facilities to be used would be determined during remedial design/remedial action process based on current pricing and availability, and the profiles of the materials for disposal.

Following soil removal activities, the excavation would be backfilled and compacted as necessary to support the Park redevelopment activities. Requirements and details for implementation of this alternative, including, shoring/sheeting, protection of existing structures, water management, and backfilling, would be specified in the remedial design that will also include details for the engineered cap to be installed over this area.

Prior to remedial design, some predesign activities may be required. These may include, but would not necessarily be limited to, the following:

- Geotechnical and hydrogeological testing for the design of the shoring/sheetpile system and estimating representative excavation dewatering rates, if necessary;
- Soil sampling and analysis for waste characterization/profiling; and
- Groundwater sampling and analysis to facilitate the design/procurement of a suitable water treatment system and/or evaluate offsite treatment/disposal options.

Waste generated during implementation this alternative (including PPE, recovered NAPL, and disposable supplies) would be properly containerized and treated/disposed at an offsite commercial facility.

7.5.3.2 Compliance with SCGs

The same SCGs are applicable to Alternative 2C as those described under the Area 1 alternative (see Subsection 7.4.2). As presented in that subsection, applicable chemical-specific SCGs are the NYS Groundwater Quality Standards (6NYCRR Part 703) and attainment of these standards beneath the Phase II Area is technically impracticable due to the widespread presence of NAPL below the water table and the thickness of the saturated zone. Removal of 22,000 cy of material above the water table (which represents only 5% of the NAPL-containing soil) would not significantly facilitate restoring groundwater quality to prerelease conditions. Additionally, removing purifier waste would not significantly satisfy the RAO of restoring groundwater quality to prerelease conditions to the extent practicable based, in part, on the following considerations:

- The effects of cyanide on groundwater were identified as limited. Moreover, studies have shown that greater than 98% of cyanide detected in groundwater at MGP sites is in a complex form with iron, which is much less toxic than free cyanide (Ghosh et al., 1999; ATSDR, 1997). Additionally, dissolved cyanide is not impacting the Mohawk River under current, unremediated conditions.

- Only two of the 47 soil samples collected in the Phase II Area had cyanide concentrations greater than 100 ppm. The two highest concentrations were detected in soil samples collected from monitoring well MW-6. In this well, cyanide was detected at a concentration of 280 ppm in the 2- to 4-foot interval, and 360 ppm in the 12- to 14-foot interval. The cyanide concentrations were much lower in the deeper geologic units.

7.5.3.3 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment and meet the RAOs established for the Phase II Area, as would the other two alternatives for this area. For details, please refer to the discussion presented in Subsection 7.4.3.

Removing the minimal amount of NAPL-containing soil (estimated to be approximately 5%) located above the low winter water table and the majority of the purifier wastes and MGP-related structures (e.g., piping) would not provide an additional substantive measure of protection beyond that provided by the barrier wall, engineered cap, NAPL recovery, and institutional controls. Even after removing the substantial volume material located above the low winter water table, the potential for vapors and odors would still need to be considered. Potential risks (e.g., direct contact and inhalation) associated with future subsurface work activities for the Park would be reduced by removing MGP-impacted materials from the Phase II Area; however, these potential risks would be addressed through implementing institutional controls and a NYSDEC/NYSDOH-approved HASP. Removing all of MGP-impacted materials above the low winter water table would not eliminate the need for health and safety requirements for intrusive activities (institutional controls) due to the MGP-impacted materials remaining onsite.

7.5.3.4 Short-Term Effectiveness

The short-term effectiveness discussion provided for Alternative 2A is also applicable to this alternative, with the additional short-term considerations related to the excavation and materials management activities required to remove the relatively significant quantity of materials above the low-water table. These additional short-term risks would include potential risk of exposure and injury to onsite workers in association with the extensive, deep, and structurally supported excavation, combined with potentially harsh winter conditions and the extended duration of the remedial construction activities. Truck traffic associated with this alternative would be considerable to remove/dispose of the existing materials and structures above the water table and backfill the excavation. Although greater short-term considerations are associated with this alternative, they would be expected to be effectively managed using (in general) the same measures discussed in Subsection 7.5.1.4 for Alternative 2A.

7.5.3.5 Long-Term Effectiveness and Permanence

The evaluation of long-term effectiveness and permanence presented in Subsection 7.4.5 for the Area 1 alternative is applicable to this alternative, with the addition of permanently removing (at a minimum) the larger rubble/debris and materials above the winter low water table that are observed to contain NAPL or tars.

Removing all of the soil above the winter low water table at the Phase II Area (estimated to be approximately 22,000 cy based on the results of the 3-D data visualization model) would remove less than 5% of the NAPL-containing soil below the Phase II Area (an estimated 95% of NAPL-containing soil is present below the low water table). Removing this minimal amount of NAPL-containing soil would not significantly help ensure success of the barrier wall (see Subsection 7.3.1) function by eliminating the potential for shallower NAPL to migrate to the wall. The wall would need to be designed to cut-off potential NAPL discharge to the Mohawk River regardless of whether soil above the low water table is removed. Additionally seasonally unsaturated soils (as is the case for the soil above the low water table) are not expected to contain mobile NAPL as the NAPL has likely been driven to residual saturation by the seasonal fluctuations of the water table which are accompanied by approximately unit downward gradients.

Given the agreed-upon remedial components of an engineered cap, barrier wall, and institutional controls, the additional remedial effectiveness of removing structures and piping appears to be limited. In addition, removal of structures and piping would not facilitate meeting the RAOs beyond the level that would be met by the agreed-upon remedial components of an engineered cap, barrier wall, NAPL removal behind the wall, and institutional controls. A structure containing discernable NAPL/tar source material was not identified during the investigation activities, except for the tar/water separator that was addressed through removal during the IRM, as discussed in the *IRM Final Engineering Report* (BBL, 2003).

7.5.3.6 Reduction of Toxicity, Mobility, or Volume through Treatment

The evaluation of this criterion presented in Subsection 7.4.2 for Area 1 is applicable to this alternative.

7.5.3.7 Implementability

Excavation is a proven process for the removal of MGP-impacted materials, structures, and piping, and is administratively feasible. The materials, equipment, and laborers required for excavation activities are readily available. Excavating materials above the winter low water table, which is the extent feasible for the Phase II Area, can be implemented.

The evaluation of implementability presented in Subsection 7.5.1.7 for Alternative 2A is applicable to this alternative, with the additional implementability issues posed by the substantial volume of materials to be removed across the Phase II Area under this alternative. As identified in that subsection, potential implementability issues (if any) would generally be anticipated to be associated with scheduling and space limitations for completing the remedial construction activities for the Site.

Implementation of the remedial construction activities for the Phase II Area would be coordinated with the Site-wide components (barrier wall) and area-specific components for the Mohawk River. These activities would be targeted for completion during the fall/winter months of 2005/2006. Construction activities in the winter tend

take longer than if implemented during other times of the year. Coordinating a number of significant remedial activities in a relatively limited space and under a tight-schedule, combined with the difficulties associated with construction in the winter, would pose implementability challenges.

7.5.3.8 Cost

The estimated costs and a listing of corresponding notes/assumptions associated with Alternative 2C are presented in Table 9. The total estimated capital cost for implementing this alternative is $10 million. Annual O&M costs are estimated to be $38,000. The total estimated 30-year present worth cost associated with implementing Alternative 2C is $10.5 million.

The primary elements of the cost associated with implementation of Alternative 2C include:

- mobilization/demobilization;
- excavation, transport, and disposal of existing soil/debris necessary to support installation of the cap and Park redevelopment (assumed to be approximately 8,700 cy);
- installation of a cap across Area 2;
- removal, transport, and disposal of remaining existing materials to the low winter water table (estimated to be approximately 13,300 cy);
- installing sheeting/shoring to support the excavation activities; and
- importing and placing backfill.

7.5.3.9 Comparative Analysis of Area 2 Alternatives

Three remedial alternatives were evaluated for Area 2, which is identified as the Phase II Area, excluding the area under the State Route 30 bridge (Area 1). The three remedial alternatives include:

- **Alternative 2A** – Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials as Required.
- **Alternative 2B** – Institutional Controls, Barrier Wall, Engineered Cap, Removal of Former Gas Holder No. 2, and Removal of MGP Materials as Required.
- **Alternative 2C** – Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials to the Extent Feasible.

A comparative analysis of the remedial alternatives identified for Area 2 is provided below using the seven NYSDEC/NCP evaluation criteria.

7.5.3.10 Compliance with SCGs

Each of the three alternatives identified for Area 2 would be expected to achieve applicable action-, and location-specific SCGs. NYS Groundwater Quality Standards, a chemical-specific SCG, would not be attained throughout Area 2, as MGP-impacted materials would remain in place under each of these three alternatives. The only difference between the three alternatives is the amount of MGP-impacted materials that would be removed, with the least amount removed under Alternative 2A and the most under Alternative 2C, where MGP materials would be removed above the winter low water table. The additional and substantial activities proposed as part of Alternative 2C (removal of an estimated 22,000 cy of materials) would not significantly be more effective in achieving applicable chemical-specific SCGs primarily because an estimated 95% of the soil containing NAPL would remain on site, all of which is located below the winter low water table.

7.5.3.11 Overall Protection of Human Health and the Environment

Each of the three alternatives would be expected to provide overall protection of human health and the environment and meet the RAOs established for the Phase II Area. Removal of the contents and floor of Former Gas Holder No. 2 (Alternative 2B) or removal of 22,000 cy of materials above the winter low water table (Alternative 2C) would not provide an additional substantive measure of protection beyond that which would be provided by the barrier wall, engineered cap, NAPL collection, and institutional controls. Potential risks (e.g., direct contact and inhalation) associated with future subsurface work activities for the Park would be reduced by removing additional MGP-impacted materials from the Phase II Area; however, these potential risks would not be eliminated and would still require implementation of institutional controls and a NYSDEC/NYSDOH-approved HASP.

7.5.3.12 Short-Term Effectiveness

The short-term impacts for the Area 2 alternatives would vary based on the amount of materials removed/managed, with Alternative 2C posing the most short-term impacts due to the comparatively longer duration and substantially larger volume of material to be removed across the Phase II Area. The greater short-term risks associated with increased volumes of materials to be removed/managed would, however, be expected to be effectively managed.

7.5.3.13 Long-Term Effectiveness and Permanence

Each of the Area 2 Alternatives would effectively and permanently remove NAPL from the Phase II Area. The engineered cap and institutional control components of these alternatives have been proven effective over the long-term at numerous sites, and implementation of long-term monitoring and maintenance program would help ensure that the remedy for the Phase II Area remains effective. Alternatives 2B and 2C provide for additional and permanent removal of MGP materials from the Phase II Area. However, removing this material would not substantively improve the overall long-term effectiveness of the remedy because the vast majority of soil containing NAPL would remain onsite.

7.5.3.14 Reduction of Toxicity, Mobility, or Volume through Treatment

The assessment of reduction of toxicity, mobility, or volume through treatment for each of the Area 2 Alternatives is the same. Under each of these alternatives, removal of NAPL would irreversibly reduce the mobility and volume of NAPL present within the area. The toxicity of NAPL would be reduced via offsite treatment. Additionally, the mobility, volume and toxicity of any MGP-impacted materials removed during construction would be reduced if treated at an offsite commercial facility such as ESMI.

Impacted soil would remain in-place; therefore, the volume, toxicity, or mobility of MGP-related constituents in the affected media would not be reduced through treatment. The mobility of the remaining MGP-impacted materials would be reduced by the engineered cap and subsurface barrier wall.

7.5.3.15 Implementability

The remedial components included in the Area 2 Alternatives are proven technologies that have been implemented at other sites to address MGP-impacted materials. Potential implementability issues (if any) would generally be anticipated to be associated with scheduling and space limitations for completing the remedial construction activities for the Site. Implementability issues would increase with the extent of the remedial activities to be conducted, with Alternative 2C posing the most potential implementability issues for the Phase II Area.

7.5.3.16 Cost

The following table summarizes the estimated costs associated with each of the alternatives for Area 2.

Remedial Alternative	Estimated Capital Costs (Rounded)	Estimated Annual O&M Costs (Rounded)	Estimated Present Worth of O&M Costs (Rounded)	Estimated Total Cost (Rounded)
2A - Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials as Required	$4,400,000	$38,000	$472,000	$4,900,000
2B - Institutional Controls, Barrier Wall, Engineered Cap, Removal of Former Gas Holder No. 2, and Removal of MGP Materials as Required	$6,000,000	$38,000	$472,000	$6,500,000
2C - Institutional Controls, Barrier Wall, Engineered Cap, and Removal of MGP Materials to Extent Feasible	$10,000,000	$38,000	$472,000	$10,500,000

As summarized in the above table, the costs associated with implementing Alternative 2A is roughly half that of implementing Alternative 2C.

7.6 Area 3 - Mohawk River between Low (Winter) Water Level and Outer Bound of 1-Acre "Area for Consideration"

This subsection presents the detailed analysis of each area-specific remedial alternative presented in Subsection 6.3.2.3 for Area 3, which is identified as the Mohawk River between the low (winter) water level and the outer bound of the 1-acre "Area for Consideration." The following three alternatives have been retained for detailed analysis for this area:

- **Alternative 3A** – MNR and Institutional Controls.
- **Alternative 3B** – MNR with "Focused" Removal of NAPL-Impacted Riverbed Materials, and Backfilling of the Dredged Area.
- **Alternative 3C** – Dredging of Area 3, Backfilling the Dredged Area, and Monitoring.

These alternatives are further discussed in Subsections 7.6.1, 7.6.2, and 7.6.3, below.

A long-term monitoring program would be implemented as part of the selected alternative for Area 3. While specific elements of the program would be established during detailed design, the program would generally include annual visual inspection of the Area 3 riverbed by divers (during summer). The divers would look for evidence of NAPL or NAPL seeps and verify, for any active remedies, the continued effectiveness of the remedy. If NAPL is observed, a sample or samples would be collected and analyzed, and additional remedial action would be considered, as appropriate.

7.6.1 Alternative 3A – MNR and Institutional Controls

This alternative consists of MNR for the shallow (0 to 2 feet) subsurface materials within the Mohawk River, south of the barrier wall, but within the 1-acre area to be considered (the outer bound the 1-acre area). As discussed in Section 6.2.3.5, MNR is an effective remedial component if linked with a source (NAPL) control technology as natural attenuation processes are always at work and will reduce the potential toxicity, mobility, and volume of PAHs in riverbed materials over time. Evidence for ongoing natural attenuation in the river was discussed in Subsection 5.3.4.

An analysis of the Site data reveals compositional alterations consistent with the combined effects of one or more of the following natural attenuation processes: advection, dispersion, physical-chemical weathering (specifically dissolution, sorption, and photo-oxidation), and biological degradation processes. (See Subsection 6.2.3.5 for a general discussion of natural attenuation processes active in riverbeds and surface waters.) Based on data reported in the *Mohawk River Investigation Summary Report* (BBL, 2002), there is widespread evidence of ongoing natural attenuation of Site-related PAH residues in surficial (the top 6 inches) riverbed materials at the Site. As described in more detail in Appendix F, surficial riverbed data from the Site evaluated as part of a more detailed assessment of PAH attenuation, shows evidence of extensive depletion and further depletion potential attributable to the combined effects of ongoing physical, chemical, and biological processes. The combined effects of physical-chemical weathering, biodegradation, and natural sedimentation are predicted to continue to reduce PAH concentrations in surficial riverbed materials in Area 3. The extent of the concentration reductions and the timeframe for those reductions would be governed by several factors, including effectiveness of source control/management, surficial riverbed material conditions, the extent of riverbed material turnover,

PAH concentrations in naturally deposited riverbed materials, etc. The installation of the barrier wall, as described in Subsection 7.3.1, is expected to have a positive impact on the rate of natural attenuation in Area 3, effectively cutting the primary potentially ongoing source of Site-related NAPL to Area 3. At T-7-50, located outside the barrier wall, NAPL and sheens were reported in the upper 8 feet of the boring log. Natural attenuation of the surficial riverbed materials at T-7-50 would be expected to occur at a much slower rate. Annual monitoring of Area 3 would be conducted to assess the effectiveness of the barrier wall. The need for and extent of any future remedial measures would be determined based on the results compiled from the annual monitoring program.

An analysis of the riverbed environment in and around Area 3 (included in Appendix F) provides further evidence that monitored natural recovery – particularly related to mixing and dispersion – is a viable option. The river bottom is rocky and cobbly, but there are areas of fine sands and silts in the gaps among the rocks and cobbles. There is evidence that the river in Area 3 is generally not a net depositional environment and these sands and silts are transitory during moderate to high flow events. That means that the sand and silt on the river bottom, where present, are mixed with upstream materials and periodically mobilized during these higher flow events. Evidence of this mixing and dispersion is apparent in the results of PAH compositional analysis within the Site, which reflects both MGP and non-MGP sources of PAHs, and the results of sampling, which indicate that PAH concentrations upstream and downstream of the Site are comparable. In fact, as described in the March 14, 2003 letter to the NYSDEC (Morgan, 2003c), PAH concentrations downstream of the Site within the area to be considered and in the top 2 feet of riverbed materials are less than or similar in magnitude to levels upstream of the Site.

7.6.1.1 Compliance with SCGs

Chemical-Specific SCGs

As discussed in Section 7.3.2.1 (Site-wide Alternative B), the NYSDEC's performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may apply, although its application is questionable. It is unlikely that this goal would be met over all of Area 3 either over the short or long term due to the impact of ongoing, upstream sources of PAHs unrelated to the Site that have been reported at concentrations up to 80.9 ppm in upgradient riverbed material. However, as described above, area-wide concentrations in surficial riverbed materials are already below background levels, and after installation of the barrier wall, Site-related inputs of NAPL to the River would be mitigated, and natural recovery is expected to proceed at a faster rate.

Action-Specific SCGs

Because this alternative does not include any intrusive remedial actions associated with impacted riverbed materials, action-specific SCGs are not applicable.

Location-Specific SCGs

Because no intrusive remedial activities would be conducted under this alternative, location-specific SCGs are not applicable.

7.6.1.2 Overall Protection of Human Health and the Environment

Over time, natural attenuation, in conjunction with Site-wide source control activities and institutional controls, is anticipated to reduce the Site-related PAH concentrations in surficial riverbed materials, and thereby reduce any potential ecological exposure risks to Site-related material. At location T-7-50, where surficial riverbed PAH concentrations are highest and NAPL is present beneath the surficial materials, natural attenuation processes are expected to occur at a much slower rate. Given the location of the Area 3 materials, there is no viable current or future human exposure pathway. MNR is not intended to be a stand-alone remedy, but rather one element of an overall solution for the Site. USEPA (2002) recommends an iterative approach to remedy evaluation and selection in which "it may be appropriate to take an interim action to control a source... followed by a period of monitoring in order to evaluate the effectiveness of these interim actions before addressing less contaminated areas." Although existing NAPL in the riverbed materials near T-7-50 would not be addressed, installation of the barrier wall is expected to mitigate potential Site-related sources of NAPL to the River, enhance conditions for natural attenuation in Area 3, and allow ongoing physical, biological, and chemical processes to reduce Site-related PAH concentrations over time. Achievement of NYSDEC's performance specification of 4 ppm PAH in the top 2 feet of riverbed materials through Area 3 would not likely be possible due to the presence of ongoing, upstream sources of PAHs unrelated to the Site at concentrations up to 80.9 ppm.

7.6.1.3 Short-Term Effectiveness

No intrusive remedial action would be implemented for the riverbed materials within Area 3; therefore, there would be no short-term environmental impacts or risks to workers, the environment, or nearby communities associated with implementing this alternative.

7.6.1.4 Long-Term Effectiveness and Permanence

Under the MNR alternative, the Site-related PAH concentrations in surficial riverbed materials are expected to decrease over time due to natural recovery processes (i.e., weathering, mixing, dispersion, and other chemical/biological processes). As described above and in Appendix F, monitored natural recovery is a viable option for Area 3 that when used in conjunction with the installation of the barrier wall and the remedies proposed for the Phase II Area. Natural recovery processes are not reversible, so the reductions achieved through degradation, mixing, dispersion, and weathering are permanent. The presence of an ongoing, upstream source of PAHs unrelated to the Site that would not be addressed through the remedial actions contemplated in this document could impact the long-term effectiveness of monitored natural recovery in Area 3. However, the presence of upstream sources of PAHs (which have been documented at concentrations up to 80.9 ppm) would not impact the ability of a monitored natural recovery approach to achieve the RAOs for the River, which are to prevent exposure to riverbed materials containing Site-related constituents above background concentrations.

7.6.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Under the MNR alternative, impacted riverbed materials would not be subject to any intrusive treatment processes; however, the natural attenuation processes active in the River would continue to reduce the mass, toxicity, mobility, and volume of Site-related PAHs over time. Natural attenuation of PAHs preferentially

weathers the lower molecular weight PAHs, which, in effect, enhances the relative concentration of the higher molecular weight PAHs. The higher molecular weight PAHs, however, are less bioavailable than the lighter weight molecules; therefore, the overall toxicity is reduced. There is clear evidence of ongoing weathering and depletion of PAHs in the Area 3 surficial riverbed material, and these processes are expected to continue to reduce concentrations of Site-related PAHs – and hence their toxicity and volume – to the predicted endpoint concentrations, with further concentration-related reductions anticipated through physical processes. Reductions are expected to occur at a slower rate in the vicinity of T-7-50, for reasons noted previously.

7.6.1.6 Implementability

The MNR alternative does not require implementation of active remedial activities; therefore, there are no significant implementability issues to consider. The workers and equipment necessary to conduct the monitoring component of this alternative (i.e., diver inspections) are readily available, and since sampling has already occurred in Area 3, it is anticipated that any necessary permits or approval could be easily secured.

7.6.1.7 Cost

The estimated costs associated with Alternative 3A are presented in Table 10. There are no capital costs associated with implementation of this alternative. Annual O&M costs (associated with the annual monitoring effort) are estimated to be $35,000. The total estimated 30-year present worth cost associated with implementation of Alternative 3A is $430,000.

7.6.2 Alternative 3B – MNR with "Focused" Removal of NAPL-Impacted Riverbed Materials, and Backfilling of the Dredged Area

Alternative 3B incorporates MNR along with the removal of certain NAPL-impacted riverbed materials within Area 3 (Figure 19). This modification addresses transect sampling location T-7-50, the only location within Area 3 where NAPL has been observed within the limits of the bioactive zone (0 to 2 feet below the surface) and outside the location of the proposed barrier wall. The areas of impacted riverbed materials targeted for removal include an approximate 20-foot east-west by 40-foot north-south area centered around transect sampling location T-7-50 with removal of materials up to a targeted depth of 8 feet, the depth which the shallower NAPL was reported to in sample location T-7-50. Consideration was initially given to implementing a more limited removal, and capping in-place the NAPL reported at depths more than 3 feet beneath the river bottom. However, T-7-50 is located within the navigation channel, and shallow water depths at T-7-50 would preclude restoration to original grade. Rather than excavate several feet deeper to accommodate both the cap thickness requirements and the minimum navigation depth at T-7-50, the decision was made to attempt an 8-foot excavation to remove the upper NAPL zone, followed by backfilling. If successful, implementation of this alternative would result in the removal and offsite disposal of approximately 300 cy of NAPL- and PAH-impacted riverbed materials from Area 3. The remaining PAH-impacted riverbed materials in the area would continue to recover as a result of natural processes that are already actively reducing concentrations of PAHs in surficial riverbed materials at the Site. Refer to Subsection 7.6.1 and Appendix F for additional details on the natural attenuation processes applicable to Alternative 3B.

Prior to dredging, the targeted area would be isolated with a steel sheetpile enclosure to minimize the potential for downstream transport of materials resuspended during dredging. The riverbed materials would be excavated in the wet using mechanical dredging equipment (e.g., clamshell buckets). The specific sheetpile enclosure system would be determined during the remedial design and would be constructed at an elevation that reduces the potential for overtopping of the wall due to natural fluctuations in the Mohawk River surface water elevation.

Following dredging, backfill materials would be placed to restore the riverbed to its approximate pre-remedy bathymetric conditions, while considering the minimum depth required to be maintained within the navigation channel. The backfill material would provide protection against erosional forces and restore habitat for aquatic biota. Locally available sand or other appropriate material (up to 6.5 feet considering the minimum depth required to be maintained within the navigation channel) would be used as backfill material. The top 1.5 feet of backfill is anticipated to consist of armoring (i.e., rip-rap stone) to provide protection against erosional forces and to restore habitat for aquatic biota. It is possible that the cobbles and stones removed from the river surface during dredging could be washed and reused as the armor layer. The feasibility of this option would be assessed during detailed design. It is anticipated that, over time, fine-grained material would fill in spaces between the stones and possibly cover the armor layer to create a benthic habitat similar to current conditions that would support the re-establishment of the benthic community. The actual configuration and sources of the backfill and armor layers would be finalized/modified during remedial design.

This remedial approach results in average total PAH concentration of 17.6 ppm for the 0- to 2-foot interval of Area 3 outside of the proposed barrier wall (excluding T-7-50 which would be removed).[5] The maximum single sampling point concentration for this area is of 38.5 ppm, which is well below the background maximum concentration of 80.9 ppm total PAHs at sample point SS-2 0 to 0.5 feet.

Although the equipment, materials, and processes used during implementation may be modified during the remedial design, this alternative is generally anticipated to consist of the following steps:

- The substantive requirements of any necessary permits required to implement this alternative would have to be met. Permits may include, but are not limited to, USACE permits for work affecting navigable waters and discharge of dredged or fill material, and a New York State dredge and fill permit and water quality certification.

- Construction would begin with development of river access and land-based facilities for mobilization/support operations. It is assumed that portions of the NYSDOT property located adjacent to and along the shoreline would be used for this purpose. A temporary dock capable of mooring work boats, scows, and barges may need to be constructed along the NYSDOT's and NYSCC's property.

- Installation of a silt curtain(s) would be necessary before initiating activities that may disturb riverbed materials within Area 3. The purpose of the silt curtain would be to mitigate, to the extent practicable, the potential for downstream transport of materials that may become suspended in the water column during the remedial activities. For cost-estimating purposes, it is assumed that a silt curtain would be installed to encompass the entire perimeter of the removal area. Sorbent material (e.g., oil booms) may also be installed

[5]Note: Data from BBL, 2002. SD-7 superceded by T-07-50. SD-8 superceded by T-08-25. SD-9 superceded by T-08-50.

around and/or downstream of the removal area to mitigate the spreading of any sheens/oils on the water surface generated during intrusive river activities.

- A temporary sheetpile wall would be driven around the perimeter of the excavation area to a depth sufficient to support excavation to up to 8 feet bgs. The top of the sheeting would be at an elevation sufficient to prevent overtopping due to normal winter water level fluctuations. Since the potential exists for subsurface cobbles/boulders to be present, a predesign investigation would first be conducted to determine the most appropriate sheeting installation and support techniques.

- Riverbed materials would be mechanically removed in the wet with a clamshell dredge or other suitable equipment. The dredging device would likely consist of a large crane-mounted "sealed" clamshell located on a barge.

- If necessary, geotextile would be placed as a base layer in the completed excavation area before the placement of the sand layer. It is anticipated, however, that geotextile would be used only as a separation layer between the sand and armor stone layers. The geotextile may be deployed by anchoring the material to and unrolling the fabric from a barge. The geotextile would be submerged by placing sandbags on top of the fabric, if necessary. If placed as a base layer, the geotextile would serve as both a separation layer between existing riverbed materials and the sand and as a stabilizing agent (e.g., to prevent mixing of the sand with underlying riverbed materials). For cost-estimating purposes, only one geotextile layer, between the sand and armor stone layers, has been included as a remedy component. The need for a base layer of geotextile would be determined during remedial design.

- It was assumed that the removed riverbed materials would be dewatered/stabilized at a land-based facility by use of a stabilizing agent (e.g., lime, portland cement) to the degree necessary for offsite disposal. The dewatering/stabilization system to be used for the dredged riverbed materials would be determined during remedial design. Stabilization of the wet riverbed materials would be performed at the land-based processing facility by mechanically mixing the stabilizing agent to facilitate offsite transportation of the materials for treatment/disposal. For cost estimating purposes, it was assumed that 90% of the materials generated under this alternative would be non-hazardous and subject to treatment at ESMI's LTTD facility in Fort Edward, New York. The remaining 10% of materials generated under this alternative are assumed to be RCRA-regulated and subject to landfill disposal at CWM's facility in Model City, New York. Actual methods/processes/facilities for handling removed riverbed materials, water generated during implementation, and selection of final disposal facilities would be determined during remedial design based on pricing/availability and profile of the dredged riverbed materials. All materials would be disposed of in accordance with applicable rules and regulations. For cost estimating purposes, it was also assumed that water generated during construction activities would be treated and subsequently discharged to the Mohawk River.

- Restoration materials (sand and stone armoring) would be loaded into scows from stockpiles on the shoreline and transported to the removal area. A loader mounted on a second barge would be used to off-load and place the materials within the excavated area.

- Water column monitoring for turbidity would be performed downstream of the removal area during construction activities to monitor the effectiveness of the sheetpiling and silt curtain. Based on monitoring results, removal activities may be modified until acceptable turbidity levels (to be determined during the remedial design) are achieved. Remedial construction monitoring would also consist of probing within the backfill area to evaluate the installed sand thickness and coverage.

Following completion of the restoration activities, a long-term monitoring program would be implemented. This monitoring program would be consistent with the monitoring program described in Subsection 7.6.1. The need for and extent of any additional remedial measures would be determined in the future based on the results compiled from the monitoring program.

7.6.2.1 Compliance with SCGs

Chemical-Specific SCGs

The same chemical-specific SCGs described under Site-wide Alternative B apply to Alternative 3B as well. As discussed in Subsection 7.3.2.1 (Site-wide Alternative B), the NYSDEC's performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may apply, although its application is questionable. It is unlikely that this goal would be met either in the short or long term due to the impact of ongoing, upstream sources of PAHs unrelated to the Site that range as high at 80.9 ppm.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are associated with the dredging and offsite disposal of NAPL-impacted riverbed materials, removal and treatment of water from dredging and dewatering activities, monitoring requirements, and OSHA health and safety requirements.

Worker activities that occur during implementation of this alternative would need to comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1910, 1926, and 1904. Compliance with these SCGs would be accomplished by following a NYSDEC-approved design and project-specific HASP.

USDOT and disposal facility requirements for packaging, labeling, transportation, and disposal of regulated materials would also be applicable to this alternative. Compliance with these SCGs would be achieved by utilizing licensed and properly permitted waste transporters and treatment/disposal facilities.

Action-specific SCGs associated with the removal and treatment of water generated as a result of implementing this alternative relate to the management and the discharge/disposal of this water. For the purposes of this RAR, the assumed disposal option for generated water is onsite treatment followed by discharge to the Mohawk River. Applicable SCGs could be met through appropriate design of a water treatment system.

Location-Specific SCGs

Location-specific SCGs that apply to this alternative are associated with discharge of dredge or fill materials, modification of waterways, and obstruction/alteration of navigable waters. Compliance with these SCGs would be achieved by meeting the substantive requirements of any required permits and by implementing a design that would minimize disturbance to the Mohawk River. The Clean Water Act (CWA) (Section 404 [33 USC § 1344])is a potentially applicable location-specific SCG.

Placement of the backfill would occur to existing grade or lower, as appropriate considering the minimum depth required to be maintained with the navigation channel and to address concerns related to infilling of waterways.

7.6.2.2 Overall Protection of Human Health and the Environment

Removal of a targeted area of impacted riverbed materials and backfilling the dredged area, in conjunction with MNR for the rest of Area 3, installation of the barrier wall, and the remedies contemplated for the Phase II Area contribute to achievement of the RAOs for the Mohawk River. The removal of materials at transect sampling location T-7-50 would enhance the overall protection described under Alternative 3A with limited implementability issues and short-term impacts. Concentrations of Site-related constituents in the transient bioavailable layer of riverbed materials present between the rocks and cobbles on the river bottom are expected to decline over time, reducing the potential for ecological exposure to Site-related PAHs in Area 3.

This alternative is not intended to be a stand-alone remedy, but rather one element of an overall solution for the Site. Long-term monitoring would be conducted to verify that source control and targeted removal effectively address Site-related contributions of NAPL. If monitoring results indicate that the remedy is not performing as expected, then additional measures would be considered as necessary to provide overall protection of human health and the environment. The combined benefits of the remedies implemented for the various portions of the Site should lead to long-term attainment of the RAOs that apply to both the River and the Site. Achievement of NYSDEC's performance specification of 4 ppm PAH in the top 2 feet of riverbed materials through Area 3 would not likely be possible due to the presence of ongoing, upstream sources of PAHs unrelated to the Site at concentrations reported up to 80.9 ppm.

Removal and restoration activities, in conjunction with institutional controls and the long-term monitoring and maintenance programs, would effectively reduce the potential for ecological exposure to MGP-related materials within the riverbed over the long term. Additionally, natural attenuation processes are expected to continue in the river over the long term, which would also reduce the potential risks to human health and the environment from exposure to Site-related PAHs present in the surficial riverbed materials in Area 3.

7.6.2.3 Short-Term Effectiveness

The short-term impacts of dredging and backfilling a focused area of impacted riverbed materials would include some disruption/alteration of areas to construct access points, alteration of the existing riverbed surface, alteration/destruction of the existing benthic community, and potential releases of Site-related constituents to the surface water during implementation of remedial activities. Reasonable and appropriate controls (e.g., temporary sheetpiling, silt curtains) would be implemented to mitigate releases to the surface water during implementation activities, but these controls may be compromised by high surface-water velocities or ice build-up/movement in the Mohawk River. The overall control measures would be augmented by monitoring turbidity during dredging and backfilling activities. Based on the monitoring results, production rates may be decreased, dredging and backfilling placement techniques may be modified, and/or additional measures may be implemented (e.g., modification of construction methods).

In addition, there could be temporary disruption to river-related activities in the area targeted for dredging; however, by conducting the removal during the winter non-navigation season, the disruption would be minimal. There would be additional truck traffic in the area associated with transporting removed materials offsite and delivering backfill materials. Since the removal volume is fairly small (300 cy), the number of trucks necessary would be minimal (likely only about 45 trips to transport removed materials offsite and to haul backfill materials in), and impacts to neighboring communities (e.g., noise, increased truck traffic) would be minimal. Further, the necessary time period for active remediation is estimated to be approximately 3 to 4 weeks, so the impacts would not occur over an extended period of time.

In general, during dredging and backfilling operations, potential health risks to remediation workers and the community would be mitigated through the use of appropriate health and safety practices (29 CFR Part 1910.129) and by compliance with the project-specific HASP. Special consideration would have to be given to the risks associated with working on the river in the winter (e.g., cold temperatures, "flashy" water velocities, and ice formation/movement).

7.6.2.4 Long-Term Effectiveness and Permanence

Under Alternative 3B, natural attenuation processes are expected to continue to reduce Site-related PAH concentrations in surficial riverbed materials. As described under Alternative 3A, MNR is a viable option for Area 3 that, when used in conjunction with focused removal around transect sampling location T-7-50, installation of the barrier wall, and the remedies proposed for the Phase II Area, would provide an appropriate level of long-term effectiveness. Removal of a focused area would permanently remove NAPL present as a potential ongoing source of Site-related PAHs to the surficial riverbed materials and accelerate the natural attenuation process at T-7-50.

The presence of ongoing, upstream sources of PAHs unrelated to the Site that would not be addressed through the remedial actions contemplated in this document could impact the long-term effectiveness of MNR and focused removal in Area 3. However, the presence of the upstream sources (which have been documented at concentrations up to 80.9 ppm total PAHs that are not Site-related) would not impact the ability of an MNR approach to achieve the RAOs for the River, which are intended to prevent exposure to riverbed materials containing Site-related constituents above background concentrations. Further, potential human access to riverbed materials in Area 3 is limited to non-existent, as the riverbed is submerged in this area and there is an existing no-swim restriction on the canal. The cobbly nature of the riverbed coupled with the highly transient nature of the fine-grained silts and sands in between the cobbles limit the potential for ecological exposure to a bioavailable layer.

7.6.2.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Excavation of an estimated 250 cy of PAH- and NAPL-containing riverbed materials would reduce the volume and mobility of MGP-related material present. Treatment of the material before disposal (if necessary) would reduce toxicity. The natural attenuation processes active in the River would reduce the mass, toxicity, and volume of PAHs in Area 3 over time. There is clear evidence of ongoing weathering and depletion of PAHs, and these processes are expected to continue to reduce concentrations of PAHs – and hence their toxicity and volume. Further, if PAH- and NAPL-containing water were generated/treated during construction and the dewatering process, additional reductions in toxicity, mobility, and volume would be realized.

7.6.2.6 Implementability

Both dredging and backfilling/capping are proven technologies that have been implemented at other sites to address impacted riverbed materials. The equipment and materials necessary to implement this alternative are available for use, and the project could likely be completed in one construction season (active work in the River would last approximately 3 to 4 weeks) following the winter drawdown of the Mohawk River (i.e., between

November and April). It may be difficult to install sheetpiles around the dredge area if significant embedment depths are necessary to facilitate achievement of the targeted excavation depth. The sheetpile system would be finalized during remedial design.

NAPL is present to some degree in the subsurface within the area for proposed removal; controlling the NAPL while dredging in the wet would be difficult and may necessitate the installation of an engineered cap as opposed to using sand backfill. The rocky, cobbly nature of the river bottom could present challenges regardless of the final equipment choice. Rocks can sometimes prevent clamshells from closing completely and cause dredged materials to leak out. Finally, working in the winter and dealing with potentially "flashy" water velocities, cold temperatures, and ice formation/movement would pose construction challenges and increase potential risks to workers. Other potential difficulties associated with the remedial construction activities could be limited space available on land near Area 3 for staging materials and equipment and processing removed materials.

With respect to administrative feasibility, the substantive requirements of applicable USACE and NYSDEC permits would have to be met for dredging and backfilling within the waterway. If applicable, the substantive requirements of any permits would also have to be met for the discharge of water generated and treated during dredging and dewatering activities.

7.6.2.7 Cost

The estimated costs associated with Alternative 3B are presented in Table 11. The total estimated capital cost for implementation of this alternative is $780,000. Annual O&M costs for this alternative are estimated to be $40,000. The total estimated 30-year present worth cost associated with implementation of Alternative 3B is $1,300,000.

The primary elements of the cost associated with implementation of Alternative 3B include:

- temporary sheetpile around the removal area; and
- removal, dewatering, transport, and disposal of approximately 250 cy of riverbed materials.

Assumptions related to the costs are described in Table 11.

7.6.3 Alternative 3C – Dredging of Area 3, Backfilling the Dredged Area, and Monitoring

Alternative 3C consists of removal of the top 2 feet of riverbed materials throughout all of Area 3 to satisfy the NYSDEC's sediment performance specification (i.e., achieve less than 4 ppm PAHs in the top 2 feet), "focused" removal of NAPL-impacted riverbed materials at transect sampling location T-7-50, backfilling, and monitoring (Figure 20). In addition to considering the 2-foot removal depth to address the performance specification, some additional material would be removed to maintain the required navigation depth following backfilling. Implementing Alternative 3C would result in the removal and offsite disposal of approximately 2,800 cy of NAPL- and PAH-impacted riverbed materials from Area 3. Post-implementation monitoring would be conducted. The remedial components pertaining to "focused" removal of NAPL-impacted riverbed materials in Alternative 3C are the same as to Alternative 3B and are discussed above in Subsection 7.6.2. Therefore, only a description of the modified activities is provided here.

In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC requested that Niagara Mohawk include removal of riverbed materials across all of Area 3 to a "feasible" depth in the analysis of alternatives for the Mohawk River (Spellman, 2003d). Niagara Mohawk does not believe that removal of riverbed materials throughout Area 3 is a necessary component of an effective remedial alternative. The average total PAH concentration for the surficial 2-foot interval in Area 3 and outside of the proposed wall is 17.6 ppm (excluding T-7-50, which would be removed under Alternative 3B), compared to upstream background levels that are as high as 80.9 ppm. Sands, silts, and clays present in the surficial riverbed environment in Area 3 are transient under high-flow conditions (see Appendix D). Therefore, it is highly unlikely that widespread removal in Area 3 would be an effective way to achieve and maintain the NYSDEC's performance specification of 4 ppm PAHs in the top 2 feet since the upstream PAH sources are unrelated to the Site and would not be controlled as part of an overall Site-wide remedy.

Dredging activities would be performed within a sheetpile and silt curtain enclosure to minimize, to the extent practicable, adverse impacts on surface water quality caused by the dredging activities. After dredging, the backfill materials would be placed to restore the riverbed to its approximate pre-remedy bathymetric conditions, while considering the minimum depth required to be maintained within the navigation channel. The backfill would be designed to provide protection against erosional forces and restore habitat for aquatic biota. Similar to Alternative 3B, locally available sand or other appropriate material would be used as backfill material. The top 1.5 feet of backfill is anticipated to consist of armoring (i.e., rip-rap stone) to provide protection against erosional forces and to restore habitat for aquatic biota. It is possible that the cobbles and stones removed from the river surface during dredging could be washed and reused at the armor layer. The feasibility of this backfill option would be assessed during detailed design. It is anticipated that, over time, fine-grained material would fill in spaces between the stones and cover the armor layer to create a benthic habitat similar to current conditions that would support the re-establishment of the benthic community. The actual configuration and sources of the backfill and armor layers would be finalized/modified during the remedial design.

The equipment, materials, and processes used to implement Alternative 3B (see Subsection 7.6.2) would also be applicable for implementing Alternative 3C. However, additional steps would be required to address the expanded dredging of riverbed materials throughout all of Area 3. Therefore, a brief discussion of the dredging activities is provided below.

- In an attempt to minimize impacts to water quality, Alternative 3C includes both hydraulic controls and water quality monitoring. The hydraulic controls include a temporary sheetpile wall system in conjunction with silt curtain(s) along the perimeter of the 1-acre area.

- Sorbent material (e.g., oil booms) may also be installed around the dredging area to mitigate the spreading of sheens/oils on the water surface (if any) generated during dredging activities.

- A clamshell dredge would likely be used for mechanical removal of the riverbed materials in the wet. The dredging device would consist of a large crane-mounted "sealed" clamshell located on a barge. Dredging would be performed to a depth of 2 feet throughout the 1-acre area (with the exception of the NAPL-impacted area at transect sampling location T-7-50, where removal is targeted for up to 8 feet, as discussed in Section 7.6.2 above), and overdredging necessary to achieve minimum navigation depth requirements following restoration, resulting in the removal of approximately 2,800 cy of riverbed materials. The removed riverbed materials would be dewatered/stabilized and transported offsite for disposal. Following dredging activities, the suspended materials within the dredge cell would be allowed to settle prior to

backfilling and again prior to pulling the sheeting. Once the water column has sufficiently cleared, the sheetpile enclosure would be pulled, washed, and transported offsite for potential reuse by the contractor.

- Based on a typical production rate for environmental dredging operations in the US (75 to 100 cy per day) this removal program would be projected to last between 30 to 40 work days (or approximately 1½ to 2 months); however, because of the nature of the subsurface materials and because the work is anticipated to occur during the winter months, delays could push this activity into two "construction seasons."

- It is assumed that the removed riverbed materials would be dewatered/stabilized at the land-based facility by use of a stabilizing agent (e.g., lime, portland cement) to the degree necessary for offsite disposal. The dewatering/stabilization system to be used for the dredged riverbed materials would be determined during remedial design. Stabilization of the wet riverbed materials would be performed at the land-based processing facility by mechanically mixing a stabilizing agent (e.g., lime, portland cement) to facilitate offsite transportation of the materials for treatment/disposal. For cost estimating purposes, it was assumed that 90% of the materials generated under this alternative would be non-hazardous and subject to treatment at ESMI's LTTD facility in Fort Edward, New York. The remaining 10% of materials generated under this alternative are assumed to be RCRA-regulated and subject to landfill disposal at CWM's facility in Model City, New York. Actual methods/processes/facilities for handling removed riverbed materials, water generated during implementation, and selection of final disposal facilities would be determined during remedial design based on pricing/availability and profile of the dredged riverbed materials. All materials would be disposed of in accordance with applicable rules and regulations. It has also been assumed that water generated during construction activities would be treated and subsequently discharged to the Mohawk River.

- Following the completion of dredging activities, backfilling would be performed as discussed above and described for Alternative 3B (see Section 7.6.2). The areas of the proposed dredging and backfilling for this alternative are shown on Figure 20.

- As in Alternative 3B, water column turbidity monitoring downstream of the dredging and backfilling area would be conducted during construction activities to monitor the effectiveness of the sheetpile and silt curtain systems. Based on monitoring results, dredging/backfilling activities may be modified (e.g., slowed or halted) or additional measures implemented (e.g., placement of an additional silt curtain) until acceptable turbidity levels (to be determined during the remedial design and approved by NYSDEC) are achieved. Monitoring would also consist of probing within the backfill area to evaluate the installed sand thickness and coverage.

- Following completion of the alternative, a visual monitoring program would be implemented as part of this alternative to assess stability of the riverbed in the remedial area.

7.6.3.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs discussed for Alternative 3B above are also applicable to this alternative.

The NYSDEC's performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may apply, although as described under Site-wide Alternative B, its application is questionable. It is unlikely that this goal would be met in either the short or long term due to the impact of ongoing, upstream sources of PAHs unrelated to the Site that range as high at 80.9 ppm.

Action-Specific SCGs

Action-specific SCGs that may apply to this alternative are the same as for Alternative 3B, above.

Location-Specific SCGs

Location-specific SCGs that apply to this alternative are the same as Alternative 3B, above.

7.6.3.2 Overall Protection of Human Health and the Environment

Implementation of Alternative 3C, in conjunction with implementation of the remedies selected for other areas of the Site, would contribute to achievement of the RAOs for the River and the Site through removal of the top 2 feet of riverbed materials in Area 3 and deeper removal at transect sampling location T-7-50. However, due to the presence of ongoing, upstream sources of PAHs unrelated to the Site at concentrations up to 80.9 ppm, even if implementation of the removal action were wholly successful, achievement of the NYSDEC's performance specification of 4 ppm PAH throughout the top 2 feet of Area 3 would likely not be possible. If not complicated by associated resuspension issues caused by dredging, removal and restoration activities associated with Alternative 3C should effectively eliminate the potential for any human or ecological exposure to MGP-related PAHs in Area 3.

7.6.3.3 Short-Term Effectiveness

The short-term impacts associated with implementation of Alternative 3C could be significant, and would include disruption/destruction of areas to construct access points, alteration/destruction of benthic community across all of Area 3, potential releases of PAHs downstream, and potential mobilization of subsurface NAPL from the T-7-50 Area. Reasonable and appropriate controls (e.g., temporary sheetpiling and silt curtains) would be implemented to mitigate constituent release to the surface water during implementation activities, but these controls may not be entirely effective, especially considering the large-scale of removal throughout all of Area 3. These measures would be augmented by turbidity monitoring. Based on the monitoring results, production rates and dredging/placement techniques may be modified and/or additional measures implemented (e.g., placement of an additional silt curtain or modifications of construction methods).

If Alternative 3C was implemented, the greatest risk posed to the community would likely relate to increased truck traffic (e.g., highway accidents, potential for spillage, inherent risks crossing high-speed rail line) during construction. For soil handling alone, an estimated 520 truck trips would be required to transport PAH-containing material from the Site and deliver clean backfill to the Site. In general, during dredging and backfilling/capping operations, potential health risks to remediation workers and the community would be mitigated through the use of appropriate health and safety practices (29 CFR Part 1910.129) and by compliance with the project-specific HASP. Special consideration would have to be given to the risks associated with

working on the River in the winter (e.g., cold temperatures, "flashy" water velocities, and ice formation/movement).

With regard to the environment, the habitat and any biota residing in the riverbed material would be destroyed during excavation. Following restoration, the excavated area is expected to become re-inhabited. Placing booms or silt curtains around the temporary sheetpile wall should adequately contain a potential release of any Site-related material, if not compromised by high surface water velocities or ice build-up/movement in the Mohawk River. There is a potential for short-term compliance issues with New York State Surface Water Standards.

Completion of Alternative B in one fall/winter construction season may be difficult to achieve, especially if harsh winter conditions persist or excavation rates are low. Such concerns would need to be considered and addressed during design.

7.6.3.4 Long-Term Effectiveness and Permanence

This alternative would result in the permanent removal of the upper 2 feet of riverbed materials in an effort to achieve the NYSDEC's performance specification of 4 ppm PAH in surficial riverbed materials. In addition, this alternative would result in the permanent removal of NAPL-impacted riverbed materials at transect sampling location T-7-50. A long-term monitoring and maintenance program would be implemented to assess stability of the remediated area.

A number of issues exist with regard to the degree of permanence of this approach and the expectations regarding long-term effectiveness. Removal across Area 3 would have to occur in the wet, as there is no underlying confining unit present to key in a vertical barrier wall and permit removal in the dry. As a result, PAH-bound solids would be resuspended during removal. Although containment systems would be in place to mitigate downstream transport of these materials to the extent possible, resuspension would still occur throughout Area 3.

Considering the fact that the background PAH concentrations are as high as 80.9 ppm, attaining and maintaining a goal of 4 ppm in the upper 2 feet is likely unachievable. Further, if subsurface NAPL is mobilized during dredging, the current extent of NAPL impacts could actually be expanded as a result of remedy implementation. These issues could jeopardize attainment of the RAOs for the Site.

With regard to permanence, although approximately 2,800 cy of PAH- and NAPL-containing materials would be removed from Area 3, due to the transient nature of the riverbed environment and the presence of ongoing, upstream sources of PAHs (at concentrations up to 80.9 ppm) unrelated to the Site that will not be addressed, there is little assurance that the goal of a surficial PAH concentration of 4 ppm could be achieved or maintained, rendering a costly, intrusive, risky remedy fairly ineffective.

7.6.3.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Excavation of an estimated 2,800 cy of PAH- and NAPL-containing riverbed materials would reduce the volume and mobility of MGP-related material present. Treatment of the material before disposal (if necessary) would reduce toxicity. Further, there would be treatment of PAH- and potentially NAPL-impacted water during the riverbed material dewatering process. There is a possibility that dredging throughout Area 3 could actually

increase the mobility of PAH-impacted materials, complicating implementation and preventing achievement of the NYSDEC performance specification and the RAOs for the Site.

7.6.3.6 Implementability

Both dredging and backfilling are proven technologies that have been implemented at other sites to address impacted riverbed materials. The equipment and materials necessary to implement this alternative are available for use, as are remediation contractors.

However, a number of potentially significant implementability issues could present serious complications and necessitate expanding the scope, timeframe, and cost of the alternative. These issues include:

- Removal in the wet during the winter would present issues associated with the "flashiness" of surface water velocities and water depth, ice formation and movement, and cold temperatures. All these issues complicate implementation and increase risk.

- The presence of cobbles, rocks, and debris across the riverbed surface in Area 3 would pose challenges during excavation. Rocks and debris could prevent mechanical clamshells from closing and cause dredged materials to leak out of the bucket.

- Dredging in the navigation channel could cause disruption to river activities, and final navigation depths would have to be considered as part of the backfilling activities for Area 3.

With respect to administrative feasibility, the substantive requirements of applicable USACE and NYSDEC permits would have to be met for modification and alteration of the waterway. Substantive permit requirements would also have to be met for the discharge of water generated and treated during dredging and dewatering activities. Other potential difficulties associated with the remedial construction activities could be related to the limited space available on land within and near Area 3.

7.6.3.7 Cost

The estimated costs associated with Alternative 3C are presented in Table 12. The total estimated capital cost for implementation of this alternative is $4,400,000. Annual O&M costs for this alternative are estimated to be $50,000. The total estimated 30-year present worth cost associated with implementation of Alternative 3C is $5,000,000.

The primary elements of the cost associated with implementation of Alternative 3C include:

- mobilization/demobilization;
- temporary sheetpile around the removal area; and
- removal, dewatering, transport, and disposal of approximately 3,400 cy of riverbed materials.

Assumptions related to the costs are described in Table 12.

7.6.4 Comparative Analysis of Area 3 Alternatives

Three remedial alternatives were evaluated for Area 3, which is identified as the Mohawk River between the low (winter) water level and the outer bound of the 1-acre "Area for Consideration." As presented above, the three remedial alternatives include:

- **Alternative 3A** – MNR and Institutional Controls;

- **Alternative 3B** – MNR with "Focused" Removal of NAPL-Impacted Riverbed Materials, and Backfilling the Dredged Area; and

- **Alternative 3C** – Dredging of Area 3, Backfilling the Dredged Area, and Monitoring.

A comparative analysis of the remedial alternatives identified for Area 3 is provided below using the seven NYSDEC/NCP evaluation criteria.

7.6.4.1 Compliance with SCGs

All three alternatives have the potential to achieve the applicable chemical-, action-, and location-specific SCGs, with the exception of the NYSDEC's performance specification of achieving a concentration of less than 4 ppm PAH in the upper 2 feet of riverbed materials. As a result, this criterion does not present a significant point of differentiation. With respect to the 4 ppm performance specification, it is unlikely that any remedy could successfully achieve and maintain this goal. Currently, the average surficial PAH concentration in Area 3 riverbed materials is 31.1 ppm. While this concentration would be expected to decrease after installation of the barrier wall and subsequent mitigation of potential discharges from the Phase II Area to the river, and the continuing declines expected due to the natural attenuation processes, the presence of ongoing, uncontrolled, upstream sources of PAHs unrelated to the Site at concentrations up to 80.9 ppm will prevent achievement and maintenance of a 4 ppm target regardless of the option chosen for Area 3. The extensive, intrusive measures proposed as part of Alternative 3C do not make achievement of the performance specification any more likely than if Alternative 3B were implemented, and the extensive intrusive measures present a host of short-term impacts and implementability concerns that do not exist for the other options. In summary, none of the options would achieve and maintain the 4 ppm PAH performance specification, but all would be expected to achieve the other applicable SCGs.

7.6.4.2 Overall Protection of Human Health and the Environment

When considered in conjunction with the installation of the barrier wall (designed to mitigate potential Site-related sources of NAPL to the River) and a remedy for the Phase II Area, Alternative 3B likely affords the greatest degree of overall protection of human health and the environment. While no evidence exists that the NAPL observed at the T-7-50 location is above residual saturation (and is therefore not likely mobile), the presence of this NAPL within the upper 2 feet of the riverbed would inhibit the rate of natural recovery in this area. The focused removal of materials at transect sampling location T-7-50 proposed as part of Alternative 3B would speed the recovery in and around this area while natural attenuation processes would continue to reduce concentration of PAHs throughout the balance of Area 3. The extensive, intrusive removal proposed as part of Alternative 3C presents significant short-term risks and implementability concerns without providing any assurance of increased overall protection. The sands, silts, and clay material present in the surficial riverbed of Area 3 is transient (undergoes periodic mixing and dispersion) based on observations and the results of the riverbed stability assessment (Appendix D). That means that in the first summer (high water) season after implementation, new materials will be deposited from upstream. A portion of those materials will likely erode during the next winter (low water) season, with periodic turnover of fine grained material over time. This exchange will occur whether or not the entire Area 3 is covered with backfill materials or an engineered cap; therefore, the surficial bioavailable layer will be fairly similar regardless of the remedy selected (with the possible exception of the T-7-50 area). From an overall perspective, the additional time, risks, implementability issues, and costs associated with Alternative 3C are not justified.

The approach envisioned in Alternatives 3A and 3B – source control via installation of the barrier wall and focused removal at transect sampling location T-7-50 (Alternative 3B only) followed by monitoring of the progress of natural attenuation throughout the area – are consistent with the iterative approach recommended by the USEPA (2002). A decision regarding whether or not additional actions are necessary would be made based on the results of the annual monitoring program.

7.6.4.3 Short-Term Effectiveness

Since Alternative 3A does not include any intrusive remedial actions, there would be no short-term risks to workers, the environment, or neighboring communities due to implementation. Implementation timeframes for Alternatives 3B and 3C are, respectively, 3 to 4 weeks and 5 to 7 months. There are more significant short-term impacts associated with Alternative 3C than with Alternative 3B, in part due to the increased magnitude and extent of excavation activities (disruption/destruction of areas to construct access points, potential releases of PAHs downstream, potential mobilization of subsurface NAPL, disruption to River-related activities, truck traffic, and risks to workers). In addition, the entire existing benthic community across Area 3 would be destroyed. In contrast, the implementation of Alternative 3B would be fairly straightforward, and the focused removal action would cause less disruption to River activities and less destruction of the benthic environment. The additional short-term impacts associated with Alternative 3B (as compared to Alternative 3A) may be justified based on the potentially accelerated timeframe to achieve benefits associated with the focused removal. The additional impacts associated with Alternative 3C do not appear to be justified considering the fact that there is no assurance the increased risks would provide an increased level of protection.

7.6.4.4 Long-Term Effectiveness and Permanence

Under Alternatives 3A and 3B, the concentrations of Site-related PAHs present in surficial riverbed materials would be reduced over time as ongoing natural attenuation processes continue. When considered in conjunction with the installation of the barrier well, both options provide an adequate degree of long-term protection. The natural attenuation element of Alternatives 3A and 3B is extensively documented in the literature as both reliable and permanent. The focused removal included as part of the Alternative 3B would accelerate the natural recovery of this area. In contrast, there are potential issues with respect to the degree of permanence afforded by Alternative 3C and the expectations of long-term effectiveness. These include potential resuspension of PAH-bound solids throughout Area 3, making achievement at the 4 ppm PAH performance specification difficult to achieve, and the presence of an ongoing, upstream source of PAHs unrelated to the Site that, when coupled with the transient nature of the riverbed environment, indicate that this highly intrusive, expensive option will be no more permanent than the other options. The results from the long-term monitoring program included as part of Alternatives 3A and 3B would be used to assess the effectiveness of these options over time and evaluate whether or not additional remedial action is necessary.

7.6.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Removal of an estimated 2,800 cy of potentially impacted materials as part of Alternative 3C would potentially provide the fastest reduction in mobility and volume, although the average total PAH concentration of these materials (excluding the T-7-50 area) is only 17.6 ppm. Removing 250 cy of impacted materials as part of Alternative 3B would also reduce the mobility and volume of impacted materials in the River. Materials removed during Alternatives 3B and 3C would be treated (if necessary) prior to offsite disposal/treatment (further reducing toxicity and mobility) and potentially impacted water generated during the dewatering process in Alternatives 3B and 3C would be subject to treatment. The natural attenuation processes included in Alternatives 3A and 3B would continue to reduce the toxicity, mobility, and volume of PAH-impacted materials over time throughout Area 3.

7.6.4.6 Implementability

Alternative 3A is clearly the most straightforward option to implement. The equipment and workers necessary for the long-term monitoring program would be readily available and any necessary permits or approvals could be secured. Similar implementability concerns exist for the removal components of Alternatives 3B and 3C, including difficulty designing and installing an effective sheetpile system; difficulty controlling resuspension; the impacts of the rocky/cobbly river bottom on dredging equipment; and issues associated with working in the winter. These issues would all be magnified for Alternative 3C, since removal would occur over a much larger area and take a longer time to complete. Further, due to the highly transient nature of the riverbed, the additional implementability issues associated with Alternative 3C do not come with any assurance of increased long term performance or permanence. In summary, Alternative 3A is the most straightforward option and the implementation issues associated with Alternative 3B are likely manageable, while the same cannot be said about the additional issues and concerns associated with Alternative 3C.

7.6.4.7 Cost

The following table summarizes the estimated costs associated with each of the alternatives for Area 3.

Remedial Alternative	Estimated Capital Costs (Rounded)	Estimated Annual O&M Costs (Rounded)	Estimated Present Worth of O&M Costs (Rounded)	Estimated Total Cost (Rounded)
3A – MNR and Institutional Controls	$0	$35,000	$430,000	$430,000
3B - MNR with "Focused" Removal of NAPL-Impacted Riverbed Materials, Backfilling of the Dredged Area, and Institutional Controls	$800,000	$40,000	$500,000	$1,300,000
3C – Dredging of Area 3, Backfilling of the Dredged Area, Monitoring, and Institutional Controls	$4,400,000	$50,000	$620,000	$5,000,000

As summarized in the above table, the costs associated with implementing either Alternative 3A or 3B are significantly less than the costs associated with implementing Alternative 3C.

7.7 Area 4 – Eastern 0.1-Acre "Area for Consideration" (East of the Terminal Wall)

This subsection presents the detailed analysis of each area-specific remedial alternatives identified in Subsection 6.3.2.4 for Area 4, which is identified as the approximately 0.1-acre area located to the east of the terminal wall.

The following two alternatives have been retained for detailed analysis for Area 4:

- **Alternative 4 A** – Removal of Area 4 to 4 feet and Backfill of the Excavated Area.
- **Alternative 4B** – Removal of Area 4 to 4 feet, Removal Around SD-11 and SD-12, Backfill of the Excavated Areas, and Monitoring.

These alternatives are further discussed in Subsections 7.7.1 and 7.7.2, below.

7.7.1 Alternative 4 A – Removal of Area 4 to 4 feet and Backfill of the Excavated Area

Alternative 4A consists of the removal of the upper 4 feet of riverbed materials across all of Area 4 – the approximately 0.1-acre area east of the terminal wall (Figure 17). Following removal, backfill materials would be placed to restore the area to its approximate pre-remedy bathymetric conditions. Under this alternative, no removal will be performed within the navigation channel. Restoration would consist of placement of locally available fill beneath a layer of armor stone, restored to original grade. The actual configuration and materials would be finalized/modified during remedial design.

Prior to dredging, the targeted area would be isolated with Jersey barriers. The riverbed materials would be excavated in the dry, to the extent feasible, using mechanical dredging equipment (e.g., excavator), resulting in the removal and offsite disposal of approximately 550 cy of impacted materials from Area 4. The specific

Jersey barrier system would be determined during the remedial design based on such factors as water depths, subsurface riverbed conditions, and excavation depth.

Although the equipment, materials, and processes used during implementation of this alternative may be modified during the remedial design, this alternative would generally consist of the following steps:

- The substantive requirements of any necessary permits required for implementing this alternative would have to be met. Permits may include, but are not limited to, USACE permits for work affecting navigable waters and discharge of dredged or fill material, and a New York State dredge and fill permit and water quality certification.

- Construction would begin with development of land-based facilities for mobilization/support operations. It is assumed that portions of the NYSCC's property located adjacent to and along the shoreline would be used for this purpose.

- A silt curtain(s) would be installed prior to initiating activities that may disturb materials within this area. The purpose of the silt curtain would be to mitigate, to the extent practicable, the potential for downstream transport of materials that may become suspended into the water column during the remedial activities. For cost-estimating purposes, it is assumed that a silt curtain would be installed to encompass the entire length of the removal area. Sorbent material (e.g., oil booms) may also be installed around and/or downstream of the removal area to mitigate the spreading of sheens/oils on the water surface (if any) generated during intrusive river activities.

- Before initiating and to facilitate Jersey barrier installation activities, cobbles present along the length of the area to be excavated may be removed and transported offsite for disposal. In addition, a bedding material, such as a clean offsite gravel, may be placed to facilitate a uniform bed surface for the Jersey barrier.

- Mechanical excavators would be used to remove the targeted materials to a depth of 4 feet. The equipment would be long-reach excavators located on the shore on NYSCC property. Excavated materials would be stockpiled and dewatered/stabilized, as necessary, prior to shipping offsite for disposal.

- During backfilling, a geotextile layer would be placed between the sand and armor stone layers. The geotextile would serve as both a separation layer and a stabilizing agent.

- Restoration materials would be loaded into earth-moving equipment (e.g., front-end loader) from stockpiles in the Phase II Area and then transported and placed within the removal area.

- Water column monitoring for turbidity would be performed downstream of the removal area during construction activities to monitor the effectiveness of the Jersey barrier and silt curtain. Based on monitoring results, removal activities may be modified until acceptable turbidity levels (to be determined during the remedial design) are achieved.

Following completion of the restoration activities, a long-term monitoring and maintenance program would be implemented. For cost-estimating purposes, it was assumed that this program would involve annual visual inspection of the restored area. Inspections may also be conducted subsequent to episodic events (e.g., high-flow events). Damages observed during inspections (e.g., wash-outs) would be repaired appropriately and

evaluated to determine if alternative backfill materials (e.g., armor stone) are required to maintain the long-term effectiveness and reliability of the area.

7.7.1.1 Compliance with SCGs

Chemical-Specific SCGs

The applicable chemical-specific SCGs would be achieved by completing appropriate characterization and profiling of the excavated riverbed materials prior to offsite transportation and disposal. Chemical-specific SCGs that potentially apply to this alternative are New York State regulations regarding the identification and listing of hazardous wastes listed in 6NYCRR Part 371. Included in those regulations are the regulated levels of TCLP constituents. The TCLP constituent levels are a set of numerical criteria at which solid waste is considered a hazardous waste by the characteristic of toxicity. In addition, the hazardous characteristic of ignitability, reactivity, and corrosivity may also apply, depending on the results of waste characterization activities. The TCLP constituent levels are outlined in 40 CFR 261. The NYSDEC's performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may apply, and likely could be achieved through the removal action. Maintenance of the 4 ppm standard over the long term would likely be difficult due to the presence of non-Site-related PAHs at concentrations well in excess of the 4 ppm total PAH performance standard in riverbed materials upstream of the Site, combined with the fact that Area 4 is an apparent depositional area during waning flow events.

Another set of chemical-specific SCGs that may apply to the Site are the UTSs/LDRs, as listed in 6NYCRR Part 376. These standards and restrictions identify hazardous wastes for which land disposal is restricted and define acceptable treatment technologies for those hazardous wastes on the basis of their waste code characteristics. The UTSs/LDRs also provide a set of numerical criteria for which hazardous waste is restricted from land disposal, based on the concentration of select constituents present. In addition, the UTSs/LDRs define hazardous debris and specify treatment methods required to treat and destroy hazardous constituents on or in hazardous debris.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are associated with the dredging and offsite disposal/treatment of PAH-impacted riverbed materials, monitoring requirements, and OSHA health and safety requirements.

Worker activities that occur during implementation of this alternative would need to comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1910, 1926, and 1904. Compliance with these SCGs would be accomplished by following a NYSDEC-approved design and project-specific HASP.

USDOT and disposal facility requirements for packaging, labeling, transportation, and disposal of regulated materials would also be applicable to this alternative. Compliance with these SCGs would be achieved by utilizing licensed and properly permitted waste transporters and disposal/treatment facilities.

Location-Specific SCGs

Location-specific SCGs that apply to this alternative are associated with discharge of dredge or fill materials, modification of waterways, and obstruction/alteration of navigable waters. Compliance with these SCGs would be achieved by meeting the substantive requirements of any required permits – including NYSDEC's Use and Protection of Waters Program (6NYCRRPart 608) – and by implementing designs that would minimize disturbance and/or alteration of the Mohawk River. The CWA (Section 404 [33 USC § 1344])is a potentially applicable location-specific SCG.

In addition, for this alternative, placement of the backfill to existing grade would address issues related to infilling of waterways. The backfill would be placed such that the riverbed is restored to its pre-remedy bathymetric and substrate conditions.

7.7.1.2 Overall Protection of Human Health and the Environment

This alternative would result in the permanent removal of the upper 4 feet of riverbed materials and would achieve the RAOs established for the Mohawk River and NYSDEC's performance specifications related to the upper 2 feet of riverbed materials (i.e., 4 ppm PAH). When carried out in conjunction with the alternatives for Areas 1 through 3 and installation of the barrier wall, this alternative would also contribute to the attainment of the RAOs that apply to the Site as a whole.

Removal and backfill of Area 4 would be expected to provide a permanent solution that is protective of both human health and the environment. Continued compliance with a 4 ppm total PAH performance standard, however, may not be possible, due to deposition of river-transported materials from upstream locations where non-MGP related PAHs have been found in concentrations well in excess of 4 ppm.

7.7.1.3 Short-Term Effectiveness

The short-term impacts of excavating riverbed materials and backfilling would include some disruption/alteration of areas to construct access points, alteration of the existing riverbed surface, and alteration/destruction of the existing benthic community. Potential releases of Site-related constituents to surface water during implementation of remedial activities should be minimal, and restricted to set up and tear down of the Jersey barriers and silt curtains. The resuspension control measures would be augmented by performing daily monitoring of turbidity during excavation and backfilling activities to document downstream observations of suspended solids..

There would be additional truck traffic in the area associated with transporting removed materials offsite and delivering backfill materials, although since the removal volume is relatively small (550 cy), the number of trucks necessary would be minimal and impacts (i.e., noise, increased potential for accidents) would be manageable. Further, the necessary time period for active remediation is estimated to be short (i.e., and estimated 10 days).

In general, during excavation and backfilling operations, potential health risks to remediation workers and the community would be mitigated through the use of appropriate health and safety practices (29 CFR Part 1910.129) and by compliance with the project-specific HASP.

7.7.1.4 Long-Term Effectiveness and Permanence

This alternative would result in the permanent removal of all PAH-impacted riverbed materials from the top 4 feet of Area 4. The River RAOs would be met at Area 4, since all Site-related PAHs present in the upper 4 feet of riverbed material that humans and ecological receptors could be exposed to would be permanently removed and replaced with clean fill. When carried out in conjunction with alternatives for Areas 1-3 and installation of the barrier wall, Alternative 4A would contribute to the attainment of the RAOs applicable to the Site as a whole. The techniques that would be used to excavate and backfill the area are well understood and there is little chance the remedy would fail over the long term. Therefore, the residual risk after implementation would be minimal. Area 4 is a depositional environment; as such it is not subject to the ongoing seasonal scour and redeposition described for Area 3. Continued compliance with a 4 ppm total PAH performance standard, however, may not be possible, due to deposition of river-transported materials from upstream locations where non-MGP related PAHs have been found in concentrations well in excess of 4 ppm.

7.7.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Removal of an estimated 550 cy of impacted riverbed materials would reduce the mobility and volume of Site-related PAHs present in the Area 4 riverbed material, and treatment of these materials (if necessary) prior to disposal would reduce toxicity.

7.7.1.6 Implementability

Both excavation and backfilling are proven technologies that have been implemented at other sites to address impacted riverbed materials. The equipment and materials necessary to implement this alternative are available for use, and the project could be completed within a portion of one construction season (an estimated 10 days) following the winter drawdown of the Mohawk River (i.e., between November and April). The impact of changes in surface water elevation would be considered during final design of the Jersey barrier system, but impacts are expected to be minor since Area 4 is typically exposed during the winter season. Implementation of this alternative is not expected to present any issues that could not be addressed during detailed design.

With respect to administrative feasibility, the substantive requirements of applicable USACE and NYSDEC permits would have to be met for dredging and backfilling within the waterway. Area 4 is not in the navigation channel; therefore, final depth after implementation is not a critical consideration. There could be potential difficulties associated with identifying adequate space on land adjacent to the excavation area to construct staging and material handling areas and to locate excavation equipment.

7.7.1.7 Cost

The estimated costs associated with Alternative 4A are presented in Table 13. The total estimated capital cost for implementation of this alternative is $410,000. There are no annual O&M costs for this alternative. The total estimated 30-year present worth cost associated with implementation of Alternative 4A is $410,000.

The primary elements of the cost associated with implementation of Alternative 4A include:

- staging/access area development and restoration; and
- removal, transport, and disposal of approximately 550 cy of riverbed materials.

Assumptions related to the costs are described in Table 13.

7.7.2 Alternative 4B – Removal of Area 4 to 4 feet, Removal Around SD-11 and SD-12, Backfill of the Excavated Areas, and Monitoring

Alternative 4B is similar to Alternative 4A, with the addition of activities in an attempt to satisfy the NYSDEC's sediment performance specification (i.e., achieve less than 4 ppm PAHs in the top 2 feet) outside Area 4 by removing riverbed materials around sample locations SD-11 and SD-12 (Figure 22). This would result in the removal of an estimated additional 200 cy of impacted riverbed materials, for a total of approximately 700 cy. In its December 19, 2003 letter to Niagara Mohawk, the NYSDEC requested that this alternative be evaluated (Spellman, 2003d). Niagara Mohawk does not believe that removal of riverbed materials is necessary near SD-11 and SD-12 to achieve RAOs for the River. SD-11 and SD-12 are outside the boundary of the 0.1-acre area to be considered (Area 4). The need to include these sample locations was evaluated during the process NYSDEC and Niagara Mohawk went through to establish the areas to be considered, and the result of that collaborative process was that SD-11 and SD-12 did not need to be included as documented in the March 14, 2003 Technical Memorandum to the NYSDEC (Morgan, 2003c) and the NYSDEC's June 19, 2003 letter providing acceptance of the areas to be considered (Spellman, 2003b). Surficial PAH concentrations at co-located sample locations T15-75 and T15-100 were only 5.5 ppm and 1.6 ppm respectively in 2002 – these concentrations are well below background in the area, and indeed well below the maximum concentration at T15-25 (within Area 4) of 442 ppm. Therefore, removal at SD-11 and SD-12 would appear to serve little purpose. Nevertheless, this alternative is included in this RAR at the request of the NYSDEC.

The general components of the alternative would be as described below:

- The additional activities for Alternative 4B would consist of dredging of an approximately 40 by 65 by 2 feet deep area around sample points SD-11 and SD-12, and backfilling the area. The backfill materials would be placed to restore the riverbed to its approximate pre-remedy bathymetric conditions, while considering the minimum depth required to be maintained within the navigation channel. The backfill would be designed to restore habitat for aquatic biota. Similar to Alternative 4A, locally available clean fill would be used as backfill material. Given the nature of materials and river velocities in the SD-11/SD-12 vicinity, no armor stone is assumed.

Dredging activities around SD-11 and SD-12 would be performed in the wet within a sheetpile enclosure to minimize, to the extent practicable, adverse impacts on surface water quality caused by the dredging activities. The additional remedial components pertaining to dredging of riverbed materials around SD-11 and SD-12 in the wet are provided below:

- In an attempt to minimize the potential water quality impacts, Alternative 4B includes both hydraulic controls and water quality monitoring. The hydraulic controls include a closed sheetpile wall system in conjunction with silt curtain(s) along the perimeter of the SD-11 and SD-12 removal area.

- A clamshell dredge would likely be used for mechanical removal of the riverbed materials in the wet. The dredging device would consist of a large crane-mounted "sealed" clamshell located on a barge. Dredging would be performed to a depth of 2 feet or more (when considering the minimum depth required to be maintained within the navigation channel) throughout the area around SD-11 and SD-12 within the sheetpile enclosure, resulting in the removal of approximately 200 cy of PAH-containing riverbed materials. The removed riverbed materials would be stockpiled and dewatered/stabilized and transported offsite for disposal. Following dredging activities, the suspended materials within the dredge cell would be allowed to settle prior to backfilling and again prior to pulling the sheeting Once the water column has sufficiently cleared, the sheetpile enclosure would be retrieved, washed, and transported offsite for potential reuse by the contractor.

- It is assumed that the removed materials would be dewatered/stabilized at the land-based facility by use of a stabilizing agent (e.g., lime, portland cement) to the degree necessary for offsite disposal. The dewatering/stabilization system to be used for the dredged riverbed materials would be determined during remedial design. Stabilization of the wet riverbed materials would be performed at the land-based processing facility by mechanically mixing a stabilizing agent (e.g., lime, portland cement) to facilitate offsite transportation of the materials for treatment/disposal. For cost estimating purposes, it was assumed that the materials generated under this alternative would be non-hazardous and subject to treatment at ESMI's LTTD facility in Fort Edward, New York. Actual methods/processes/facilities for handling removed riverbed materials, water generated during implementation, and selection of final disposal facilities would be determined during remedial design based on pricing/availability and profile of the dredged riverbed materials. All materials would be disposed of in accordance with applicable rules and regulations. It has also been assumed that water generated during construction activities would be treated and subsequently discharged to the Mohawk River.

- Following completion of dredging activities, backfilling would be performed as described for Alternative 4A. The areas of the proposed dredging and backfilling for this alternative are shown on Figure 17.

- Water column turbidity monitoring downstream of the dredging and backfilling area would be conducted during construction activities to monitor the effectiveness of the sheetpile and silt curtain systems. Based on monitoring results, dredging/backfilling activities may be modified (e.g., slowed or halted) or additional measures implemented (e.g., placement of an additional silt curtain) until acceptable turbidity levels (to be determined during the remedial design and approved by the NYSDEC) are achieved.

7.7.2.1 Compliance with SCGs

Chemical-Specific SCGs

Chemical-specific SCGs discussed in Subsection 7.7.1.1 above are also applicable to this alternative

The NYSDEC's performance specification of 4 ppm PAH in the upper 2 feet of riverbed materials may also apply, although as described under Site-wide Alternative B (Section 7.3.2.1), the application of this specification is questionable. While this goal could be met in the short term within Area 4, it is unlikely that 4 ppm PAH could be consistently maintained over the long term in Area 4 due to the impact of ongoing upstream sources of PAHs that range as high at 80.9 ppm.

Action-Specific SCGs

Action-specific SCGs that may apply to this alternative are the same as apply to Alternative 4A, with the addition of action-specific SCGs associated with the removal and treatment of water generated as a result of implementing this alternative relate to the management and the discharge/disposal of this water. As stated above, for the purposes of this RAR, the assumed disposal option for generated water is onsite pretreatment followed by discharge to the Mohawk River. Applicable SCGs could be met through appropriate design of a water treatment system.

Location-Specific SCGs

Location-specific SCGs that may apply to this alternative are the same as apply to Alternative 4A, with the addition of location-specific SCGs related to the placement of the backfill in the SD-11 and SD-12 area. Consideration must be given to maintaining the minimum depth requirement for the navigation channel and the need to address concerns related to infilling of waterways. The backfill would be designed such that the riverbed is restored to its pre-remedy bathymetric and substrate conditions, or in some cases, to a slightly lower pre-remedy bathymetric and substrate conditions to provide the minimum depth required to maintain the navigation channel.

7.7.2.2 Overall Protection of Human Health and the Environment

The overall protection of human health and the environment would be the same in Alternative 4B as in Alternative 4A. Additional removal activities proposed at SD-11 and SD-12 would not be expected to provide additional benefits, and in fact, would unnecessarily complicate implementation. Current data indicate that surficial PAH concentrations in this area are already well below background levels as the surficial concentration at T15-100 (near SD-12) was 1.6 ppm in 2002 (below the NYSDEC's performance specification). It is unlikely that removal activities could improve the situation in the area of SD-11 and SD-12, and are more likely to result in increased risk associated with work-related incidents.

7.7.2.3 Short-Term Effectiveness

Removal in the wet within the SD-11 and SD-12 area presents additional short-term impacts, including the potential for releases of Site-related constituents to the surface water during implementation of remedial activities. Reasonable and appropriate controls (e.g., temporary sheetpiling, silt curtains) would be implemented to mitigate releases to the surface water during implementation activities. The overall control measures would be augmented by performing turbidity monitoring during dredging and backfilling activities to document downstream observations of suspended solids. Based on the monitoring results, production rates, dredging/backfilling techniques, and mitigative measures may need to be modified or augmented during the implementation program.

In addition, there would be temporary disruption to river-related activities in the area targeted for dredging; however, by conducting the removal during the winter non-navigation season, the disruption would be minimal. There would be additional truck traffic in the area associated with transporting removed materials offsite and delivering backfill/cap materials. Since the removal volume is relatively small (700 cy), the number of trucks necessary would be minimal, and impacts to neighboring communities (i.e., noise, increased potential for

accidents) is anticipated to be manageable. Further, the necessary time period for active remediation is estimated to be 20 days, so the impacts would not occur over an extended period of time.

In general, during dredging and backfilling/capping operations, potential health risks to remediation workers and the community would be mitigated through the use of appropriate health and safety practices (29 CFR Part 1910.129) and by compliance with the project-specific HASP. Special consideration would have to be given to the risks associated with working on the river in the winter (e.g., cold temperatures, "flashy" water velocities, and ice formation/movement).

7.7.2.4 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence for this alternative would be the same as for Alternative 4A with the exception of issues associated with removal/backfilling of the SD-11 and SD-12 area.

Removing 200 cy of impacted materials from the SD-11 and SD-12 area may not be effective over the long term, and several issues could compromise its permanence. Removal in this area would have to occur in the wet, as there is no underlying confining unit present to key in a vertical barrier wall and permit removal in the dry. As a result, PAH-bound solids would likely be resuspended during removal, although containment systems would be in place to mitigate downstream transport to the extent possible. Considering that surficial PAH concentrations in the are low (5.5 ppm at T15-75 and 1.6 ppm at T15-100), it is unlikely that dredging in the wet would result in lower concentrations over the long term.

7.7.2.5 Reduction of Toxicity, Mobility, and Volume through Treatment

These issues are the same for Alternative 4B as for Alternative 4A.

7.7.2.6 Implementability

The excavation and backfilling activities associated with removal in Area 4 are proven technologies that have been implemented at other sites to address impacted riverbed materials. Implementability issues associated with the Area 4 activities are the same as described under Alternative 4A. Removal at the SD-11 and SD-12 area presents a number of additional implementability issues, including:

- Removal in the wet during the winter would present issues associated with the "flashiness" of surface water velocities and water depth, ice formation and movement, and cold temperatures. All these issues would complicate implementation and increase risk.

- The presence of cobbles, rocks, and debris across the riverbed surface in the area would pose challenges for mechanical or hydraulic dredging equipment. Rocks and debris would likely render hydraulic equipment ineffective and can prevent mechanical clamshells from closing and cause dredged materials to leak out of the bucket.

- Dredging in the navigation channel could cause disruption to river activities, and final navigation depths would have to be achieved after capping/backfilling the area.

7.7.2.7 Cost

The estimated costs associated with Alternative 4B are presented in Table 14. The total estimated capital cost for implementation of this alternative is $1,000,000. There are no annual O&M costs for this alternative. The total estimated 30-year present worth cost associated with implementation of Alternative 4B is $1,000,000.

The primary elements of the cost associated with implementation of Alternative 3B include:

- staging/access area development and restoration;
- temporary sheetpile around the removal area; and
- removal, dewatering, transport, and disposal of approximately 700 cy of riverbed materials.

Assumptions related to the costs are described in Table 14.

7.7.3 Comparative Analysis of Area 4 Alternatives

Two remedial alternatives were evaluated for Area 4, which is identified as an area east of the terminal wall. As presented above, these two remedial alternatives include:

- **Alternative 4A** – Removal of Area 4 to 4 feet, Backfill of the Excavated Area; and

- **Alternative 4B** – Removal of Area 4 to 4 feet, Removal Around SD-11 and SD-12, and Backfill of the Excavated Areas.

A comparative analysis of the remedial alternatives identified for Area 4 is provided below using the seven NYSDEC/NCP evaluation criteria.

7.7.3.1 Compliance with SCGs

Both alternatives would be expected to achieve the applicable chemical-, action-, and location-specific SCGs in Area 4, including the NYSDEC's performance specification of achieving a PAH concentration of less than 4 ppm in the upper 2 feet of riverbed materials. Continued compliance with a 4 ppm total PAH performance standard, however, may not be possible, due to deposition of river-transported materials from upstream locations where non-MGP related PAHs have been found in concentrations well in excess of 4 ppm.

7.7.3.2 Overall Protection of Human Health and the Environment

Both alternatives would be expected to provide overall protection of human health and the environment in Area 4 with minimal issues, and when carried out in conjunction with the Alternatives for Areas 1 through 3 and installation of the barrier wall, would contribute to the attainment of the RAOs for the Site. The additional activities proposed as part of Alternative 4B would not enhance overall protection in either Area 4 or across the Site as a whole. Instead, dredging in the wet in the navigation channel outside the boundary of Area 4

introduces issues associated with implementability, short-term impacts, long-term effectiveness, and increased cost that do not justify the additional effort at the SD-11 and SD-12 area. Current data indicate that surficial PAH concentrations in this area are already well below the total PAH concentration observed in some upstream sample locations. There does not appear to be any technical justification for expanding the scope of activities beyond the boundary of Area 4, as proposed in Alternative 4B.

7.7.3.3 Short-Term Effectiveness

The short-term impacts associated with removal in the dry of 500 cy of impacted riverbed materials from Area 4 would be the same for either Alternative 4A or 4B. Removal in the wet at the SD-11 and SD-12 area included as part of Alternative 4B would introduce a number of additional short-term impacts (resuspension and the potential for downstream transport, destruction of the benthic environment at SD-11 and SD-12, and increased truck traffic) and would take longer to implement (20 days for Alternative 4B compared to 10 days for Alternative 4A).

7.7.3.4 Long-Term Effectiveness and Permanence

Removal and backfill activities proposed in both Alternatives 4A and 4B for the entire 0.1-acre Area 4 are expected to be effective over the long term and provide a permanent solution in this area. Removal and backfilling of riverbed materials at SD-11 and SD-12 are not expected to enhance the performance of Alternative 4A, since PAH concentrations in this area are already well below background levels.

7.7.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

There is no difference in the between Alternatives 4A and 4B with regard to overall reduction of toxicity, mobility, and volume through treatment.

7.7.3.6 Implementability

Alternatives 4A and 4B do not present any significant implementability issues, and all necessary equipment and skilled labor should be readily available. Implementation of the additional removal activities contemplated as part of Alternative 4B present a host of issues associated with removal in the wet in the navigation channel in the winter that do not appear to be justified by any associated improvement in long-term effectiveness, permanence, or overall protection.

7.7.3.7 Cost

The following table summarizes the estimated costs associated with each of the alternatives for Area 4.

Remedial Alternative	Estimated Capital Costs (Rounded)	Estimated Annual O&M Costs (Rounded)	Estimated Present Worth of O&M Costs (Rounded)	Estimated Total Cost (Rounded)
4A – Removal of the 0.1-Acre Area to 4 feet, and Backfill of the Excavated Area	$410,000	$0	$0	$410,000
4B – Removal of the 0.1-Acre Area to 4 feet, Removal Around SD-11 and SD-12 to Achieve NYSDEC "Sediment" Performance Specification, Backfill of the Excavated Areas, and Monitoring	$1,000,000	$0	$0	$1,000,000

As summarized in the above table, the total cost associated with implementing Alternative 4A is less than half that of implementing Alternative 4B.

8. Conclusions and Recommended Remedy

This section presents a summary of this Remedial Action Report (RAR), and describes the recommended remedy for the Site. The recommended remedy is an overall approach that would collectively satisfy the remedial action objectives (RAOs), support use of the Site as a public recreation area, and provide necessary access to the public highway (State Route 30 bridge). As requested by NYSDEC, this section also provides information to support the NYSDEC's publication of a notice in the Environmental Notice Bulletin regarding the public's opportunity to submit comments on the proposed remedy for the Site. The notice is a requirement set forth in Paragraph I.D.4 of the VCA.

8.1 RAR Purpose and Scope

This RAR, developed on behalf of Niagara Mohawk, presents a detailed and comparative evaluation of potential remedial alternatives that may be implemented for the Phase II Area of the Park and the Mohawk River near the Park to address conditions related to MGP materials. The evaluation of the potential remedial alternatives was performed in accordance with the November 25, 1999 VCA (Index Number: D4-0001-99-03) between the NYSDEC and the Volunteers: Niagara Mohawk, the NYSDOT, and the NYSCC.

The purpose of this RAR is to identify and evaluate potential Site-specific remedial alternatives that are protective of human health and the environment, and consistent with applicable rules and regulations. Moreover, this report provides a mechanism for the NYSDEC, the other Volunteers (NYSDOT and NYSCC), the City, and the public to review/comment on the proposed remedial alternatives at a conceptual level prior to development of the Remediation Work Plan (RWP), which is a detailed remedial design document required by the VCA. This RAR is not a requirement of the VCA; however, due to the complexity of the Site and the number of parties involved, the NYSDEC and the Volunteers agreed that this report was necessary as an interim submittal to facilitate and streamline the development of the RWP.

Development of the details and information in this report has been a collaborative and multi-step process involving the Volunteers, the NYSDEC, and the City that has included a number of meetings, conference calls, and submittals/correspondence, as detailed in this report and the cited references. In general, the remedial alternatives identified and evaluated herein are those presented in Niagara Mohawk's draft December 2003 Remedial Alternatives Development Document (RADD) and the NYSDEC's December 19, 2003 letter to Niagara Mohawk, which included comments on the RADD.

8.2 RAR Basis

The basis for this RAR is the information obtained from a series of investigation and data assessment activities. As detailed in Section 2, a number of investigation programs have been completed since 1999, beginning with the Preliminary Site Assessment (PSA) conducted by Harza (on behalf of the NYSDOT). The PSA was conducted subsequent to the discovery of subsurface impacts in 1998.

Subsequent to the PSA, Niagara Mohawk performed an Interim Remedial Measure Investigation (IRMI) and then completed an IRM (July 1999 to January 2000) to remediate a portion of the Park. After substantial completion of the IRM, additional construction work for the Phase I Area of the Park recommenced on September 5, 2000. The official opening for this portion of the Park was held on June 15, 2001. An extensive investigation and evaluation of the Phase II Area and the adjacent Mohawk River was conducted by Niagara

Mohawk between November 1999 and December 2001, followed by additional field data collection and technical data assessment activities in 2003 to support the development and evaluation of the remedial alternatives for the Site.

8.3 Identification and Evaluation of Remedial Alternatives

The identification and evaluation of alternatives for the Site has been a multi-step process due to the complexity of the Site and the number of parties involved. Initially, Niagara Mohawk presented potentially applicable technology management options (TMOs) to the NYSDEC in the August 2003 updated outline for this RAR (Morgan, 2003e). The NYSDEC approved this outline, including the TMOs, in a September 9, 2003 letter to Niagara Mohawk (Spellman, 2003c). Based on the NYSDEC-approved RAR outline and TMOs, Niagara Mohawk developed a draft RADD, which presented a preliminary screening of potential remedial TMOs and identified the proposed remedial alternatives. Submittal of the RADD was followed by a December 10, 2003 Project Team Meeting, as well as a number of conference calls, communications, and a Site meeting on March 19, 2004. As agreed during those conference calls and presented in Niagara Mohawk's March 12, 2004 letter to the NYSDEC, the remedial alternatives identified and evaluated herein are (in general) those presented in Niagara Mohawk's draft December 2003 RADD and the NYSDEC's December 19, 2003 letter to Niagara Mohawk commenting on the RADD.

In Section 7, the identified remedial alternatives are described in detail and evaluated with respect to the following NCP criteria specified by NYSDEC in TAGM No. 4030 (which incorporates the NCP by reference):

- Compliance with SCGs;
- Overall protection of human health and the environment;
- Short-term effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Implementability; and
- Cost.

These criteria are consistent with evaluation factors required by the VCA and set forth in 6NYCRR Part 375-1.10(c), with the exception (absence) of Community Acceptance. The community acceptance assessment will be completed by NYSDEC after issuing a notice in the Environmental Notice Bulletin regarding the public's opportunity to submit comments on the proposed remedial activities for the Site.

In addition to the individual assessment of each of the remedial alternatives, a comparative analysis of the remedial alternatives developed for each targeted area is provided, except for Area 1, where only one alternative was identified. In Section 7, the Site-wide alternatives are considered first, followed by an assessment of the alternatives developed for each of the four specific areas identified in Section 4. The comparative analysis identifies the advantages and disadvantages of each alternative relative to one another and with respect to the seven NYSDEC/NCP criteria. The results of the comparative analyses provide the basis for the recommended remedy for the Site, described below.

8.4 Recommended Remedy for the Site

The recommended remedy for the Site is an overall approach that would effectively address MGP-related materials in both Phase II Area and the adjacent Mohawk River. It would achieve the best balance of the seven NYSDEC/NCP evaluation criteria, provide overall protection of human health and the environment, enhance the future use of the Site as a public recreation area, and support use of the Site for access to the Route 30 bridge. The primary components of the remedy include:

- Installation of a barrier wall along the winter low-water line adjacent to the Phase II Area, connected to a perimeter barrier wall around the eastern, western, and potentially northern boundaries of the Phase II Area;
- Placement of backfill behind the low-water barrier wall to support the grade of the Phase II Area;
- Installation of NAPL collection wells along the interior southern and eastern sides of the barrier wall and downgradient of and/or near Former Gas Holder No. 1;
- Excavation of MGP-related material from the Phase II Area, and installation of a multi-layered engineered cap across the entire approximately 2.1-acre area;
- Focused removal of riverbed materials from transect sampling location T-7-50 in the River;
- Removal of riverbed materials from the approximately 0.1-acre area at the eastern end of the terminal wall;
- Monitored natural recovery throughout the portion of the Mohawk River included as part of the Site;
- Institutional controls generally consisting of non-intrusive, legal and/or administrative controls that reduce the potential exposure to MGP-impacted materials and prohibit the use of the Site for other than its contemplated uses. These are a requirement of the VCA; and
- Long-term monitoring to assess and document the effectiveness and performance of the remedy.

These elements are drawn from Site-wide Alternative A, the Area 1 Alternative, Alternative 2A, Alternative 3B, and Alternative 4A, as described in Section 7; however, it is important to note that the overall remedy is an integrated approach developed for the Site as a whole. The total estimated (rounded) cost for the recommended remedy is $14,000,000[6].

As detailed in Section 7, assumptions have been made for RAR cost estimating purposes due to uncertainties regarding a number of issues, including final grade and other details for development of the Park. One of those cost assumptions consistently used for each of the alternatives is that the entire volume of any removed material would be treated/disposed offsite. This is a conservative assumption consistent with USEPA and NYSDEC guidance for estimating remedial alternative costs, however, the excavated materials not observed to contain NAPLs or tars could be used as onsite backfill in deeper areas of the Site (e.g., behind the barrier wall or inside Former Gas Holder No. 2, if excavated). This is consistent with the NYSDEC-approved IRM conducted by

[6] Pre-design investigations will be completed within the limits of Former Holder No. 2 to assess the volume of NAPL containing soils/debris within the holder and immediately below the holder floor. If significant volumes of NAPL containing soil/debris are found to be present within and immediately below the holder, removal of the holder contents, holder floor, and the soil immediately below the holder will completed. The additional estimated capital costs associated with this action is $1,6 00,000.

Niagara Mohawk in the Phase I Area and would reduce the estimated costs. The requirements for reuse of removed material would be determined during the design process based on engineering considerations for the remedial components and the Park construction, in addition to the requirement that backfill materials not contain NAPL and coal tars based on visual observation during remedial construction.

8.5 Benefits of the Recommended Remedy

The recommended remedy for the Site would result in a number of significant Site-wide improvements, provide long-term protection of human health and the environment, and support desired future uses of the Site. The primary benefits of the remedy include the following:

1) Mitigate the potential for NAPL discharge from the Phase II Area to the Mohawk River through installation of a barrier wall.

2) Mitigate potential exposure by the general public/visitors by placement of a cap and vapor control system in the Phase II Area.

3) Eliminate potential human or fish/wildlife exposure to NAPL potentially migrating to or currently present in the riverbed materials located between the high and low water lines, through installation of a low-water barrier wall and isolation beneath up to 20 feet of backfill.

4) Result in a current maximum total PAH concentration of 38.5 ppm and an average total PAH concentration of 17.6 ppm for the 0 to 2 foot interval of Area 3 after installation of the proposed barrier wall and focused removal at transect sampling location T-7-50. This resulting average concentration is well below the background maximum concentration of 80.9 ppm total PAHs, thereby achieving the goals of preventing human and fish/wildlife exposure to materials containing Site-related constituents at concentrations above background. Continued natural attenuation/recovery processes are anticipated to further reduce the current concentrations in the River to the extent possible considering the ongoing input of PAHs from upstream background sources unrelated to the Site.

5) Contain approximately 70% more soil containing NAPL by placing the barrier wall at the low-water line (as opposed to the top-of-bank) while avoiding the significant concerns associated with the design of an effective seal between the cap liner and barrier walls proposed with Site-wide Alternative C. Backfilling behind the low-water barrier wall to the grade of the Phase II Area would also eliminate the potential for future human or fish/wildlife exposure to NAPLs that could migrate upward through an engineered cap installed between the low- and high-water lines to the restored riverbank/bed materials if the seal(s) were to leak.

6) Meet the substantive requirements of USACE and NYSDEC permits required for installation of the barrier wall. Compliance with these requirements would be achieved (in general) by implementing a design that would minimize disturbance to the Mohawk River and maintain the navigation channel. The existing habitat provided by the riverbank materials, boulders, and debris present between the low water line and the top of the Phase II Area riverbank would be lost as a result of barrier wall placement and backfilling however, the current habitat between the high- and low-water lines is of questionable quality. Performance of a habitat restoration program in a nearby reach of the River would likely provide higher quality, less transient habitat to compensate for expected losses that would occur as a result of remedy implementation.

7) Reduce the toxicity, volume, and mobility of MGP-related materials through treatment by implementing a long-term NAPL recovery program and removing MGP-related materials to allow for installation of the multi-layer engineered cap and Park development. Additionally, the contents and bottom of Former Gas Holder No. 2 may also be removed, depending on the results of predesign investigations within the former holder, as requested by the NYSDEC. The overall benefit of this removal is questionable given the results of the investigation activities indicating the presence of debris in the holder that appears to be relatively non-impacted, except for the bottom 1.5 feet of the holder contents which was identified as containing "free-product." Removal and treatment/disposal of the holder contents and floor is estimated to cost approximately $1.6 million; $350,000 of which is for removal/disposal of the holder floor (which is most likely stone or brick) and 1 foot of soil below the holder floor.

8) Offer the best potential for completion during the anticipated timeframe (November 2005 – April 2006). The cap installation, however, may be more appropriately completed and/or finished during initial Park development activities, pending status and schedule for the Park construction.

9) Provide the least long-term operation and maintenance requirements.

10) Provide numerous community benefits that would have a direct positive impact on the social and economic climate for those near the waterfront. Those benefits would include (but may not be limited to):

- significantly increasing the Phase II portion of the park by approximately 45% (0.8 acres);
- increasing the waterfront docking (an additional 4+ slips);
- increasing the useable pedestrian area of the Phase II Area by 20,000 square feet (approximately 0.5 acres);
- providing sufficient space for installation of a sound barrier along north side of Phase II Area;
- providing a safer and more stable river edge (an even engineered surface [similar to the eastern terminal wall] vs. the current irregular, steep slope covered with heavy rip-rap);
- increasing the potential seating capacity for the Phase II Amphitheater by approximately 300 people (relative to an Amphitheater in a smaller Phase II Area); and
- increasing the viability of an interpretive center along the north side of the Phase II Area as a result of the additional available area.

This overall remedial approach is designed to provide overlapping and synergistic remedial benefits across the entire Site. For example, installation of the barrier wall at the low water line provides for greater control of NAPL-containing soils in the subsurface and control of potentially mobile NAPL behind the wall, concurrently isolates the more heavily impacted riverbed materials from the river environment under 20 feet of backfill, and provides opportunities for enhanced public use of the area and expanded River access. Installation of the barrier wall would also mitigate the potential discharge of NAPL to the Mohawk River (if any is occurring under existing conditions), contribute to further reductions in constituent concentrations and enhanced natural recovery of the River in Area 3, and mitigate potential future impacts to Area 4 at the downstream end of the existing terminal wall. Further, implementation of the remedy as one overall remedial program is anticipated to result in

some construction efficiencies. Because of the size of the Site and the extent of anticipated remedial activities, scheduling will be an important component of this project.

8.6 Anticipated Remediation Schedule

The anticipated remedial construction schedule is November 2005 through April 2006, a time period when the Park is closed. It is possible, however, that the installation of the multi-layer engineered cap over the Phase II Area may be completed at a later date in conjunction with the Park development activities. While working during the winter could lead to complications or delay due to cold temperatures and ice flow conditions, conducting the shoreline barrier wall installation and backfilling activities while the River water elevation is drawn down should simplify implementation. The potential exists for subsurface cobbles/boulders present beneath the Site to interfere with conventional sheetpile wall construction techniques and extend implementation time. Therefore, a pre-design investigation would be conducted along/near the proposed alignment of the barrier wall to obtain geotechnical and other data necessary for the design. Using these data, as well as existing data, the most appropriate barrier wall type(s) and installation techniques would be determined during detailed design. The pre-design investigations would also be used to assess the value/need to remove the contents of Former Holder No. 2 during the early stages of remedial design, thereby providing flexibility early in the design process, if it is determined that removal is required.

Once the recommended remedial alternatives for the Site have been agreed upon by NYSDEC and the Volunteers, Niagara Mohawk will commence the pre-design investigation and preparation of the RWP concurrent with the public comment period to continue moving this project forward. As defined in the VCA, the RWP will specify the remedial actions to be implemented by Niagara Mohawk to address onsite and offsite conditions to the extent that such conditions have been determined to require remediation and have not been addressed through the prior implementation of IRMs. The work plan will include the means by which each element of the selected remedial alternatives will be implemented along with "biddable quality" documents for the remedial design.

9. References

ATSDR. 1997. *Toxicological Profile for Cyanide (Draft).* U.S. Department of Health and Human Services, Public Health Service, Atlanta, Georgia.

Atlas et al., 1981: Atlas RM, Beohm PD, Calder JA (1981) Chemical and biological weathering of oil from the Amoco Cadiz spillage, within the littoral zone. Estuary Cstl Shelf Sci 12:589-608

BBL. 2003. *Final Engineering Report, Riverlink Plaza Area, Interim Remedial Measure.* February 2003.

BBL. 2002. *Mohawk River Investigation Summary Report, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site.* May 2002.

BBL. 2001. *Phase II Area Investigation Report, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site.* December 2001.

BBL. 1999a. *Draft Interim Remedial Measure Investigation Work Plan, Greater Amsterdam Riverlink Park.* March 1999.

BBL. 1999b. *Preliminary Interim Remedial Measure Investigation Report, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site.* June 1999.

BBL. 1999c. *Interim Remedial Measure Work Plan, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site.* June 1999.

BBL. 1999d. *Draft Investigation Work Plan, Phase II Area, Greater Amsterdam Riverlink Park, Amsterdam (Front Street) Former MGP Site.* October 1999.

Brenner et al., 2002. See Page 5-5.

Dergosits, J.R., NYSCC. 2003. Letter to G.M. Thomas, BBL re: comments on proposed alternative. November 24, 2003.

GE. 2000. Appendix B, *Comments of General Electric Company on the Feasibility Study and Proposed Plan for the Hudson River PCBs Superfund Site.* December 2000.

Ghosh, R.S., D.A. Dzombak, R.G. Luthy, and D.V. Nakles. 1999. "Subsurface Fate and Transport of Cyanide Species at a Manufactured Gas Plant Site". *Water Environ. Res.*, v. 71, no. 6, pp. 1205-1216.

Harza. 1999a. Preliminary Site Assessment of the Amsterdam Riverlink Park, Amsterdam, New York. Prepared for the NYSDOT Region 2. February 1999.

Harza. 1999b. *Sediment Sampling Report for the Amsterdam Riverlink Park, Amsterdam, New York.* July 1999.

McDonald, M.G. and A.W. Harbaugh. 1988. A modular, Three-Dimensional, Finite-Difference Groundwater Flow Model, USGS Techniques of Water Resource Investigations (Book 6).

Morgan, J.F., Niagara Mohawk. 2003a. Letter to J. Spellman, NYSDEC re: response to NYSDEC's comments on the RAR outline. February 27, 2003.

Morgan, J.F., Niagara Mohawk. 2003b. Letter to J. Spellman, NYSDEC re: areas to be considered in the RAR. February 28, 2003.

Morgan, J.F., Niagara Mohawk. 2003c. Letter to J. Spellman, NYSDEC re: areas in the Mohawk River to be considered in the RAR. March 14, 2003.

Morgan, J.F., Niagara Mohawk. 2003d. Letter to J. Spellman, NYSDEC re: additional data collection activities in the Mohawk River. June 20, 2003.

Morgan, J.F., Niagara Mohawk. 2003e. Letter to J. Spellman, NYSDEC re: proposed project schedule and updated RAR outline. August 12, 2003.

Morgan, J.F., Niagara Mohawk. 2003f. Letter to J. Spellman, NYSDEC re: follow up to conference calls and letters, September 12, 2003.

Morgan, J.F., Niagara Mohawk. 2003g. Letter to J. Spellman, NYSDEC transmitting Remedial Alternatives Development Document. December 3, 2003.

Neff et al. 2001. See Page 6-28.

NYSDEC. 2003. TOGS 5.1.9, *Draft In-Water and Riparian Management of Sediment and Dredge Material*, January 2003.

NYSDEC. 2002. TAGM No. 4061, *Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants*. January 11, 2002.

NYSDEC. 1999a. *Technical Guidance for Screening Contaminated Sediment*. January 1999.

NYSDEC. 1999b. *Voluntary Cleanup Agreement*. November 26, 1999.

NYSDEC. 1998. TOGS 1.1.1, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*. June 1998.

NYSDEC. 1994. TAGM No. 4046, *Determination of Soil Cleanup Objectives and Cleanup Levels*. January 24, 1994.

NYSDEC. 1990. TAGM No. 4030, *Selection of Remedial Actions at Inactive Hazardous Waste Sites*. May 15, 1990.

NYSDEC. 1989. TAGM No. 4031, *Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites*. October 27, 1989.

NYSDEC. Date Unknown. *MGP Remediation Strategy*.

Pastorok, R.A., C. Noftsker, T.J. Iannuzzi, D.F. Ludwig, R.C. Barrick, M.V. Ruby, and D.F. Bodishbaugh. 2000. "Natural Remediation of Polynuclear Aromatic Hydrocarbons and Other Petroleum Hydrocarbons" in *Natural Remediation of Environmental Contaminants: Its Role in Ecological Risk Assessment and Risk Management* (M. Swindoll, R.G. Stahl, S.J. Ells, eds.). Society of Environmental Toxicology and Chemistry.

Renholds, J. 1998. *In Situ Treatment of Contaminated Sediments*. Prepared for USEPA Office of Solid Waste and Emergency Response, Technology Innovation Office, Washington, D.C. December 1998.

Spellman, J., NYSDEC. 2003a. Letter to S.P. Stucker, Niagara Mohawk re: comments on RAR outline. January 17, 2003.

Spellman, J., NYSDEC. 2003b. Letter to J.F. Morgan, Niagara Mohawk re: approval of areas in Mohawk River to be considered in the RAR. June 19, 2003.

Spellman, J., NYSDEC. 2003c. Letter to J.F. Morgan, Niagara Mohawk re: comments on the revised RAR outline. September 9, 2003.

Spellman, J., NYSDEC. 2003d. Letter to J.F. Morgan, Niagara Mohawk re: comments on the RADD. December 19, 2003.

Spellman, J., NYSDEC. 2002a. Letter to S.P. Stucker, Niagara Mohawk re: the Mohawk River Summary Report and preparation of the Remediation Work Plan. August 26, 2002.

Spellman, J., NYSDEC. 2002b. Letter to S.P. Stucker, Niagara Mohawk re: alternatives evaluation. October 3, 2002.

Spellman, J., NYSDEC. 2002c. Letter to S.P. Stucker, Niagara Mohawk re: RAR schedule and approval of RAOs. November 7, 2002.

Spellman, J., NYSDEC. 2001. Letter to S.P. Stucker, Niagara Mohawk re: approval of the Phase II Area Investigation Summary Report. May 14, 2001.

(None of these Stucker docs were found referenced in the text):

Stucker, S.P., Niagara Mohawk. 2002a. Letter to J. Spellman, NYSDEC re: September 9 call and comments on NYSDEC's August 26 letter. September 24, 2002.

Stucker, S.P., Niagara Mohawk. 2002b. Letter to J. Spellman, NYSDEC re: comments on NYSDEC's October 3 letter. October 21, 2002.

Stucker, S.P., Niagara Mohawk. 2002c. Letter to J. Spellman, NYSDEC transmitting draft outline for RAR. December 10, 2002.

Stucker, S.P., Niagara Mohawk. 2002d. Letter to J. Spellman, NYSDEC, J.R. Dergosits, NYSCC, and J.L. Hewitt, NYSDOT re: RAO-related comments on NYSDEC's October 3 letter. November 1, 2002.

Stucker, S.P., Niagara Mohawk. 2002e. Letter to J. Spellman, NYSDEC transmitting Draft Mohawk River Investigation Summary Report. May 3, 2002.

Stucker, Steven P., Niagara Mohawk. 2002f. Letter to John Spellman, NYSDEC re: response to NYSDEC's August 26, 2002 letter. September 24, 2002.

Stukey, G., NYSDOT. 2003. E-mail to G.M. Thomas, BBL re: comments on proposed alternative. November 17, 2003.

USDA. 1997. New *York – Guidelines for Urban Erosion & Sediment Control*, April 1997.

USEPA. 2003. *Site Summary Sheet - Gulf States Utilities*.

USEPA. 2002. *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*. OSWER Directive 9285.6-08. February 12, 2002.

USEPA. 2000. *A Resource for MGP Site Characterization and Remediation: Expedited Site Characterization and Source Remediation at Former Manufactured Gas Plant Sites*. EPA/542/R-00/005. July 2000.

USEPA. 1998a. *EPA's Contaminated Sediment Management Strategy*. EPA/823/R-98/001. April 1998.

USEPA. 1998b. *Evaluation of Subsurface Engineered Barriers at Waste Site*. EPA 542 R-98 005. Office of Solid Waste and Emergency Response (OSWER). August 1998.

USEPA. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. EPA/540/G-89/004, October 1988.

USEPA. 1986. *Quality Criteria for Water – 1986*. EPA/440/5-86/001. May 1986.

USEPA-ORD. 1999. *Monitored Natural Attenuation of Petroleum Hydrocarbons*. EPA/600/F-98/021. Washington D.C., Office of Research and Development, National Risk Management Research Laboratory. May 1999.

USEPA-OSWER. 1999. *Use of Monitored Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*. OSWER Directive 9200.4-17P. Washington D.C., Office of Solid Waste and Emergency Response.

USEPA-OSWER. 1993. *Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis*. OSWER Directive No. 9355.3-20. June 25, 1993.

Tables

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Niagara Mohawk, a National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Summary Screening of Technologies/Management Options for the Phase II Area

Technology/Management Option	Remedial Technology	General Description	Screening Summary
Institutional Controls	Institutional controls (e.g., land use restrictions)	Institutional controls generally consist of non-intrusive, legal, and/or administrative controls that reduce the potential exposure to manufactured gas plant- (MGP-) related materials and/or mitigate the potential for jeopardizing the integrity of a remedy.	Institutional controls, in conjunction with other technologies/management options (TMOs), are retained for further consideration for the Phase II Area.
Onsite Treatment	Destruction via chemical, thermal, and biological methods	Destruction technologies irreversibly destroy or detoxify the materials to "acceptable cleanup levels" using chemical, thermal, and/or biological methods.	Site-specific constraints (e.g., the lack of a discernable non-aqueous phase liquid [NAPL] source area, thickness of the saturated zone, widespread presence of NAPL below the water table, limited available space for treatment operations, considerable depth of MGP-impacted material, heterogeneity of the subsurface, presence of State Route 30 bridge piers and other structures, proximity to the Mohawk River, and scheduling constraints) make in-situ destruction infeasible for the Phase II Area. Additionally, in-situ destruction may alter the chemistry and bearing capacity of the soil making it infeasible for areas near the State Route 30 bridge piers and other structures. In-situ destruction is not retained for further consideration.
	Separation/treatment (i.e., flushing, in-situ thermal desorption, and soil vapor extraction [SVE])	Separation/treatment technologies separate or concentrate the constituents of interest. Flushed constituents and NAPLs are typically recovered and then treated or disposed of in accordance with applicable rules and regulations.	The same constraints discussed above make in-situ separation/treatment infeasible for the Phase II Area. In-situ separation/treatment is not retained for further consideration.
	Solidification/stabilization (S/S)	S/S processes immobilize constituents of interest within a solid mass (monolith) by injecting and mixing an immobilization agent into the soil. A variety of agents (e.g., portland cement, lime kiln dust, polymerics, and proprietary agents) have been utilized.	The same constraints discussed above, in addition to the possible increase in soil volume, make in-situ S/S infeasible for the Phase II Area. In-situ S/S is not retained for further consideration.
Removal	Excavation of MGP-impacted materials	Removal includes the physical removal of MGP-related materials (e.g., NAPL-impacted soils, MGP waste, structures, piping) for subsequent treatment and/or disposal.	The lack of a discernable NAPL source area above the water table, presence of the vast majority of the site-related MGP-impacted soil and NAPL below the water table, considerable depth of MGP-impacted material (i.e., up to 71 feet below ground surface), presence of the State Route 30 bridge piers and other structures, proximity of the Mohawk River, and the hydraulic connection between the sand-and-gravel unit and the river make removal impractical for the Phase II Area. Additionally, partial removal of MGP-related soil/debris from the Phase II Area would not meet or facilitate meeting the remedial action objectives (RAOs). Removal is retained for further consideration at the request of the New York State Department of Environmental Conservation (NYSDEC).
Engineered Containment	Capping	As a form of engineered containment, capping involves the covering or encapsulating of MGP-impacted materials with "clean" material(s) (e.g., clay, soil, asphalt, concrete, and/or a synthetic membrane) to mitigate potential exposure to Site-related constituents.	Placement of a cap over the entire Phase II Area is retained for further consideration. An engineered cap is an effective and implementable option that could be employed at the Phase II Area.

See Note on Page 2.

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Summary Screening of Technologies/Management Options for the Phase II Area

Technology/Management Option	Remedial Technology	General Description	Screening Summary
Source (NAPL) Control	Physical barriers	Physical barriers include barrier walls that restrict the movement of NAPL.	A barrier wall that encompasses the east, south, and west sides of the Phase II Area and a wall that fully encompasses the area are retained for further consideration. Three riverside wall configurations are retained for further consideration, based on the NYSDEC's December 2003 comments on the *Remedial Alternatives Development Document* (RADD).
	Hydraulic containment	Hydraulic containment includes controlling hydraulic gradients by pumping groundwater to mitigate the potential offsite migration of NAPL. Extracted groundwater and NAPL are treated or disposed of in accordance with applicable rules and regulations.	Hydraulic containment for NAPL control is not feasible for the following reasons: 1) the pumping rate due to the highly permeable sand-and-gravel unit would be impracticable, and control may not be achievable; 2) the sand-and-gravel unit is hydraulically connected to the Mohawk River; and 3) the seasonally strong gradients will affect pumping rates when the river is lowered and raised. Hydraulic containment is not retained for further consideration.
	Changing the physical properties of the NAPL via chemical, biological, and/or thermal methods	Changing the physical properties of the NAPL irreversibly changes the NAPL to "acceptable cleanup levels" using chemical, biological, and/or thermal methods.	Changing the physical properties of the NAPL is not well demonstrated and will take an indeterminate period of time to render the NAPL immobile. Site-specific constraints include the lack of a discernable NAPL source area, thickness of the saturated zone, widespread presence of NAPL below the water table, limited available space for treatment operations, considerable depth of the NAPL, heterogeneity of the subsurface, presence of State Route 30 bridge piers and other structures, and proximity to the Mohawk River. Changing the physical properties of the NAPL is not retained for further consideration.
	Density-based separation	These processes separate the NAPL from the groundwater due to differences in density, followed by removal of the NAPL. NAPL is treated or disposed of in accordance with applicable rules and regulations.	Density-based separation would not be effective because of the near neutral density of the NAPL present at the Site. Density-based separation is not retained for further consideration.
	Active or passive recovery of NAPL	Active or passive recovery of NAPL involves the removal of NAPL via vertical wells and/or collection trenches. Recovered NAPL is treated or disposed of in accordance with applicable rules and regulations.	Passive NAPL collection with offsite treatment of collected NAPL, which has been performed at the Site since April 1999, is retained for further consideration.
Groundwater Control/Treatment	Groundwater control/treatment	Groundwater control includes technologies that involve controlling discharge of MGP-impacted groundwater from the Phase II Area to the Mohawk River by actively pumping groundwater from the area. It also includes hydraulic control of groundwater behind a barrier wall. Groundwater treatment, whether in-situ or ex-situ, includes technologies that destroy constituents of interest present in groundwater or separate these constituents from the groundwater.	Groundwater control/treatment is retained for further consideration in association with installing a barrier wall to bedrock. Groundwater control/treatment is not necessary for the Phase II Area from a remediation standpoint. Note that groundwater quality within the Phase II Area is not adversely impacting the Mohawk River surface-water quality near and downstream of the Site.

Note: Shaded technologies/management options retained for further consideration.

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Screening Summary of Technologies/Management Options for the Mohawk River

Technology/Management Option	Remedial Technology	General Description	Screening Summary
Institutional Controls	Institutional controls (e.g., land use restrictions)	Institutional controls generally consist of non-intrusive, legal and/or administrative controls that reduce the potential exposure to manufactured gas plant (MGP)-impacted materials and/or mitigate the potential for jeopardizing the integrity of a remedy.	Institutional controls, in conjunction with other technologies/ management options (TMOs), are retained for further consideration for the Mohawk River.
In-Situ Treatment	Solidification/stabilization (S/S)	S/S involves the injection/mixing of binding agents (e.g., portland cement, lime kiln dust, polymers, and proprietary agents) to alter the physical and/or chemical characteristics of the MGP-impacted riverbed materials and render them unavailable for ecological/human exposure.	Methods to implement this technology that would reliably achieve the Mohawk River remedial action objectives (RAOs) have not been identified due to the Mohawk River bottom characteristics (i.e., presence of large cobbles at surface, depth of impacted materials). Additionally, no other sites have successfully implemented in-situ S/S (on a full-scale basis) to address MGP-impacted materials in riverbeds. S/S is not retained for further consideration.
	Biological/chemical treatment	Biological/chemical treatment involves the injection/mixing of microorganisms and/or nutrients (chemicals) to enhance the ongoing biodegradation process and reduce potential ecological/human exposure risks.	The same site-specific constraints discussed with respect to S/S make in-situ biological/chemical treatment not reliable, and therefore, this type of treatment is not retained.
Removal	Dredging	Dredging involves the physical removal of MGP-impacted materials from the riverbed for subsequent treatment and/or disposal. Depending on site-specific conditions, removal may be performed either through the water column (in-the-wet) using hydraulic or mechanical dredging equipment, or in-the-dry following containment and dewatering of the removal area.	The presence of debris, boulders, cobbles, and gravel in the riverbed materials may pose challenges with dredging equipment. The applicability and effectiveness of a specific removal technique would be dictated by factors that include site accessibility, water depths, removal depths, site hydrology, material composition, and the need for/extent of any subsequent treatment/disposal techniques. Achieving river-related RAOs with a removal remedy alone is not considered feasible, but this technology is retained for consideration in combination with other TMOs.
In-Situ Containment	Engineered cap	Capping involves the covering or encapsulating of MGP-impacted materials with "clean" material(s) (e.g., gravels, sand, organoclay, geotextile, membranes) and/or armoring to achieve physical, biological, and chemical isolation.	An engineered cap is an effective and implementable option. Long-term operation and maintenance (O&M) activities would be required to verify that the cap materials remain in place and are functioning as designed. An engineered cap is retained for further consideration.
	Containment	Containment involves the use of a subsurface physical barrier to restrict NAPL movement.	Barrier walls are proven in-situ containment remedies. Three riverside wall configurations are retained for further consideration, based on the NYSDEC's December 2003 comments on the *Remedial Alternatives Development Document* (RADD).
Monitored Natural Attenuation (MNA)	Monitoring of naturally-occurring processes	MNA includes the physical-chemical weathering and biological degradation processes whereby concentrations of MGP-impacted materials decrease, thus reducing the potential exposure risks to these materials. MNA would involve the collection and analysis of Site samples and/or performance of visual reconnaissance to track Site conditions over time.	MGP-related constituents are good candidates for natural attenuation. When coupled with periodic monitoring of the riverbed materials, MNA is easily implementable and is an effective means of tracking the rate and extent to which ongoing natural attenuation is achieving both river-related and site-wide RAOs. MNA is retained for further consideration.

Note: Shaded technologies/management options retained for further consideration.

Table 3

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
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Preliminary Cost Estimate for Site-Wide Alternative A

- ***Implement Institutional Controls***
- ***Wall Alternative A (includes both Phase II Area and Mohawk River barrier walls):***
  Placement of Phase II Area Perimeter Barrier Wall (960 linear feet, driven between 8 feet and 60 feet bgs)
  Placement of Barrier Wall at Low Water (Winter) Elevation (595 linear feet, driven 35 feet bgs, 25 feet above-grade)
  Placement of Material Behind Wall at Low Water (Winter) Elevation to Create Plateau (12,500 cy)
- ***Passive NAPL Monitoring/Collection***
- ***Implement Aquatic Habitat Restoration Program***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Institutional Controls	1	LS	$20,000	$20,000
2.	Pre-Design Investigation	1	LS	$200,000	$200,000
3.	Design	1	LS	$400,000	$400,000
4.	Mobilization/Demobilization	1	LS	$220,000	$220,000
5.	Traffic Control	46	day	$600	$27,600
6.	Site Security	9	week	$3,000	$27,000
7.	Support Area Development and Restoration	1	LS	$50,000	$50,000
8.	Barrier Wall System				
	- Barrier Wall Installation - Upland	16,000	SF	$50	$800,000
	- Barrier Wall Installation - Low Water	21,000	SF	$70	$1,470,000
	- Cathodic Protection	15,000	SF	$10	$150,000
	- Materials Cost (Sheeting above grade)	15,000	SF	$20	$300,000
	- Anchor Installation	37	Each	$6,000	$222,000
	- Route 30 Bridge Pier Protection	1	LS	$25,000	$25,000
9.	Silt Curtain Materials/Installation	800	LF	$100	$80,000
10.	Oil booms and absorbents	46	day	$500	$23,000
11.	Backfill - Plateau Creation				
	- Soil	12,500	CY	$20	$250,000
12.	Passive NAPL Collection Well Installation	8	Each	$10,000	$80,000
13.	Aquatic Habitat Restoration	1	LS	$75,000	$75,000
14.	Health and Safety Monitoring	9	week	$1,000	$9,000
15.	Miscellaneous Disposal	1	LS	$20,000	$20,000
				Subtotal:	$4,448,600
				Administration and Engineering (10%):	$404,860
				Contingency (25%):	$1,112,150
				Total Capital Costs:	$5,965,610
Operation and Maintenance (O&M) Costs					
16.	Annual Monitoring	1	LS	$35,000	$35,000
17.	NAPL Monitoring/Recovery	1	LS	$15,000	$15,000
				Subtotal:	$50,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$620,500
				Total Estimated Cost for Site-Wide Alternative A:	**$6,586,110**
				Total Estimated Cost for Site-Wide Alternative A (Rounded):	**$6,600,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that barrier wall installation will be coordinated with the remedial construction activities for the rest of the Site.
- All remedial activities will be performed in modified Level D protection.

Table 3

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative A

Notes and Assumptions:

1. Institutional controls cost estimate includes administrative costs associated with implementing institutional controls. As discussed in the VCA (Section XI), institutional controls for the Phase II Area include prohibiting the Phase II Area from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting the use of site groundwater without treatment, without the express written waiver of such prohibitions by the NYSDEC. Additionally, institutional controls can specify procedures to protect and maintain the integrity of a remedy and associated engineering controls (e.g., a site management plan), and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities on the Phase II Area of health and safety considerations associated with MGP-impacted materials. Institutional controls also include administrative costs associated with posting signs and methods to mitigate potential exposure. The specific scope and requirements for the institutional controls would be determined during remedial design.
2. $200,000 has been included in this cost estimate for pre-design investigation, which includes the costs for conducting activities to gather information required for the remedial design for this alternative. Pre-design investigation activities may include an evaluation of hydrodynamic conditions, an evaluation of hydrogeologic conditions, an evaluation of riverbed material geotechnical properties to facilitate an appropriate cap and dredging design, and an evaluation of soil geotechnical properties to facilitate barrier wall installation. Pre-design investigation activities may also include riverbed materials treatability studies to determine appropriate methods/processes for dewatering/stabilization and water treatment.
3. $400,000 has been included in this cost estimate for design of the remedial alternative.
4. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. Cost estimate assumes one construction season will be required to complete the project.
5. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the Site during remedial construction activities.
6. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
7. Support area development includes $50,000 for clearing staging area and preparing equipment and material for staging, storage, access, handling and decontamination areas, and construction trailers. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
8. Barrier wall cost estimate assumes a permanent stay-in-place barrier wall will be installed at the low water (winter) elevation and is assumed to be 595 linear feet by 60 feet with 35 feet driven bgs. Since a portion of the wall will be exposed to weathering conditions (25 feet), cathodic protection of the wall will be required. Additionally, to secure this cantilevered barrier wall system, anchoring (e.g., tie-backs) will be required. It has been assumed that tie-back anchoring will be approximately 25 feet long with a 1 cubic yard anchor block installed approximately every 15 linear feet along the barrier wall. State Route 30 bridge pier protection will be provided by placing additional rip rap along the pier to minimize scour/erosion following construction activities.

   For the upland barrier walls, the following assumptions have been made: 1) for the north wall, 400 linear feet with 8 feet driven bgs; 2) for the west wall, 165 linear feet with between 8 feet (at the north end) and 40 feet driven bgs (at the south end); and 3) for the east wall, 260 linear feet with between 8 feet (at the north end) and 40 feet driven bgs (at the south end). The north wall will be driven to bedrock. The side walls will be driven to the bottom of the sand-and-gravel unit or bedrock, whichever is encountered first.
9. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the permanent barrier wall.
10. Oil booms and absorbents will be used during barrier wall installation and restoration activities - 1,500 sf/10-hr day for permanent barrier wall installation, and 250 cy/10-hr day for restoration.
11. Backfill - Plateau Creation - cost is for soil at a price of $20/cy to be placed behind the barrier wall to bring final elevation near grade. The unit costs including purchase, haul, and placement of material.
12. Well installation cost estimate assumes wells would be installed at 100-foot spacing along the south and east boundaries of Area 2 to the bottom of the sand-and-gravel unit. Includes drilling, well installation (2-inch diameter PVC casing, 0.02-inch slotted screen, and sump), decontamination and waste management, well development, oversight, reporting, and survey. Cost estimate does not include repair, reinstallation, rehabilitation, or abandonment in the future.
13. $75,000 has been included in this cost estimate for aquatic habitat restoration.
14. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted as appropriate. Cost estimate assumes that control measures, if necessary, would be limited.
15. $20,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept such waste.
16. On an annual basis, $35,000 has been included in this cost estimate to perform annual monitoring associated with the observation of site conditions via use of divers and other visual reconaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
17. NAPL monitoring/recovery consists of measuring water levels and NAPL thicknesses in the new wells and removing NAPL to the extent feasible. Due to the limited amount of NAPL expected to be recovered annually, a cost of $1,000 has been assumed for the offsite transportation and treatment/disposal of recovered NAPL. It is assumed that NAPL recovery will occur once a month for twelve months a year at the wells. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA. Cost also assumed that NAPL monitoring/recovery of the newly installed wells will be incorporated into the ongoing NAPL monitoring and removal program that was initated at the Site in 1999.

Table 4

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative B

- ***Implement Institutional Controls***
- ***Wall Alternative B (includes both Phase II Area and Mohawk River barrier walls):***
  Placement of Phase II Area Perimeter Barrier Wall (960 linear feet, driven between 8 feet and 60 feet bgs)
  Placement of Barrier Wall at Top-of-Bank (525 linear feet, driven 65 feet bgs)
  Placement and Removal of Temporary Wall at Low Water (Winter) Elevation (595 linear feet, driven 45 feet bgs)
  Removal of Materials and Restore Grade (i.e., Between Top-of-Bank and Low Water - 29,200 cy)
- ***Passive NAPL Monitoring/Collection***
- ***Offsite Treatment/Disposal of Removed Materials and Recovered NAPL***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Institutional Controls	1	LS	$20,000	$20,000
2.	Pre-Design Investigation	1	LS	$150,000	$150,000
3.	Design	1	LS	$1,000,000	$1,000,000
4.	Mobilization/Demobilization	1	LS	$670,000	$670,000
5.	Traffic Control	323	day	$600	$193,800
6.	Site Security	65	week	$3,000	$193,800
7.	Support Area Development and Restoration	1	LS	$150,000	$150,000
8.	Temporary Barrier Sheetpile Installation/Removal	27,000	SF	$50	$1,350,000
9.	Barrier Wall System				
	- Barrier Wall Installation - Upland	20,000	SF	$50	$1,000,000
	- Barrier Wall Installation - Top-of-Bank	32,000	SF	$50	$1,600,000
	- Anchor Installation	38	Each	$6,000	$228,000
	- Route 30 Bridge Pier Protection	1	LS	$25,000	$25,000
10.	Silt Curtain Materials/Installation	800	LF	$100	$80,000
11.	Oil booms and absorbents	323	day	$500	$161,500
12.	Removal of Materials				
	- Mechanical Excavation/Stabilizing (land-based)	14,500	CY	$50	$725,000
	- Mechanical Dredging/Dewatering/Stabilizing	14,700	CY	$225	$3,307,500
13.	Water Treatment	590,000	gallon	$0.50	$295,000
14.	Transport and Disposal				
	- Thermal Treatment/Disposal	32,000	CY	$50	$1,600,000
	- RCRA Disposal	3,500	CY	$200	$700,000
	- Waste Characterization	108	330 CY	$2,000	$216,000
15.	Backfill/Cap				
	- Sand Layer	27,200	CY	$35	$952,000
	- Geotextile Liner	4,300	SY	$25	$107,500
	- Armor Layer	2,000	CY	$55	$110,000
16.	Passive NAPL Collection Well Installation	8	Each	$10,000	$80,000
17.	Construct Pump and Treat System	1	LS	$500,000	$500,000
18.	Health and Safety Monitoring	65	week	$1,000	$64,600
19.	Miscellaneous Disposal	1	LS	$25,000	$25,000
				Subtotal:	$15,504,700
				Administration and Engineering (10%):	$1,450,470
				Contingency (25%):	$3,876,175
				Total Capital Costs:	$20,831,345
Operation and Maintenance (O&M) Costs					
20.	Annual Monitoring	1	LS	$40,000	$40,000
21.	Operation Costs - Pump and treat System	1	LS	$75,000	$75,000
22.	NAPL Monitoring/Recovery	1	LS	$15,000	$15,000
				Subtotal:	$130,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$1,613,300
				Total Estimated Cost for Site-Wide Alternative B:	**$22,444,645**
				Total Estimated Cost for Site-Wide Alternative B (Rounded):	**$22,400,000**

Table 4

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative B

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current Site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that barrier wall installation will be coordinated with the remedial construction activities for the rest of the Site.
- All remedial activities will be performed in modified Level D protection.

Notes and Assumptions:

1. Institutional controls cost estimate includes administrative costs associated with implementing institutional controls. As discussed in the VCA (Section XI), institutional controls for the Phase II Area include prohibiting the Phase II Area from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting the use of site groundwater without treatment, without the express written waiver of such prohibitions by the NYSDEC. Additionally, institutional controls can specify procedures to protect and maintain the integrity of a remedy and associated engineering controls (e.g., a site management plan), and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities on the Phase II Area of health and safety considerations associated with MGP-impacted materials. Institutional controls also include administrative costs associated with posting signs and methods to mitigate potential exposure. The specific scope and requirements for the institutional controls would be determined during remedial design.
2. $150,000 has been included in this cost estimate for pre-design investigation, which includes the costs for conducting activities to gather information required for the remedial design for this alternative. Pre-design investigation activities may include an evaluation of hydrodynamic conditions, an evaluation of hydrogeologic conditions, an evaluation of sediment geotechnical properties to facilitate an appropriate cap and dredging design, and an evaluation of soil geotechnical properties to facilitate barrier wall installation. Pre-design investigation activities may also include sediment treatability studies to determine appropriate methods/processes for sediment dewatering/stabilization and water treatment.
3. $1,000,000 has been included in this cost estimate for design of the remedial alternative.
4. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. Cost estimate assumes one construction season will be required to complete the project.
5. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the Site during remedial construction activities.
6. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
7. Support area development includes $150,000 for clearing staging area and preparing equipment and material for staging, storage, access, handling and decontamination areas, and construction trailers. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
8. Temporary sheetpile installation/removal costs are based on installing temporary sheeting at the low water (winter) elevation with the total necessary sheeting assumed to be 595 linear feet with 45 feet driven below ground surface. It is assumed that the temporary sheeting used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor.
9. Barrier wall cost estimate assumes a permanent stay-in-place barrier will be installed at the top-of-bank assumed to be 525 linear feet by 65 feet with 60 feet driven bgs (for structural support to facilitate removal activities) The top-of-bank wall will be cut at grade. The costs associated with cutting the barrier wall at grade and disposal of the "tops" has been included with the Miscellaneous Disposal item (#19). Additionally, it has been assumed that an anchoring system will be required to secure the top-of-bank wall to facilitate removal activities. It has been assumed that tie-back anchoring will be utilized and will be approximately 25 feet long with a 1 cubic yard anchor block installed every 15 linear feet along the top-of-bank barrier wall. State Route 30 bridge pier will be provided by placing additional rip rap along and around the abutment and surrounding area to minimize scour/erosion following construction activities.

   For the upland barrier walls, the following assumptions have been made: 1) for the north wall, 400 linear feet with 8 feet driven bgs; 2) for the west wall, 165 linear feet with between 8 feet (at the north end) and 100 feet driven bgs (at the south end); and 3) for the east wall, 260 linear feet with between 8 feet (at the north end) and 50 feet driven bgs (at the south end). All three side walls will be driven to bedrock.
10. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the permanent barrier wall and the temporary sheetpile wall.
11. Oil booms and absorbents will be used during barrier wall installation and restoration activities - estimated based on production rate of 200 cy/10-hr day for land-based removal and 100 cy/10-hr day for water-based removal, 1,500 sf/10-hr day for permanent barrier wall installation, 1,000 sf/10-hr day for temporary sheetpiling installation with anchors, and 250 cy/10-hr day for restoration.

Table 4

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative B

12. Removal of materials assumes that excavation will be performed by mechanical removal in the dry (14,500 cy land-based) and in the wet (14,700 cy from a barge). A 10% bulking factor was assumed for dry materials. The costs are for removal, barging, and associated dewatering/stabilizing. For dewatering/stabilizing cost estimate, it is assumed that riverbed materials will be dewatered by removing free water from removed materials at the stockpile area at the end of each day. It is assumed 20% stabilizing agent by weight would be added to meet transportation/disposal requirements.
13. Water treatment costs are for the operation of the water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that land-based materials removal (14,500 cy) will not require water treatment. The remaining materials (approximately 14,700 cy) would be excavated via mechanical removal in the wet and would generate approximately 20% water by in-situ volume (or ~ 40 gallons of water generated per 1 cy of in-situ riverbed material).
14. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of excavated riverbed materials. The following assumptions have been made with regard to transportation and disposal of processed materials: 1) no materials will be reused onsite; 2) disposal volume includes removed in-situ materials (29,200 cy) plus stabilizing agent at 20% by weight (35,500 cy); 3) 10 percent of the riverbed materials removed will be managed as if subject to disposal as RCRA-regulated waste (3,500 cy) and will be disposed at CWM's facility in Model City, New York; and 4) the remaining riverbed materials/bank soils are assumed to be non-hazardous (32,000 cy) and will be transported to ESMI's LTTD facility in Fort Edward, New York. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
15. Backfill/Cap - the costs are for material, shipment, and placement. The following costs are assumed: 1) Sand - up to 1.5 feet below grade, 27,200 cy at $35/cy, 2) Geotextile Liner - 4,300 sy at $25/sy, and 3) Armor Layer - 1.5 feet at $55/cy. The actual components and armor layer thicknesses will be finalized during remedial design. A 10% overlap has been assumed for geotextile liner placement.
16. Well installation cost estimate assumes wells would be installed at 100-foot spacing along the south and east boundaries of Area 2 to the bottom of the sand-and-gravel unit. Includes drilling, well installation (2-inch diameter PVC casing, 0.02-inch slotted screen, and sump), decontamination and waste management, well development, oversight, reporting, and survey. Cost estimate does not include repair, reinstallation, rehabilitation, or abandonment in the future.
17. $500,000 has been included in this cost estimate for construction of an onsite groundwater pump and treat system.
18. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted. Cost estimate assumes that control measures, if necessary, would be limited.
19. $25,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept such waste. Costs to cut the permanent sheeting at grade and to dispose the "tops" is included herein at a cost of approximately $20 per linear foot.
20. On an annual basis, $40,000 has been included in this cost estimate to perform annual monitoring associated with the observation of Site conditions via use of divers and other visual reconaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
21. On an annual basis, $75,000 has been included in this cost estimate to operate the onsite groundwater pump and treat system.
22. NAPL monitoring/recovery consists of measuring water levels and NAPL thicknesses in the new wells and removing NAPL to the extent feasible. Due to the limited amount of NAPL expected to be recovered annually, a cost of $1,000 has been assumed for the offsite transportation and treatment/disposal of recovered NAPL. It is assumed that NAPL recovery will occur once a month for twelve months a year at the wells. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA. Cost also assumed that NAPL monitoring/recovery of the newly installed wells will be incorporated into the ongoing NAPL monitoring and removal program that was initated at the Site in 1999.

Table 5

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative C

- ***Implement Institutional Controls***
- ***Wall Alternative C (includes both Phase II Area and Mohawk River barrier walls):***
  Placement of Phase II Area Perimeter Barrier Wall (960 linear feet, driven between 8 feet and 60 feet bgs)
  Placement of Barrier Wall at Top-of-Bank (525 linear feet, driven 60 feet bgs)
  Placement of Barrier Wall at Low Water (Winter) Elevation (595 linear feet, driven ~75 feet bgs)
  Removal of Materials and Restore Grade (i.e., Between Top-of-Bank and Low Water - 13,350 cy)
  3-foot Removal and Placement of an Impermeable Cap between Top-of-Bank and Low Water Barrier Walls and Restore Grade (3,950 cy)
- ***Passive NAPL Monitoring/Collection***
- ***Offsite Treatment/Disposal of Removed Materials and Recovered NAPL***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Institutional Controls	1	LS	$20,000	$20,000
2.	Pre-Design Investigation	1	LS	$200,000	$200,000
3.	Design	1	LS	$850,000	$850,000
4.	Mobilization/Demobilization	1	LS	$610,000	$610,000
5.	Traffic Control	200	day	$600	$120,000
6.	Site Security	40	week	$3,000	$120,000
7.	Support Area Development and Restoration	1	LS	$200,000	$200,000
8.	Barrier Wall System				
	- Barrier Wall Installation - Upland	20,000	SF	$50	$1,000,000
	- Barrier Wall Installation - Top-of-Bank	34,000	SF	$50	$1,700,000
	- Anchor Installation	38	Each	$6,000	$228,000
	- Barrier Wall Installation - Low Water	45,000	SF	$70	$3,150,000
	- Route 30 Bridge Pier Protection	1	LS	$25,000	$25,000
9.	Silt Curtain Materials/Installation	800	LF	$100	$80,000
10.	Oil booms and absorbents	200	day	$500	$100,000
11.	Removal of Materials				
	-Mechanical Excavation/Stabilizing (land-based)	13,350	CY	$50	$667,500
	-Mechanical Dredging/Dewatering/Stabilizing	3,950	CY	$225	$888,750
12.	Water Treatment	160,000	gallon	$0.50	$80,000
13.	Transport and Disposal				
	- Thermal Treatment/Disposal	17,500	CY	$50	$875,000
	- RCRA Disposal	1,900	CY	$200	$380,000
	- Waste Characterization	59	330 CY	$2,000	$118,000
14.	Impermeable/Backfill Cap				
	- Sand Layer (Bedding Layer)	1,300	CY	$35	$45,500
	- HDPE Liner	4,300	SY	$50	$215,000
	- HDPE Attachment Layer (around perimeter)	430	CY	$50	$21,500
	- Sand Layer	14,000	CY	$35	$490,000
	- Geotextile Liner	4,300	SY	$25	$107,500
	- Armor Layer	2,000	CY	$55	$110,000
15.	Passive NAPL Collection Well Installation	8	Each	$10,000	$80,000
16.	Construct Pump and Treat System	1	LS	$500,000	$500,000
17.	Health and Safety Monitoring	40	week	$1,000	$40,000
18.	Miscellaneous Disposal	1	LS	$30,000	$30,000
				Subtotal:	$13,031,750
				Administration and Engineering (10%):	$1,218,175
				Contingency (25%):	$3,257,938
				Total Capital Costs:	$17,507,863
Operation and Maintenance (O&M) Costs					
19.	Annual Monitoring	1	LS	$50,000	$50,000
20.	Operation Costs - Pump and treat System	1	LS	$75,000	$75,000
21.	NAPL Monitoring/Recovery	1	LS	$15,000	$15,000
					$140,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$1,737,400
				Total Estimated Cost for Site-Wide Alternative C:	**$19,245,263**
				Total Estimated Cost for Site-Wide Alternative C (Rounded):	**$19,200,000**

Table 5

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative C

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current Site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that barrier wall installation will be coordinated with the remedial construction activities for the rest of the Site.
- All remedial activities will be performed in modified Level D protection.

Notes and Assumptions:

1. Institutional controls cost estimate includes administrative costs associated with implementing institutional controls. As discussed in the VCA (Section XI), institutional controls for the Phase II Area include prohibiting the Phase II Area from being used for purposes other than the contemplated use (a public recreation area and public highway) and prohibiting the use of site groundwater without treatment, without the express written waiver of such prohibitions by the NYSDEC. Additionally, institutional controls can specify procedures to protect and maintain the integrity of a remedy and associated engineering controls (e.g., a site management plan), and to inform future workers (e.g., Park maintenance crews) engaged in potential subsurface activities on the Phase II Area of health and safety considerations associated with MGP-impacted materials. Institutional controls also include administrative costs associated with posting signs and methods to mitigate potential exposure. The specific scope and requirements for the institutional controls would be determined during remedial design.
2. $200,000 has been included in this cost estimate for pre-design investigation, which includes the costs for conducting activities to gather information required for the remedial design for this alternative. Pre-design investigation activities may include an evaluation of hydrodynamic conditions, an evaluation of hydrogeologic conditions, an evaluation of riverbed material geotechnical properties to facilitate an appropriate cap and dredging design, and an evaluation of soil geotechnical properties to facilitate barrier wall installation. Pre-design investigation activities may also include riverbed materials treatability studies to determine appropriate methods/processes for dewatering/stabilization and water treatment.
3. $850,000 has been included in this cost estimate for design of the remedial alternative.
4. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. Cost estimate assumes one construction season will be required to complete the project.
5. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the Site during remedial construction activities.
6. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
7. Support area development includes $200,000 for clearing staging area and preparing equipment and material for staging, storage, access, handling and decontamination areas, construction trailers, a shoreline mooring area for loading/unloading barge and watercraft, dewatering and stabilizing facilities, and a water treatment facility. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
8. Barrier wall cost estimate assumes a permanent, stay-in-place barrier wall will be installed at the top-of-bank and is assumed to be 525 linear feet with 60 feet driven bgs (for structural support to facilitate removal activities). The permanent barrier wall to be installed at the low water (winter) elevation is assumed to be 595 linear feet with 75 feet driven below ground surface. Both walls will be cut at grade. The costs associated with cutting the barrier walls at grade and disposal of the "tops" has been included with the Miscellaneous Disposal item (#18). Additionally, it has been assumed that an anchoring system will be required to secure the top-of-bank wall to facilitate removal activities. It has been assumed that tie-back anchoring will be utilized and will be approximately 25 feet long with a 1 cubic yard anchor block installed every 15 linear feet along the top-of-bank barrier wall. State Route 30 bridge pier protection will be provided by placing additional rip rap along and around the abutment and surrounding area to minimize scour/erosion following construction activities.

   For the upland barrier walls, the following assumptions have been made: 1) for the north wall, 400 linear feet with 8 feet driven bgs; 2) for the west wall, 165 linear feet with between 8 feet (at the north end) and 100 feet driven bgs (at the south end); and 3) for the east wall, 260 linear feet with between 8 feet (at the north end) and 50 feet driven bgs (at the south end). All three side walls will be driven to bedrock.
9. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the permanent barrier walls.
10. Oil booms and absorbents will be used during permanent barrier wall instalation and restoration activities - estimated based on production rate of 200 cy/10-hr day for land-based removal and 100 cy/10-hr day for water-based removal, 1,500 sf/10-hr day for top-of-bank barrier wall installation, 1,000 sf/10-hr day for low-water barrier wall installation with anchors, and 250 cy/10-hr day for restoration.

Table 5

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Site-Wide Alternative C

11. Removal of materials assumes that "soil wedge" excavation (i.e., materials between the top-of-bank barrier wall and the low water barrier wall) can be removed from land and direct-loaded into vehicles for transportation and disposal. For riverbed material removal, it has been assumed that excavation will be performed by mechanical removal in the wet. The costs are for removal, barging and dewatering/stabilizing. For dewatering/stabilizing cost estimate, it is assumed that riverbed materials will be dewatered by removing free water from removed materials at the stockpile area at the end of each day. It is assumed 20% stabilizing agent by weight would be added to meet transportation/disposal requirements.
12. Water treatment costs are for the operation of the water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that materials removed in the dry (13,350 cy) would not require water treatment. The remaining materials (approximately 3,950 cy) would be excavated via mechanical removal in the wet and would generate approximately 20% water by in-situ volume (or ~ 40 gallons of water generated per 1 cy of in-situ riverbed material).
13. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of excavated riverbed materials. The following assumptions have been made with regard to transportation and disposal of removed materials: 1) no materials will be reused onsite; 2) disposal volume includes removed in-situ bank soils (13,350 cy) plus 10% bulking (14,700 cy) and in-situ riverbed materials (3,950 cy) plus 20% stabilizing agent by weight (4,700 cy); 3) Ten percent of the riverbank materials/bank soils removed and stabilized (19,400 cy) assumed to be managed as if subject to disposal as RCRA-regulated materials (1,900 cy) and will be disposed at CWM's facility in Model City, New York; and 4) the remaining riverbed materials/bank soils are assumed to be non-hazardous (17,500 cy) and will be transported to ESMI's LTTD facility in Fort Edward, New York. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
14. Impermeable cap - the costs include material, shipment, and placement. The following costs are assumed: 1) Sand - 0.5 foot bedding layer and placed atop HDPE liner, 1,300 cy at $35/cy, 2) HDPE Liner - 4,300 sy at $50/sy, 3) HDPE Attachment layer has assumed a bentonite layer along the top-of-bank and low water barrier walls - 3-foot by 3-foot by 1,220 linear feet at $50/cy, 4) Geotextile Liner - 4,300 sy at $25/sy, and 5) Armor Layer - 1.5 feet at $55/cy. The actual components and armor layer thicknesses will be finalized during remedial design. A 10% overlap has been assumed for HDPE and geotextile liner placement.
15. Well installation cost estimate assumes wells would be installed at 100-foot spacing along the south and east boundaries of Area 2 to the bottom of the sand-and-gravel unit. Includes drilling, well installation (2-inch diameter PVC casing, 0.02-inch slotted screen, and sump), decontamination and waste management, well development, oversight, reporting, and survey. Cost estimate does not include repair, reinstallation, rehabilitation, or abandonment in the future.
16. $500,000 has been included in this cost estimate for construction of an onsite groundwater pump and treat system.
17. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted. Cost estimate assumes that control measures, if necessary, would be limited.
18. $30,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept such waste. Costs to cut the permanent sheeting at grade and to dispose the "tops" is included herein at a cost of approximately $20 per linear foot.
19. On an annual basis, $50,000 has been included in this cost estimate to perform annual monitoring associated with the observation of Site conditions via use of divers and other visual reconaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
20. On an annual basis, $75,000 has been included in this cost estimate to operate the onsite groundwater pump and treat system.
21. NAPL monitoring/recovery consists of measuring water levels and NAPL thicknesses in the new wells and removing NAPL to the extent feasible. Due to the limited amount of NAPL expected to be recovered annually, a cost of $1,000 has been assumed for the offsite transportation and treatment/disposal of recovered NAPL. It is assumed that NAPL recovery will occur once a month for twelve months a year at the wells. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA. Cost also assumed that NAPL monitoring/recovery of the newly installed wells will be incorporated into the ongoing NAPL monitoring and removal program that was initated at the Site in 1999.

Table 6

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 1

- ***Implement institutional controls (see Table 3)***
- ***Install barrier wall (see Table 3)***
- ***Install engineered cap over 0.3-acre area***
- ***Remove MGP materials as required to install the cap***
- ***Install NAPL recovery well and perform monthly NAPL monitoring/recovery***
- ***Offsite treatment/disposal of removed materials and recovered NAPL***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs - Cap Installation					
1.	Design	1	LS	$35,000	$35,000
2.	Mobilization/Demobilization	1	LS	$4,300	$4,300
3.	Support Area Development and Restoration (See Note 3)				
4.	Excavation and Demolition for Cap Installation (Top 3 Feet)				
	- Excavation - Soil	1,100	CY	$15	$16,500
	- Demolition/Excavation - Structures	360	CY	$30	$10,800
5.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	1,400	ton	$75	$105,000
	- Hazardous Waste Landfill - Soil	450	ton	$300	$135,000
	- Nonhazardous Waste Landfill - Rubble	790	ton	$75	$59,250
6.	Waste Characterization	5	500 tons	$2,000	$10,000
7.	Draining and Capping Pipes	1	LS	$2,500	$2,500
8.	Traffic Control - CSX Flagger	15	day	$600	$9,000
9.	Cap Installation	0.3	acre	$300,000	$90,000
10.	Vegetation of Cap	0.3	acre	$3,500	$1,050
11.	Health and Safety Monitoring	3	week	$1,000	$3,000
12.	Site Security	3	week	$3,000	$9,000
13.	Stakeout, Verification, and As-built Surveys	1	LS	$2,000	$2,000
14.	Miscellaneous Disposal	1	LS	$2,000	$2,000
				Subtotal:	$494,400
Capital Costs - Installation of Additional NAPL Monitoring Well					
15.	Install NAPL Recovery Well	1	each	$10,000	$10,000
				Subtotal:	$10,000
				Subtotal:	$504,400
				Administration and Engineering (10%):	$50,440
				Contingency (25%):	$126,100
				Total Capital Costs:	$680,940
Annual O&M Costs					
16.	Cap Maintenance	1	LS	$6,000	$6,000
17.	NAPL Monitoring/Recovery	1	LS	$1,000	$1,000
				Subtotal:	$7,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$86,870
				Total Estimated Cost for Alternative:	**$767,810**
				Total Estimated Cost for Alternative (Rounded):	**$770,000**

Table 6

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 1

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs are based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when the Park is not in use (November - April).

- It is assumed that remedial construction in Area 1 will be performed in conjunction with the remedial construction in Area 2 and coordinated with the remedial construction activities for the river and barrier wall installation.
- All remedial activities will be performed in modified Level D protection.
- It is assumed to take 3 weeks for completion of the identified remedial activities.
- It is assumed that 200 cy/day of material can be excavated and transported offsite each day.

Notes and Assumptions:

1. $35,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. A 3% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization. It has been assumed that some of the labor, equipment, and materials would already be onsite for the construction activities in the remainder of the Phase II Area (which constitutes the majority of the upland area).
3. Support area development and restoration costs are included in the cost estimate for Area 2, which constitutes the majority of the Phase II Area.
4. Excavation includes removal of the top 3 feet of material in Area 1 prior to placement of the cap so that the final cap elevation will be similar to the pre-remedial elevation. It is assumed that 25% of the total excavation volume will be structure-related (e.g., walls and foundations). Removal of the top 3 feet of Former Gas Holder No. 1 includes the removal of a metal liner and sheathing that have been observed. The removal in this area will be coordinated with the NYSDOT during design/construction given the proximity of the bridge piers. It is assumed that no water management (other than implementation and maintenance of erosion and sedimentation controls) or shoring/sheeting will be needed.

5. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of excavated material (soil and rubble). The following assumptions have been made with regard to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York); and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.

6. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
7. $2,500 has been included in this cost estimate for the draining and capping of piping encountered during excavation. NAPL drained from these pipes would be treated/disposed of offsite.
8. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
9. The components of a cap include a gas venting layer, a low-permeability layer, a subsurface drainage layer, and a protective layer. The estimate also includes an anchor trench. The cap installation cost includes materials testing costs.

   - It is assumed that the redevelopment of the Park will dovetail with the design and construction of the cap, and that Niagara Mohawk will receive the City's design for the Park in time to incorporate it into the final design for the cap. Because the design of the Park is not yet finalized, a 2.5-foot thick protective soil layer with a final grade of 3±% has been assumed. The final design of the cap will incorporate the needs of the Park redevelopment, and the surface of the Phase II Area will be ready for Park construction after remedial activities are completed. Long-term stormwater management and erosion control includes drainage swales lined with erosion control mat, loose riprap, and culverts for perimeter surface water diversion.
   - The gas venting layer and subsurface drainage layer both consist of a GDC. GDC is assumed to consist of a geosynthetic drainage net with 6-oz. nonwoven geotextile (both sides). Quantity includes additional material for anchoring around the perimeter of the cap and a 5% increase for wrinkles.
   - Gas collection piping is assumed to consist of two 6-inch HDPE pipes running the full length of the capped area, west to east, with additional piping for connection to the vapor treatment system.
   - The low-permeability layer consists of a 60 mil HDPE FML. The cost assumes cold-weather installation, and the unit price has been increased over normal installation cost to account for tenting, heating, additional testing, etc. that may be required during installation. Quantity includes additional material for anchoring around the perimeter of the cap, and a 10% increase for overlap and wrinkles. Cost consists of installing a bentonite seal around the State Route 30 bridge abutment; however, the need for this seal (or other appropriate measures) will be determined during the remedial design, in conjunction with the NYSDOT. The presence of the bridge significantly reduces infiltration in this area.

   - The cap drainage layer collection system consists of slotted 6-inch HDPE collection piping with solid outlet piping (includes trenching and backfilling), crushed stone backfill, nonwoven geotextile wrap, and bentonite seal (for underlying FML) along the barrier wall. It is assumed that this system will outlet to the river.
   - Protective layer is assumed to consist of 6 inches of topsoil overlying a 24-inch general fill layer. The topsoil and general fill layers will both consist of clean imported soil. Topsoil will be placed and lightly compacted in a single lift. It is assumed that protection soil will be placed as required to achieve in-place compacted lift thicknesses of 6 inches. Estimated quantities include 10% bulking factor for shrink/swell associated with transporting, handling, and placing.

   - Cost of anchor trench excavation includes trenching along north, west, and east perimeter only (south perimeter accounted for cap drainage layer collection system). Cost also includes transport and disposal (to ESMI facility) of excavated soil. Estimated cost of transport and disposal includes 10% bulking factor.
10. After construction, the cap will be hydroseeded for erosion control.

Table 6

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 1

11. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.

12. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
13. $2,000 has been included in this cost estimate to perform an as-built survey. This does not include engineering costs associated with interpretation of survey information or development of as-built drawings (these items are covered under Engineering Costs).
14. $2,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.
15. Well installation cost estimate assumes one well would be installed in Area 1 to the bottom of the sand-and-gravel unit. Includes drilling, well installation (2-inch diameter PVC casing, 0.02-inch slotted screen, and sump), decontamination and waste management, well development, oversight, reporting, and survey. Cost estimate does not include repair, reinstallation, rehabilitation, or abandonment in the future.
16. On an annual basis, $6,000 has been included in this cost estimate to perform cap maintenance, which includes (for example) repairs of cap turf/soils, repairs of drainage features, and/or sediment removal from drainage structures, as needed. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
17. NAPL monitoring/recovery consists of measuring water levels and NAPL thicknesses in the new well and removing NAPL to the extent feasible. Due to the limited amount of NAPL expected to be recovered annually, a cost of $500 is assumed for the offsite transportation and treatment/disposal of recovered NAPL. It is assumed that NAPL recovery will occur once a month for 12 months a year at the new well. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA. Cost also assumes that NAPL monitoring/recovery of the newly installed well will be incorporated into the ongoing NAPL monitoring and removal program that was initiated at the Site in 1999.

Table 7

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2A

- ***Implement institutional controls (see Table 3)***
- ***Install barrier wall (see Table 3)***
- ***Install engineered cap over 1.8-acre area plus 0.8-acre plateau area created by installation of the barrier wall***
- ***Remove MGP materials as required to install the cap***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs - Cap Installation					
1.	Design	1	LS	$200,000	$200,000
2.	Mobilization/Demobilization	1	LS	$69,000	$69,000
3.	Support Area Development and Restoration	1	LS	$10,000	$10,000
4.	Excavation and Demolition for Cap Installation (Top 3 Feet)				
	- Excavation - Soil	6,500	CY	$15	$97,500
	- Demolition/Excavation - Structures	2,200	CY	$30	$66,000
5.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	8,000	ton	$75	$600,000
	- Hazardous Waste Landfill - Soil	2,700	ton	$300	$810,000
	- Nonhazardous Waste Landfill - Rubble	4,800	ton	$75	$360,000
6.	Waste Characterization	31	500 tons	$2,000	$62,000
7.	Draining and Capping Pipes	1	LS	$10,000	$10,000
8.	Traffic Control - CSX Flagger	110	day	$600	$66,000
9.	Cap Installation	2.6	acre	$300,000	$780,000
10.	Vapor Treatment System	1	LS	$20,000	$20,000
11.	Vegetation of Cap	2.6	acre	$3,500	$9,100
12.	Health and Safety Monitoring	22	week	$1,000	$22,000
13.	Site Security	22	week	$3,000	$66,000
14.	Stakeout, Verification, and As-built Surveys	1	LS	$15,000	$15,000
15.	Miscellaneous Disposal	1	LS	$5,000	$5,000
				Subtotal:	$3,267,600
				Administration and Engineering (10%):	$326,760
				Contingency (25%):	$816,900
				Total Capital Costs:	$4,411,260
Annual O&M Costs					
16.	Cap Maintenance	1	LS	$35,000	$35,000
17.	Vapor Treatment System Maintenance	1	LS	$3,000	$3,000
				Subtotal:	$38,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$471,580
				Total Estimated Cost for Alternative 2A:	**$4,882,840**
				Total Estimated Cost for Alternative 2A (Rounded):	**$4,900,000**

Table 7

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2A

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs are based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when the Park is not in use (November - April).

- It is assumed that remedial construction in Area 2 will be performed in conjunction with the remedial construction in Area 1 and coordinated with the remedial construction activities for the river and barrier wall installation.
- All remedial activities will be performed in modified Level D protection.
- It is assumed to take 22 weeks for completion of the identified remedial activities.
- It is assumed that 200 cy/day of material can be excavated and transported offsite each day.

Notes and Assumptions:

1. $200,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
3. Support area development includes $10,000 for labor, equipment, and materials to construct (and restore) staging, storage, access, and decontamination areas to support the remedial activities. Restoration includes the removal and disposal of these areas and fill replacement where necessary.
4. Excavation includes removal of the top 3 feet of material in Area 2 prior to placement of the cap so that the final cap elevation will be similar to the pre-remedial elevation. This cost estimate includes the labor, equipment, and materials. It is assumed that 25% of the total excavation volume will be structure-related (e.g., walls and foundations). It is assumed that no water management (other than implementation and maintenance of erosion and sedimentation controls) or shoring/sheeting will be needed.
5. Transportation and disposal costs include labor, equipment, and materials for the offsite transport and treatment/disposal of excavated material (soil and rubble). The following assumptions have been made with regard to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York); and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.
6. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.

Table 7

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2A

7. $10,000 has been included in this cost estimate for the draining and capping of piping encountered during excavation. NAPL drained from these pipes would be treated/disposed of offsite.
8. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
9. The components of a cap include a gas venting layer, a low-permeability layer, a subsurface drainage layer, and a protective layer. The estimate also includes an anchor trench. The cap installation cost includes materials testing costs.

   - It is assumed that the redevelopment of the Park will dovetail with the design and construction of the cap, and that Niagara Mohawk will receive the City's design for the Park in time to incorporate it into the final design for the cap. Because the design of the Park is not yet finalized, a 2.5-foot thick protective soil layer with a final grade of 3±% has been assumed. The final design of the cap will incorporate the needs of the Park redevelopment, and the surface of the Phase II Area will be ready for Park construction after remedial activities are completed. Long-term stormwater management and erosion control includes drainage swales lined with erosion control mat, loose riprap, and culverts for perimeter surface water diversion.

   - The gas venting layer and subsurface drainage layer both consist of a GDC. GDC is assumed to consist of a geosynthetic drainage net with 6-oz. nonwoven geotextile (both sides). Quantity includes additional material for anchoring around the perimeter of the cap and a 5% increase for wrinkles.

   - Gas collection piping is assumed to consist of two 6-inch HDPE pipes running the full length of the capped area, west to east, with additional piping for connection to the vapor treatment system.

   - The low-permeability layer consists of a 60 mil HDPE FML. The cost assumes cold-weather installation, and the unit price has been increased over normal installation cost to account for tenting, heating, additional testing, etc. that may be required during installation. Quantity includes additional material for anchoring around the perimeter of the cap, and a 10% increase for overlap and wrinkles.

   - The cap drainage layer collection system consists of slotted 6-inch HDPE collection piping with solid outlet piping (includes trenching and backfilling), crushed stone backfill, nonwoven geotextile wrap, and bentonite seal (for underlying FML) along the barrier wall. It is assumed that this system will outlet to the river.

   - Protective layer is assumed to consist of 6 inches of topsoil overlying a 24-inch general fill layer. The topsoil and general fill layers will both consist of clean imported soil. Topsoil will be placed and lightly compacted in a single lift. It is assumed that protection soil will be placed as required to achieve in-place compacted lift thicknesses of 6 inches. Estimated quantities include 10% bulking factor for shrink/swell associated with transporting, handling, and placing.

   - Cost of anchor trench excavation includes trenching along north, west, and east perimeter only (south perimeter accounted for cap drainage layer collection system). Cost also includes transport and disposal (to ESMI facility) of excavated soil. Estimated cost of transport and disposal includes 10% bulking factor.
10. Vapor treatment system is assumed to consist of two 200-lb GAC canisters (in-series system) with a passive gas treatment rate of 100 cfm. The cost also includes construction of a concrete pad (approximately 12 feet by 20 feet), construction of a locked building (including ventilation) for the system, installation and hookup of the system (including electrical), installation of an auto dialer alarm system, and installation of a privacy fence. Assumes electric is available at the site. Also assumes that methane and hydrogen sulfide treatment will not be required, and that hydrogen cyanide concentrations, if detectable, will be low enough to not require treatment in addition to the GAC.
11. After construction, the cap will be hydroseeded for erosion control.

Table 7

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2A

12. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.

13. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
14. $15,000 has been included in this cost estimate to perform an as-built survey. This does not include engineering costs associated with interpretation of survey information or development of as-built drawings (these items are covered under Engineering Costs).
15. $5,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.
16. On an annual basis, $35,000 has been included in this cost estimate to perform cap maintenance, which includes (for example) repairs of cap turf/soils, repairs of drainage features, and/or sediment removal from drainage structures, as needed. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
17. On an annual basis, $3,000 has been included in this cost estimate to perform maintenance related to the vapor treatment system, including the transportation and reactivation of carbon once a year, checking the system monthly, and operating an auto dialer alarm system. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 8

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

- ***Implement institutional controls (see Table 3)***
- ***Install barrier wall (see Table 3)***
- ***Install engineered cap over 1.8-acre area plus 0.8-acre plateau area created by installation of the barrier wall***
- ***Remove MGP materials as required to install the cap***
- ***Remove contents of Former Gas Holder No. 2***
- ***Remove bottom of Former Gas Holder No. 2, including 1 foot of soil underlying the bottom***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs - Cap Installation					
1.	Design	1	LS	$200,000	$200,000
2.	Mobilization/Demobilization	1	LS	$69,000	$69,000
3.	Support Area Development and Restoration	1	LS	$10,000	$10,000
4.	Excavation and Demolition for Cap Installation (Top 3 Feet)				
	- Excavation - Soil	6,500	CY	$15	$97,500
	- Demolition/Excavation - Structures	2,200	CY	$30	$66,000
5.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	8,000	ton	$75	$600,000
	- Hazardous Waste Landfill - Soil	2,700	ton	$300	$810,000
	- Nonhazardous Waste Landfill - Rubble	4,800	ton	$75	$360,000
6.	Waste Characterization	31	500 tons	$2,000	$62,000
7.	Draining and Capping Pipes	1	LS	$10,000	$10,000
8.	Traffic Control - CSX Flagger	110	day	$600	$66,000
9.	Cap Installation	2.6	acre	$300,000	$780,000
10.	Vapor Treatment System	1	LS	$20,000	$20,000
11.	Vegetation of Cap	2.6	acre	$3,500	$9,100
12.	Health and Safety Monitoring	22	week	$1,000	$22,000
13.	Site Security	22	week	$3,000	$66,000
14.	Stakeout, Verification, and As-built Surveys	1	LS	$15,000	$15,000
15.	Miscellaneous Disposal	1	LS	$5,000	$5,000
				Subtotal:	$3,267,600
Capital Costs - Removal of the Contents of Former Gas Holder No. 2 below 3 feet bgs					
16.	Predesign Investigation	1	LS	$10,000	$10,000
17.	Mobilization/Demobilization	1	LS	$5,900	$5,900
18.	Excavation - Holder Contents	3,100	CY	$25	$77,500
19.	Transport and Disposal				
	- Thermal Treatment/Disposal	3,800	ton	$75	$285,000
	- Hazardous Waste Landfill	1,300	ton	$300	$390,000
20.	Waste Characterization	10	500 tons	$2,000	$20,000
21.	Backfill	3,400	CY	$35	$119,000
22.	Traffic Control - CSX Flagger	15	day	$600	$9,000
23.	Health and Safety Monitoring	3	week	$1,000	$3,000

Table 8

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
24.	Site Security	3	week	$3,000	$9,000
25.	Miscellaneous Disposal	1	LS	$2,000	$2,000
				Subtotal:	$930,400
Capital Costs - Removal of the Bottom of Former Gas Holder No. 2					
26.	Mobilization/Demobilization	1	LS	$2,800	$2,800
27.	Excavation				
	- Demolition/Excavation - Structures	580	CY	$35	$20,300
	- Excavation - Soil - 1 Foot Buffer Underneath Holder Bottom	290	CY	$25	$7,250
28.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	360	ton	$75	$27,000
	- Hazardous Waste Landfill - Soil	120	ton	$300	$36,000
	- Nonhazardous Waste Landfill - Rubble	1,300	ton	$75	$97,500
29.	Waste Characterization	4	500 tons	$2,000	$8,000
30.	Water Management	1	LS	$5,000	$5,000
31.	Backfill	960	CY	$35	$33,600
32.	Traffic Control - CSX Flagger	10	day	$600	$6,000
33.	Health and Safety Monitoring	2	week	$1,000	$2,000
34.	Site Security	2	week	$3,000	$6,000
35.	Miscellaneous Disposal	1	LS	$2,000	$2,000
				Subtotal:	$253,450
				Subtotal:	$4,451,450
				Administration and Engineering (10%):	$445,145
				Contingency (25%):	$1,112,863
				Total Capital Costs:	$6,009,458
Annual O&M Costs					
36.	Cap Maintenance	1	LS	$35,000	$35,000
37.	Vapor Treatment System Maintenance	1	LS	$3,000	$3,000
				Subtotal:	$38,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$471,580
				Total Estimated Cost for Alternative 2B:	**$6,481,038**
				Total Estimated Cost for Alternative 2B (Rounded):	**$6,500,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs are based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 10% allowance is made for engineering fees and administration.

Table 8

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when the Park is not in use (November - April).

- It is assumed that remedial construction in Area 2 will be performed in conjunction with the remedial construction in Area 1 and coordinated with the remedial construction activities for the river and barrier wall installation.
- All remedial activities will be performed in modified Level D protection.
- It is assumed to take 27 weeks for completion of the identified remedial activities.
- It is assumed that 200 cy/day of material can be excavated and transported offsite each day.

Notes and Assumptions:

1. $200,000 has been included in this cost estimate for design of this component of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
3. Support area development includes $10,000 for labor, equipment, and materials to construct (and restore) staging, storage, access, and decontamination areas to support the remedial activities. Restoration includes the removal and disposal of these areas and fill replacement where necessary.
4. Excavation includes removal of the top 3 feet of material in Area 2 prior to placement of the cap so that the final cap elevation will be similar to the pre-remedial elevation. It is assumed that 25% of the total excavation volume will be structure-related (e.g., walls, foundations, and bottoms). It is assumed that no water management (other than implementation and maintenance of erosion and sedimentation controls) or shoring/sheeting will be needed.
5. Transportation and disposal costs include labor, equipment, and materials for the offsite transport and treatment/disposal of excavated material (soil and rubble). The following assumptions have been made with regard to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York); and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.
6. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
7. $10,000 has been included in this cost estimate for the draining and capping of piping encountered during excavation. NAPL drained from these pipes would be treated/disposed of offsite.
8. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
9. The components of a cap include a gas venting layer, a low-permeability layer, a subsurface drainage layer, and a protective layer. The estimate also includes an anchor trench. The cap installation cost includes materials testing costs.

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Amsterdam (Front Street) Former MGP Site
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Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

- It is assumed that the redevelopment of the Park will dovetail with the design and construction of the cap, and that Niagara Mohawk will receive the City's design for the Park in time to incorporate it into the final design for the cap. Because the design of the Park is not yet finalized, a 2.5-foot thick protective soil layer with a final grade of 3±% has been assumed. The final design of the cap will incorporate the needs of the Park redevelopment, and the surface of the Phase II Area will be ready for Park construction after remedial activities are completed. Long-term stormwater management and erosion control includes drainage swales lined with erosion control mat, loose riprap, and culverts for perimeter surface water diversion.
- The gas venting layer and subsurface drainage layer both consist of a GDC. GDC is assumed to consist of a geosynthetic drainage net with 6-oz. nonwoven geotextile (both sides). Quantity includes additional material for anchoring around the perimeter of the cap and a 5% increase for wrinkles.
- Gas collection piping is assumed to consist of two 6-inch HDPE pipes running the full length of the capped area, west to east, with additional piping for connection to the vapor treatment system.
- The low-permeability layer consists of a 60 mil HDPE flexible membrane liner (FML). The cost assumes cold-weather installation, and the unit price has been increased over normal installation cost to account for tenting, heating, additional testing, etc. that may be required during installation. Quantity includes additional material for anchoring around the perimeter of the cap, and a 10% increase for overlap and wrinkles.
- The cap drainage layer collection system consists of slotted 6-inch HDPE collection piping with solid outlet piping (includes trenching and backfilling), crushed stone backfill, nonwoven geotextile wrap, and bentonite seal (for underlying FML) along the barrier wall. It is assumed that this system will outlet to the river.
- Protective layer is assumed to consist of 6 inches of topsoil overlying a 24-inch general fill layer. The topsoil and general fill layers will both consist of clean imported soil. Topsoil will be placed and lightly compacted in a single lift. It is assumed that protection soil will be placed as required to achieve in-place compacted lift thicknesses of 6 inches. Estimated quantities include 10% bulking factor for shrink/swell associated with transporting, handling, and placing.
- Cost of anchor trench excavation includes trenching along north, west, and east perimeter only (south perimeter accounted for cap drainage layer collection system). Cost also includes transport and disposal (to ESMI facility) of excavated soil. Estimated cost of transport and disposal includes 10% bulking factor.

10. Vapor treatment system is assumed to consist of two 200-lb GAC canisters (in-series system) with a passive gas treatment rate of 100 cfm. The cost also includes construction of a concrete pad (approximately 12 feet by 20 feet), construction of a locked building (including ventilation) for the system, installation and hookup of the system (including electrical), installation of an auto dialer alarm system, and installation of a privacy fence. Assumes electric is available at the site. Also assumes that methane and hydrogen sulfide treatment will not be required, and that hydrogen cyanide concentrations, if detectable, will be low enough to not require treatment in addition to the GAC.
11. After construction, the cap will be hydroseeded for erosion control.
12. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.
13. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
14. $15,000 has been included in this cost estimate to perform an as-built survey. This does not include engineering costs associated with interpretation of survey information or development of as-built drawings (these items are covered under Engineering Costs).
15. $5,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.

Table 8

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Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

16. $10,000 has been included in this cost estimate for performance of a predesign investigation. The investigation will be completed within the limits of and adjacent to Former Gas Holder No. 2 to assess the volume of NAPL-containing soil/debris within the holder and immediately below the holder floor. Assumes a drill rig and crew for one day, and that only visual characterization will be performed. No samples will be sent to the laboratory for analysis. Includes preparation of a letter report that would be submitted to the NYSDEC.
17. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding predesign investigation, transport, disposal, and waste characterization.
18. Excavation includes removal of the contents of Former Gas Holder No. 2 deeper than 3 feet. The depth of Former Gas Holder No. 2 is assumed to be 13.5 feet bgs and the diameter is assumed to be 100 feet. It is assumed that no water treatment (other than implementation and maintenance of erosion and sedimentation controls) or shoring/sheeting will be needed, and that the walls of Former Gas Holder No. 2 will not need support and will not be removed during excavation of the holder contents.
19. Transportation and disposal costs include labor, equipment, and materials for the offsite transport and treatment/disposal of excavated materials. The following assumptions have been made with regard to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the materials will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; and 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York). It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for the holder contents.
20. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
21. Importation of clean backfill to restore the excavation to grade minus 3 feet will be necessary. Backfill costs are for obtaining, transporting, placing, compacting, and grading of backfill. It will be placed and compacted in 1-foot lifts. Availability of fill materials in this area might affect the final pricing at time of purchase.
22. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
23. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.
24. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
25. $2,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.
26. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding transport, disposal, and waste characterization.
27. Excavation includes removal of the bottom of Former Gas Holder No. 2 and a 1-foot thick layer of soil underneath the holder bottom. The diameter of Former Gas Holder No. 2 is assumed to be 100 feet, and the thickness of the bottom is assumed to be 2 feet. It is assumed that no shoring/sheeting will be needed, and that the walls of Former Gas Holder No. 2 will not need support and will not be removed during excavation of the holder bottom.

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Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2B

28. Transportation and disposal costs include labor, equipment, and materials for the offsite transport and treatment/disposal of excavated soil. The following assumptions have been made with regard to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York); and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.
29. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
30. $5,000 has been included in this cost estimate for water management during soil excavation activities, as some amount of water may enter the excavation due to the proximity of the water table to the bottom of the excavation and from precipitation. Water management includes rental of a frac tank and treatment/disposal of generated water, if any.
31. Importation of clean backfill to restore the excavation to grade minus 3 feet will be necessary. Backfill costs are for obtaining, transporting, placing, compacting, and grading of backfill. It will be placed and compacted in 1-foot lifts. Availability of fill materials in this area might affect the final pricing at time of purchase.
32. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
33. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.
34. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
35. $2,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.
36. On an annual basis, $35,000 has been included in this cost estimate to perform cap maintenance, which includes (for example) repairs of cap turf/soils, repairs of drainage features, and/or sediment removal from drainage structures, as needed. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.
37. On an annual basis, $3,000 has been included in this cost estimate to perform maintenance related to the vapor treatment system, including the transportation and reactivation of carbon once a year, checking the system monthly, and operating an auto dialer alarm system. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 9

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

- ***Implement institutional controls (see Table 3)***
- ***Install barrier wall (see Table 3)***
- ***Install engineered cap over 1.8-acre area plus 0.8-acre plateau area created by installation of the barrier wall***
- ***Remove MGP materials above the low winter water table***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs - Cap Installation					
1.	Design	1	LS	$200,000	$200,000
2.	Mobilization/Demobilization	1	LS	$69,000	$69,000
3.	Support Area Development and Restoration	1	LS	$10,000	$10,000
4.	Excavation and Demolition for Cap Installation (Top 3 Feet)				
	- Excavation - Soil	6,500	CY	$15	$97,500
	- Demolition/Excavation - Structures	2,200	CY	$30	$66,000
5.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	8,000	ton	$75	$600,000
	- Hazardous Waste Landfill - Soil	2,700	ton	$300	$810,000
	- Nonhazardous Waste Landfill - Rubble	4,800	ton	$75	$360,000
6.	Waste Characterization	31	500 tons	$2,000	$62,000
7.	Draining and Capping Pipes	1	LS	$10,000	$10,000
8.	Traffic Control - CSX Flagger	110	day	$600	$66,000
9.	Cap Installation	2.6	acre	$300,000	$780,000
10.	Vapor Treatment System	1	LS	$20,000	$20,000
11.	Vegetation of Cap	2.6	acre	$3,500	$9,100
12.	Health and Safety Monitoring	22	week	$1,000	$22,000
13.	Site Security	22	week	$3,000	$66,000
14.	Stakeout, Verification, and As-built Surveys	1	LS	$15,000	$15,000
15.	Miscellaneous Disposal	1	LS	$5,000	$5,000
				Subtotal:	$3,267,600
Capital Costs - Removal of Materials Between 3 feet bgs and Low Winter Water Table					
16.	Design	1	LS	$100,000	$100,000
17.	Mobilization/Demobilization	1	LS	$72,000	$72,000
18.	Support Area Development and Restoration	1	LS	$10,000	$10,000
19.	Excavation and Demolition				
	- Excavation - Soil	10,000	CY	$25	$250,000
	- Demolition/Excavation - Structures	3,300	CY	$35	$115,500
20.	Transport and Disposal				
	- Thermal Treatment/Disposal - Soil	12,000	ton	$75	$900,000
	- Hazardous Waste Landfill - Soil	4,100	ton	$300	$1,230,000
	- Nonhazardous Waste Landfill - Rubble	7,300	ton	$75	$547,500
21.	Waste Characterization	47	500 tons	$2,000	$94,000
22.	Draining and Capping Pipes	1	LS	$15,000	$15,000
23.	Sheeting/Shoring	1	LS	$250,000	$250,000

Table 9

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
24.	Water Management	1	LS	$25,000	$25,000
25.	Backfill	14,000	CY	$35	$490,000
26.	Traffic Control - CSX Flagger	35	day	$600	$21,000
27.	Health and Safety Monitoring	7	week	$1,000	$7,000
28.	Site Security	7	week	$3,000	$21,000
29.	Miscellaneous Disposal	1	LS	$15,000	$15,000
				Subtotal:	$4,163,000
				Subtotal:	$7,430,600
				Administration and Engineering (10%):	$743,060
				Contingency (25%):	$1,857,650
				Total Capital Costs:	$10,031,310
Annual O&M Costs					
30.	Cap Maintenance	1	LS	$35,000	$35,000
31.	Vapor Treatment System Maintenance	1	LS	$3,000	$3,000
				Subtotal:	$38,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$471,580
				Total Estimated Cost for Alternative 2C:	**$10,502,890**
				Total Estimated Cost for Alternative 2C (Rounded):	**$10,500,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs are based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when the Park is not in use (November - April).
- It is assumed that remedial construction in Area 2 will be performed in conjunction with the remedial construction in Area 1 and coordinated with the remedial construction activities for the river and barrier wall installation.
- All remedial activities will be performed in modified Level D protection.
- For purposes of this estimate, it is assumed to take 29 weeks for completion of the identified remedial activities. It is assumed that activities could take place concurrently to meet the November to April timeframe.
- It is assumed that two excavation crews can excavate and transport offsite 400 cy/day of material each day. Similarly, two crews can place backfill at a rate of 400 cy/day.

Table 9

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

Notes and Assumptions:

1. $200,000 has been included in this cost estimate for design of this component of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
3. Support area development includes $10,000 for labor, equipment, and materials necessary to construct (and restore) staging, storage, access, and decontamination areas to support the remedial activities. Restoration includes the removal and disposal of these areas and fill replacement where necessary.
4. Excavation includes removal of the top 3 feet of material in Area 2 prior to placement of the cap so that the final cap elevation will be similar to the pre-remedial elevation. It is assumed that 25% will be structure-related (e.g., walls, foundations, and bottoms). The required buffer zone around the State Route 30 bridge pier would be delineated during the remedial design. It is assumed that no water (other than implementation and maintenance of erosion and sedimentation controls) management or shoring/sheeting will be needed.
5. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of excavated material (soil and rubble). The following assumptions have been made with regards to transportation and disposal of materials: 1) no materials will be reused onsite; 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York; 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York); and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.
6. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
7. $10,000 has been included in this cost estimate for the draining and capping of piping encountered during excavation. NAPL drained from these pipes would be treated/disposed of offsite.
8. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
9. The components of a cap include a gas venting layer, a low-permeability layer, a subsurface drainage layer, and a protective layer. The estimate also includes an anchor trench. The cap installation cost includes materials testing costs.
   - It is assumed that the redevelopment of the Park will dovetail with the design and construction of the cap, and that Niagara Mohawk will receive the City's design for the Park in time to incorporate it into the final design for the cap. Because the design of the Park is not yet finalized, a 2.5-foot thick protective soil layer with a final grade of 3±% has been assumed. The final design of the cap will incorporate the needs of the Park redevelopment, and the surface of the Phase II Area will be ready for Park construction after remedial activities are completed. Long-term stormwater management and erosion control includes drainage swales lined with erosion control mat, loose riprap, and culverts for perimeter surface water diversion.

   - The gas venting layer and subsurface drainage layer both consist of a GDC. GDC is assumed to consist of a geosynthetic drainage net with 6-oz. nonwoven geotextile (both sides). Quantity includes additional material for anchoring around the perimeter of the cap and a 5% increase for wrinkles.
   - Gas collection piping is assumed to consist of two 6-inch HDPE pipes running the full length of the capped area, west to east, with additional piping for connection to the vapor treatment system.

Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

- The low-permeability layer consists of a 60 mil HDPE FML. The cost assumes cold-weather installation, and the unit price has been increased over normal installation cost to account for tenting, heating, additional testing, etc. that may be required during installation. Quantity includes additional material for anchoring around the perimeter of the cap, and a 10% increase for overlap and wrinkles.
- The cap drainage layer collection system consists of slotted 6-inch HDPE collection piping with solid outlet piping (includes trenching and backfilling), crushed stone backfill, nonwoven geotextile wrap, and bentonite seal (for underlying FML) along the barrier wall. It is assumed that this system will outlet to the river.
- Protective layer is assumed to consist of 6 inches of topsoil overlying a 24-inch general fill layer. The topsoil and general fill layers will both consist of clean imported soil. Topsoil will be placed and lightly compacted in a single lift. It is assumed that protection soil will be placed as required to achieve in-place compacted lift thicknesses of 6 inches. Estimated quantities include 10% bulking factor for shrink/swell associated with transporting, handling, and placing.
- Cost of anchor trench excavation includes trenching along north, west, and east perimeter only (south perimeter accounted for cap drainage layer collection system). Cost also includes transport and disposal (to ESMI facility) of excavated soil. Estimated cost of transport and disposal includes 10% bulking factor.

10. Vapor treatment system is assumed to consist of two 200-lb GAC canisters (in-series system) with a passive gas treatment rate of 100 cfm. The cost also includes construction of a concrete pad (approximately 12 feet by 20 feet), construction of a locked building (including ventilation) for the system, installation and hookup of the system (including electrical), installation of an auto dialer alarm system, and installation of a privacy fence. Assumes electric is available at the site. Also assumes that methane and hydrogen sulfide treatment will not be required, and that hydrogen cyanide concentrations, if detectable, will be low enough to not require treatment in addition to the GAC.
11. After construction, the cap will be hydroseeded for erosion control.
12. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.
13. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
14. $15,000 has been included in this cost estimate to perform an as-built survey. This does not include engineering costs associated with interpretation of survey information or development of as-built drawings (these items are covered under Engineering Costs).
15. $5,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., personal protective equipment and disposable equipment) at a facility permitted to accept the waste.
16. $100,000 has been included in this cost estimate for design of this component of the remedial alternative.
17. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to implement the alternative. A 6% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
18. Support area development includes $10,000 for labor, equipment, and materials necessary to construct (and restore) staging, storage, access, and decontamination areas to support the excavation activities. Restoration includes the removal and disposal of these areas and fill replacement where necessary.

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Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

19. Excavation includes the labor, equipment, and materials necessary to excavate the materials between 3 feet bgs and the winter low water table in Area 2. The total volume above the winter low water table is assumed to be 22,000 in-situ cy based on the 3-D data visualization model presented in an RAR appendix. It is assumed that 25% will be structure-related (e.g., walls, foundations, and bottoms). The sheetpiling installed during the IRM to the east of Former Gas Holder No. 2 will also be removed. The required buffer zone around the State Route 30 bridge pier would be delineated during the remedial design.

20. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of excavated material (soil and rubble). The following assumptions have been made with regards to transportation and disposal of materials: 1) no materials will be reused onsite, 2) 75% of the soil will be nonhazardous and will be transported to ESMI's LTTD facility in Fort Edward, New York, 3) 25% will be hazardous and will be transported to a hazardous waste landfill (e.g., CWM's facility in Model City, New York), and 4) all rubble will be nonhazardous and will be disposed of at a nonhazardous waste landfill. It is assumed that dewatering will not be necessary, and that stabilization will not be necessary to meet the requirements of "no free liquids" in the material being transported. A bulking factor of 10% is assumed to calculate disposal volume. A density of 1.5 tons/cy was assumed for soil and a density of 2 tons/cy was assumed for the rubble.
21. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
22. $15,000 has been included in this cost estimate for the draining and capping of piping encountered during excavation. NAPL drained from these pipes would be treated/disposed of offsite.
23. $250,000 has been included in this cost estimate for installation of temporary shoring/sheeting to facilitate removal of the designated materials and subsequent removal. The need for shoring/sheeting will be determined during remedial design, but will likely include, at a minimum, areas along the shoreline and near the State Route 30 bridge pier.
24. $25,000 has been included in this cost estimate for water management during soil excavation activities, as some amount of water may enter the excavation due to the proximity of the water table to the bottom of the excavation and from precipitation. Water management includes rental of a frac tank ($15,000) and treatment/disposal of generated water, if any ($10,000).

25. Importation of clean backfill to restore the excavation to grade minus 3 feet will be necessary. Backfill costs are for obtaining, transporting, placing, compacting, and grading of backfill. It will be placed and compacted in 1-foot lifts. Availability of fill materials in this area might affect the final pricing at time of purchase.
26. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
27. $1,000 a week has been included in this cost estimate for vapor/particulate monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor or particulate levels above pre-determined action limits, control measures would be enacted, as appropriate. These measures may include pre-application of water spray, covering exposed areas when not active, and/or other measures. Cost estimate assumes that control measures, if necessary, would be limited.
28. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday, plus 24 hrs/day on Saturday and Sunday).
29. $15,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., temporary sheeting/shoring, sheetpiling installed during the IRM, piping and monitoring wells removed during excavation, personal protective equipment, and disposable equipment) at a facility permitted to accept the waste. It has been assumed that recovered metal will be recycled.

Preliminary Cost Estimate for Upland Area 2 - Alternative 2C

30. On an annual basis, $35,000 has been included in this cost estimate to perform cap maintenance, which includes (for example) repairs of cap turf/soils, repairs of drainage features, and/or sediment removal from drainage structures, as needed. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

31. On an annual basis, $3,000 has been included in this cost estimate to perform maintenance related to the vapor treatment system, including the transportation and reactivation of carbon once a year, checking the system monthly, and operating an auto dialer alarm system. The cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 10

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3A

- ***Monitored natural recovery***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
				Total Capital Costs:	$0
Annual Operation and Maintenance (O&M) Costs					
1.	Annual Monitoring	1	LS	$35,000	$35,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$434,350
				Total Estimated Cost for Alternative 3A:	**$434,350**
				Total Estimated Cost for Alternative 3A (Rounded):	**$430,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that remedial construction in Area 3 will be coordinated with the remedial construction activities for the barrier wall installation.
- All remedial activities will be performed in modified Level D protection.

Notes and Assumptions:

1. On an annual basis, $35,000 has been included in this cost estimate to perform annual monitoring associated with the observation of site conditions via use of divers and other visual reconnaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 10

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3A

- ***Monitored natural recovery***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
				Total Capital Costs:	$0
Annual Operation and Maintenance (O&M) Costs					
1.	Annual Monitoring	1	LS	$35,000	$35,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$434,350
				Total Estimated Cost for Alternative 3A:	**$434,350**
				Total Estimated Cost for Alternative 3A (Rounded):	**$430,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that remedial construction in Area 3 will be coordinated with the remedial construction activities for the barrier wall installation.
- All remedial activities will be performed in modified Level D protection.

Notes and Assumptions:

1. On an annual basis, $35,000 has been included in this cost estimate to perform annual monitoring associated with the observation of site conditions via use of divers and other visual reconnaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 11

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3B

- ***Remove up to 8 feet in "focused" area around T-7-50 (800 ft^2)***
- ***Place sand and armor layers to restore area***
- ***Offsite treatment/disposal of removed materials***
- ***Monitored natural recovery***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Design	1	LS	$60,000	$60,000
2.	Mobilization/Demobilization	1	LS	$62,000	$62,000
3.	Support Area Development and Restoration	1	LS	$50,000	$50,000
4.	Temporary Sheetpile Installation/Removal (in river)	4,750	SF	$50	$237,500
5.	Silt Curtain Materials/Installation	115	LF	$100	$11,500
6.	Oil Booms and Absorbents	15	day	$500	$7,500
7.	Traffic Control	15	day	$600	$9,000
8.	Site Security	3	week	$3,000	$9,000
9.	Mechanical Dredging/Dewatering/Stabilizing	250	CY	$225	$56,250
10.	Water Treatment	10,000	gallon	$0.50	$5,000
11.	Transport and Disposal				
	- RCRA Disposal	300	CY	$200	$60,000
	- Waste Characterization	1	330 CY	$2,000	$2,000
12.	Backfill				
	- Sand Layer (6.5 feet)	200	CY	$35	$7,000
	- Geotextile Liner	100	SY	$25	$2,500
	- Armor Layer (1.5 feet)	50	CY	$55	$2,750
13.	Health and Safety Monitoring	3	week	$1,000	$3,000
14.	Miscellaneous Disposal	1	LS	$10,000	$10,000
				Subtotal:	$595,000
				Administration and Engineering (10%):	$53,500
				Contingency (25%):	$148,750
				Total Capital Costs:	$797,250
Annual Operation and Maintenance (O&M) Costs					
15.	Annual Monitoring	1	LS	$40,000	$40,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$496,400
				Total Estimated Cost for Alternative 3B:	**$1,293,650**
				Total Estimated Cost for Alternative 3B (Rounded):	**$1,300,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 15% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that remedial construction in Area 3 will be coordinated with the remedial construction activities for the barrier wall installation.
- All remedial activities will be performed in modified Level D protection.

Table 11

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3B

Notes and Assumptions:

1. $60,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to remove and backfill the targeted area. Cost estimate assumes one construction season will be required to complete the project.
3. Support area development includes $50,000 for clearing staging area and preparing equipment and material for staging, storage, access and decontamination areas, construction trailers, and a shoreline mooring area for loading/unloading barge and watercraft. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
4. Temporary sheetpile installation and removal costs are based on installing and removing sheeting around the area to be removed with the total necessary sheeting assumed to be 95 linear feet with 50 feet driven below riverbed surface to facilitate removal activities. Sheetpile penetration depth of 50 feet is assumed to be suitable for a river fluctuation of approximately 4 feet and an removal depth of 8 feet. The costs associated with cleaning the temporary sheeting have been included with the Miscellaneous Disposal item (#14).
5. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the temporary sheeting and removal activities, and will be removed following completion of restoration activities.
6. Oil booms and absorbents will be used during installation/removal of the temporary sheetpile and will remain in place until the temporary sheeting has been removed.
7. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
8. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
9. Riverbed material removal assumed to be performed by mechanical removal in the wet. The costs are for removal, barging, and dewatering/stabilizing. For dewatering/stabilizing cost estimate, it is assumed that materials will be dewatered by removing free water from removed riverbed materials at the stockpile area at the end of each day. It is assumed 20% stabilizing agent by weight would be added to meet transportation/disposal requirements.
10. Water treatment costs are for the operation of a portable water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that mechanical removal in the wet would generate approximately 20% water by in-situ riverbed material volume (or ~ 40 gallons of water generated per 1 cy of in-situ sediment).
11. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of removed riverbed materials. The following assumptions have been made with regard to transporation and disposal of processed riverbed materials: 1) no materials will be reused onsite, 2) disposal volume includes removed in-situ riverbed materials (250 cy) plus stabilizing agent at 20% by weight (300 cy); and 3) all riverbed materials removed will be managed as if subject to the disposal requirements under the Resource Conservation and Recovery Act (RCRA) and will be disposed at CWM's facility in Model City, New York. A 20% bulking factor was assumed for all wet materials. Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill.
12. Backfill costs include the material, shipment, and placement. The following costs are assumed: 1) Sand - up to 6.5 feet at $35/cy (considering the minimum depth required to be maintained within the navigation channel); 2) Geotextile Liner - 100 sy at $25/sy (includes an additional 10% for overlap), and 3) Armor Layer - 1.5 feet at $55/cy. The actual components and armor layer thicknesses will be finalized during remedial design.
13. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted as appropriate. Cost estimate assumes that control measures, if necessary, would be limited.
14. $10,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept the waste. It is assumed that the temporary sheeting used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor.
15. On an annual basis, $40,000 has been included in this cost estimate to perform annual monitoring associated with the observation of site conditions via use of divers and other visual reconnaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 12

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3C

- ***Remove 2 feet on the river side of the barrier wall***
- ***Within the navigation channel, remove to elevation 239 for minimum depth required to maintain channel***
- ***Remove up to 8 feet in limited "focused" area around T-7-50 (800 ft^2)***
- ***Place sand and armor layers to restore area***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Design	1	LS	$300,000	$300,000
2.	Mobilization/Demobilization	1	LS	$350,000	$350,000
3.	Support Area Development and Restoration	1	LS	$75,000	$75,000
4.	Temporary Sheetpile Installation/Removal (in river)	26,000	SF	$50	$1,300,000
5.	Silt Curtain Materials/Installation	800	LF	$100	$80,000
6.	Oil Booms and Absorbents	28	day	$500	$14,000
7.	Traffic Control	28	day	$600	$16,800
8.	Site Security	6	week	$3,000	$18,000
9.	Mechanical Dredging/Dewatering/Stabilizing	2,800	CY	$225	$630,000
10.	Water Treatment	110,000	gallon	$0.50	$55,000
11.	Transport and Disposal				
	- Thermal Treatment/Disposal	3,000	CY	$50	$150,000
	- RCRA Disposal	360	CY	$200	$72,000
	- Waste Characterization	10	330 CY	$2,000	$20,000
12.	Backfill				
	- Sand Layer	450	CY	$35	$15,750
	- Geotextile Layer	2,500	SY	$25	$62,500
	- Armor Layer (1.5 feet)	1,250	CY	$55	$68,750
13.	Health and Safety Monitoring	6	week	$1,000	$6,000
14.	Miscellaneous Disposal	1	LS	$20,000	$20,000
				Subtotal:	$3,253,800
				Administration and Engineering (10%):	$295,380
				Contingency (25%):	$813,450
				Total Capital Costs:	$4,362,630
Annual Operation and Maintenance (O&M) Costs					
15.	Annual Monitoring	1	LS	$50,000	$50,000
				Present Worth Factor (30 years @ 7%):	12.41
				Total Present Worth O&M Cost:	$620,500
				Total Estimated Cost for Alternative 3C:	**$4,983,130**
				Total Estimated Cost for Alternative 3C (Rounded):	**$5,000,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 15% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that remedial construction in Area 3 will be coordinated with the remedial construction activities for the barrier wall installation.
- All remedial activities will be performed in modified Level D protection.

Table 12

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3C

Notes and Assumptions:

1. $300,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to remove and backfill the targeted area. Cost estimate assumes one construction season will be required to complete the project.
3. Support area development includes $75,000 for clearing staging area and preparing equipment and material for staging, storage, access and decontamination areas, construction trailers, and a shoreline mooring area for loading/unloading barge and watercraft. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
4. Temporary sheetpile installation/removal costs are based on installing and removing sheeting around the area to be removed. It has been assumed that approximately 75% of the sheeting length will be required to be driven to facilitate removal activities. The costs associated with cleaning the temporary sheeting have been included with the Miscellaneous Disposal item (#14).

   - Temporary sheetpile installation/removal costs are based on installing and removing sheeting around the 1-acre area (excluding the shoreline). Sheetpile penetration depth of 22 to 30 feet is based on a river fluctuation of approximately 4 feet and an excavation depth of 2 feet. Based on preliminary assessment, the total necessary sheeting is approximately 600 linear feet by 40 feet (outer edge of area) and 150 linear feet by 30 feet (interior dividing wall) total height for removing the targeted riverbed materials within the 1-acre area in a total of two work cells (each approximately 300 feet long by 50 feet wide).

   - Temporary sheetpile installation for T-7-50 based on installing and removing sheeting around the area to be removed. The total necessary sheeting is assumed to be 95 linear feet with 50 feet driven below riverbed surface to facilitate removal activities. Sheetpile penetration depth of 50 feet is assumed to be suitable for a river fluctuation of approximately 4 feet and an excavation depth of 8 feet.
5. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the temporary sheeting and removal activities, and will be removed following completion of restoration activities.
6. Oil booms and absorbents will be used during installation/removal of the temporary sheetpile and will remain in place until the temporary sheeting has been removed.
7. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
8. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
9. Riverbed material removal assumed to be performed by mechanical removal in the wet. The costs are for removal, barging, and dewatering/stabilizing. For dewatering/stabilizing cost estimate, it is assumed that materials will be dewatered by removing free water from removed riverbed materials at the stockpile area at the end of each day. It is assumed 20% stabilizing agent by weight would be added to meet transportation/disposal requirements.
10. Water treatment costs are for the operation of a portable water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that mechanical removal in the wet would generate approximately 20% water by in-situ riverbed material volume (or ~ 40 gallons of water generated per 1 cy of in-situ riverbed materials).
11. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of removed riverbed materials. The following assumptions have been made with regard to transportation and disposal of processed riverbed materials: 1) no materials will be reused onsite, 2) disposal volume includes removed in-situ riverbed materials (2,800 cy) plus stabilizing agent at 20% by weight (3,360 cy); 3) 10 percent of the riverbed materials from the "Area for Consideration" and all of the materials removed adjacent to T-7-50 (360 cy) will be managed as if subject to the disposal requirements under the Resource Conservation and Recovery Act (RCRA) and will be disposed at CWM's facility in Model City, New York; and 4) the remaining riverbed materials are assumed to be non-hazardous (3,000 cy) and will be transported to ESMI's LTTD facility in Fort Edward, New York.

    -Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.

Preliminary Cost Estimate for Mohawk River Area 3 - Alternative 3C

12. Backfill costs include the material, shipment, and placement. The following costs are assumed for the area adjacent to T-7-50: 1) Sand - up to 6.5 feet at $35/cy (considering the minimum depth required to be maintained within the navigation channel); 2) Geotextile Liner - 100 sy at $25/sy, and 3) Armor Layer - 1.5 feet at $55/cy. The following costs are assumed for the remainder of the 1-acre area: 1) Sand - 0.5 feet at $35/cy, 2) Geotextile Liner - 2,500 sy per liner at $25/sy, and 3) Armor Layer - 1.5 feet at $55/cy. The actual components and armor layer thicknesses will be finalized during remedial design. A 10% overlap has been assumed for geotextile liner placement.
13. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted as appropriate. Cost estimate assumes that control measures, if necessary, would be limited.
14. $20,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept the waste. It is assumed that the temporary sheeting used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor.
15. On an annual basis, $50,000 has been included in this cost estimate to perform annual monitoring associated with the observation of site conditions via use of divers and other visual reconnaissance. The long-term monitoring program will be developed during the remedial design. This cost is also assumed to include reporting to the NYSDEC in accordance with the requirements set forth in the VCA.

Table 13

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 4 - Alternative 4A

- ***Remove 4 feet in the 0.1-acre area***
- ***Place a sand layer to restore area***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Design	1	LS	$50,000	$50,000
2.	Mobilization/Demobilization	1	LS	$30,000	$30,000
3.	Support Area Development and Restoration	1	LS	$50,000	$50,000
4.	Jersey Barrier Installation/Removal	160	LF	$75	$12,000
5.	Silt Curtain Materials/Installation	200	LF	$100	$20,000
6.	Oil booms and absorbents	10	day	$500	$5,000
7.	Traffic Control	10	day	$600	$6,000
8.	Site Security	2	week	$3,000	$6,000
9.	Mechanical Dredging/Dewatering/Stabilizing	500	CY	$75	$37,500
10.	Water Treatment	10,000	gallon	$0.50	$5,000
11.	Transport and Disposal				
	- Thermal Treatment/Disposal	500	CY	$50	$25,000
	- RCRA Disposal	50	CY	$200	$10,000
	- Waste Characterization	2	330 CY	$2,000	$4,000
12.	Backfill				
	- Geotextile Layer	400	SY	$25	$10,000
	- Sand Layer (2.5 feet)	300	CY	$35	$10,500
	- Armor Layer (1.5 feet)	200	CY	$55	$11,000
13.	Health and Safety Monitoring	2	week	$1,000	$2,000
14.	Miscellaneous Disposal	1	LS	$10,000	$10,000
				Subtotal:	$304,000
				Administration and Engineering (10%):	$25,400
				Contingency (25%):	$76,000
				Total Capital Costs:	$405,400
				Total Estimated Cost for Alternative 4A:	**$405,400**
				Total Estimated Cost for Alternative 4A (Rounded):	**$410,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 15% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- It is assumed that remedial construction in Area 4 will be coordinated with the remedial construction activities for the remainder of the Site.
- All remedial activities will be performed in modified Level D protection.

Table 13

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 4 - Alternative 4A

Notes and Assumptions:

1. $50,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to remove and backfill the targeted area. Cost estimate assumes one construction season will be required to complete the project.
3. Support area development includes $50,000 for clearing staging area and preparing equipment and material for staging, storage, access and decontamination areas, construction trailers, and a shoreline mooring area for loading/unloading barge and watercraft. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
4. Jersey barrier installation/removal costs are based on installing and removing jersey barriers around the 0.1-acre area of the Site (east of NYSCC property) to be removed (excluding the shoreline). It is assumed that the Jersey barriers used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor.
5. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the Jersey barriers and removal activities, and will be removed following completion of restoration activities.
6. Oil booms and absorbents will be used during installation/removal of the temporary sheetpile and will remain in place until the temporary sheeting has been removed.
7. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
8. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
9. Riverbed material removal assumed to be performed by mechanical removal in the dry. For dewatering/stabilizing cost estimate, it is assumed that materials will be dewatered by removing free water from removed riverbed materials at the stockpile area at the end of each day. It is assumed 10% stabilizing agent by weight would be added to meet transportation/disposal requirements.
10. Water treatment costs are for the operation of a portable water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that mechanical removal in the dry would generate approximately 10% water by in-situ riverbed material volume (or ~ 20 gallons of water generated per 1 cy of in-situ riverbed materials).
11. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of removed riverbed materials. The following assumptions have been made with regard to transportation and disposal of processed riverbed materials: 1) no materials will be reused onsite, 2) disposal volume includes removed in-situ riverbed materials (500 cy) plus stabilizing agent at 10% by weight (550 cy); 3) 10 percent of the riverbed materials from the 0.1-acre area (50 cy) will be managed as if subject to the disposal requirements under the Resource Conservation and Recovery Act (RCRA) and will be disposed at CWM's facility in Model City, New York; and 4) the remaining riverbed materials are assumed to be non-hazardous (500 cy) and will be transported to ESMI's LTTD facility in Fort Edward, New York.

    -Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
12. Backfill costs include the material, shipment, and placement. The following costs are assumed: 1) Geotextile Liner - 400 sy at $25/sy, 2) Sand - 2.5 feet at $35/cy, and 3) Armor - 1.5 feet at $55/cy. The actual components will be finalized during remedial design. A 10% overlap has been assumed for geotextile liner placement.
13. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted as appropriate. Cost estimate assumes that control measures, if necessary, would be limited.
14. $10,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept the waste.

Table 14

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 4 - Alternative 4B

- ***Remove 4 feet in the 0.1-acre area***
- ***Remove 2 feet around SD-11 and SD-12 (~300ft^2) to meet NYSDEC's performance specification***
- ***Place a sand layer to restore area***
- ***Offsite treatment/disposal of removed materials***

Item	Description	Estimated Quantity	Unit	Unit Price (Labor and Materials)	Cost
Capital Costs					
1.	Design	1	LS	$75,000	$75,000
2.	Mobilization/Demobilization	1	LS	$70,000	$70,000
3.	Support Area Development and Restoration	1	LS	$70,000	$70,000
4.	Temporary Barrier Sheetpile Installation/Removal (in river)	5,300	SF	$50	$265,000
5.	Jersey Barrier Installation/Removal	120	LF	$75	$9,000
6.	Silt Curtain Materials/Installation	300	LF	$100	$30,000
7.	Oil Booms and Absorbents	20	day	$500	$10,000
8.	Traffic Control	20	day	$600	$12,000
9.	Site Security	4	week	$3,000	$12,000
10.	Removal of Materials				
	Mechanical Dredging/Dewatering/Stabilizing	200	CY	$150	$30,000
	Mechanical Dredging/Dewatering/Stabilizing (Shoreline)	500	CY	$75	$37,500
11.	Water Treatment	18,000	gallon	$0.50	$9,000
12.	Transport and Disposal				
	- Thermal Treatment/Disposal	760	CY	$50	$38,000
	- RCRA Disposal	100	CY	$200	$20,000
	- Waste Characterization	3	330 CY	$2,000	$6,000
13.	Backfill				
	- Geotextile Layer	400	SY	$25	$10,000
	- Sand Layer (2.5 feet)	300	CY	$35	$10,500
	- Armor Layer (1.5 feet)	200	CY	$55	$11,000
	- Geotextile Layer	600	SY	$25	$15,000
	- Sand Layer (2 feet)	380	CY	$35	$13,300
14.	Health and Safety Monitoring	4	week	$1,000	$4,000
15.	Miscellaneous Disposal	1	LS	$20,000	$20,000
				Subtotal:	$777,300
				Administration and Engineering (10%):	$70,230
				Contingency (25%):	$194,325
				Total Capital Costs:	$1,041,855
				Total Estimated Cost for Alternative 4B:	**$1,041,855**
				Total Estimated Cost for Alternative 4B (Rounded):	**$1,000,000**

General Comments and Assumptions:

- All costs include materials, equipment, and labor, unless otherwise noted.
- Costs do not include legal fees, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2004 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- Costs based on current site information and project understanding. This may change following collection of additional data, receipt of NYSDEC/NYSDOH input, the City's design for the Park, and/or actual project design.
- A 12% allowance is made for mobilization/demobilization activities for project capital costs, excluding design, transport, disposal, and waste characterization.
- A 10% allowance is made for engineering fees and administration.
- A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, labor, and material costs.
- O&M costs are presented as a 30-year present worth cost assuming a 7% discount factor.
- It is assumed that measures will not be necessary to address utilities within the work area.
- Remedial construction is anticipated to occur during the winter season when water levels are drawn down (November - April).
- Assumed that remedial construction in Area 4 will be coordinated with the remedial construction activities for the remainder of the Site.
- All remedial activities will be performed in modified Level D protection.

Table 14

Niagara Mohawk, A National Grid Company
Amsterdam (Front Street) Former MGP Site
Remedial Action Report

Preliminary Cost Estimate for Mohawk River Area 4 - Alternative 4B

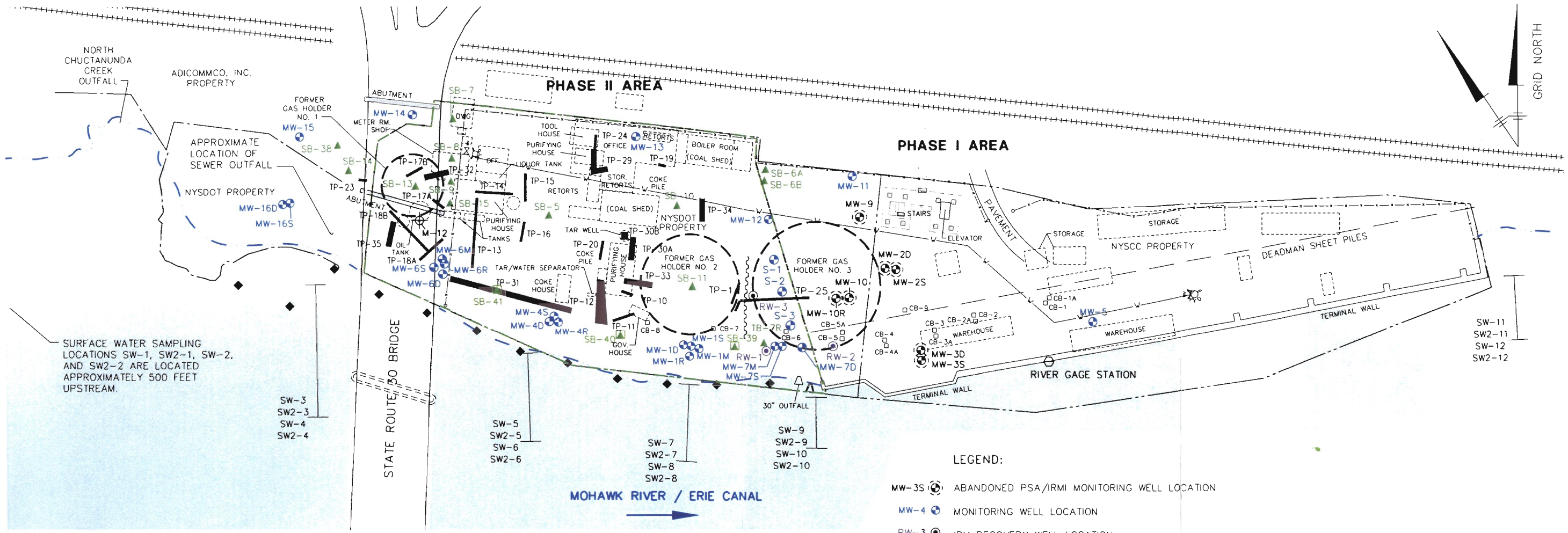
Notes and Assumptions:

1. $75,000 has been included in this cost estimate for design of the remedial alternative.
2. Mobilization/demobilization includes mobilization and demobilization of labor, equipment, and materials necessary to remove and backfill/cap the targeted area. Cost estimate assumes one construction season will be required to complete the project.
3. Support area development includes $70,000 for clearing staging area and preparing equipment and material for staging, storage, access and decontamination areas, construction trailers, and a shoreline mooring area for loading/unloading barge and watercraft. Restoration includes the replacement of gravel and fill where necessary, followed by topsoil application and vegetation, as appropriate.
4. Temporary sheetpile installation/removal costs are based on installing and removing sheeting around the area to be removed around SD-11 and SD-12. Sheetpile penetration depth is based on a river fluctuation of approximately 4 feet and an excavation depth of 2 feet. Based on preliminary assessment, the total necessary sheeting is approximately 175 linear feet by 40 feet for removing the targeted riverbed materials adjacent to SD-11 and SD-12. It has been assumed that approximately 75% of the sheeting length will be required to be driven to facilitate removal activities. The costs associated with cleaning the temporary sheeting have been included with the Miscellaneous Disposal item (#14).
5. Jersey barrier installation/removal costs were previously based on installing and removing jersey barriers around the eastern portion of the Site (east of NYSCC property) to be removed (excluding the shoreline). It is assumed that the Jersey barriers used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor. It has been assumed that jersey barriers will no longer provide appropriate water diversion to facilitate 2-foot removal to address samples SD-11 and SD-12.
6. It is assumed that a silt curtain will be used to control suspended solids migration during installation of the temporary sheeting and removal activities, and will be removed following completion of restoration activities.
7. Oil booms and absorbents will be used during installation/removal of the temporary sheetpile and will remain in place until the temporary sheeting has been removed.
8. Traffic control includes $600/day for a CSX flagger to direct/control traffic from the site during remedial construction activities.
9. Security costs are based on $30/hr, 108 hrs/wk (12 hrs/day on Monday through Friday plus 24 hrs/day on Saturday and Sunday).
10. Riverbed material removal adjacent to SD-11 and SD-12 assumed to be performed by mechanical removal in the wet. Riverbed material removal in Area 4 assumed to be performed by mechanical removal in the dry. A 10% bulking factor was assumed for dry materials. The costs are for removal, barging (for in the wet removal), and dewatering/stabilizing. For dewatering/stabilizing cost estimate, it is assumed that materials will be dewatered by removing free water from removed riverbed materials at the stockpile area at the end of each day. It is assumed 20% stabilizing agent by weight would be added to meet transportation/disposal requirements.
11. Water treatment costs are for the operation of a portable water treatment facility to treat water generated during removal, dewatering, and decontamination activities, with discharge of the treated water to the Mohawk River. It is assumed that mechanical removal in the dry (200 cy) would generate approximately 10% water by in-situ riverbed material volume (or ~ 20 gallons of water generated per 1 cy of in-situ riverbed materials). It is assumed that mechanical removal in the wet (500 cy) would generate approximately 20% water by in-situ riverbed material volume (or ~ 40 gallons of water generated per 1 cy of in-situ riverbed materials).
12. Transportation and disposal costs include labor, equipment, and materials necessary for the offsite transport and treatment/disposal of removed riverbed materials. The following assumptions have been made with regard to transportation and disposal of processed riverbed materials: 1) no materials will be reused onsite, 2) disposal volume includes removed in-situ riverbed materials (700 cy) plus stabilizing agent at 20% by weight (900 cy); 3) 10 percent of the riverbed materials (100 cy) will managed as if these were subject to the disposal requirements under the Resource Conservation and Recovery Act (RCRA) and will be disposed at CWM's facility in Model City, New York; and 4) the remaining riverbed materials are assumed to be non-hazardous (800 cy) and will be transported to ESMI's LTTD facility in Fort Edward, New York.

    -Waste characterization includes specific analytical testing required by the receiving facility. They are assumed to include TCLP, ignitability, reactivity, corrosivity, and paint filter testing for an offsite landfill. ESMI also requires data on TPH, total VOCs, total SVOCs, total PCBs, total Metals, total CN, and percent sulfur.
13. Backfill costs include the material, shipment, and placement. The following costs are assumed: 1) Geotextile Liner - 1000 sy at $25/sy, 2) Sand - 4 feet and 2 feet, as appropriate, at $35/cy, and Armor - 1.5 feet at $55/cy where appropriate. The actual components will be finalized during remedial design. A 10% overlap has been assumed for geotextile liner placement.
14. $1,000 a week has been included in this cost estimate for vapor/particulate and turbidity monitoring and control during remedial activities. Vapor/particulate monitoring would include using a PID for organic vapors and a MiniRAM for particulates. If monitoring indicates vapor, particulate, or turbidity levels above pre-determined action limits, control measures would be enacted as appropriate. Cost estimate assumes that control measures, if necessary, would be limited.
15. $20,000 has been included in this cost estimate for the disposal of miscellaneous materials (e.g., used silt curtain, personal protective equipment, and disposable equipment) at a facility permitted to accept the waste. It is assumed that the temporary sheeting used during removal activities would need to be cleaned and sampled prior to being removed off-site by the contractor.

Figures

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists



NOTES:

1. BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.
5. GEOTECHNICAL BORING LOCATION M-12 WAS INSTALLED BY NYSDOT. SOIL BORINGS SB-6A/B THROUGH SB-15, TEST PITS TP-1 THROUGH TP-24 AND MONITORING WELLS MW-1D, MW-2S/D, MW-3D, MW-4D, MW-5D, MW-6D, AND MW-7D COMPLETED BY HARZA DURING THE PRELIMINARY SITE ASSESSMENT (PSA), FEBRUARY 1999. ALL OTHER SOIL BORINGS, TEST PITS, MONITORING WELLS, RECOVERY WELLS, AND RIVERBANK ASSESSMENT POINTS WERE INSTALLED/COMPLETED BY BBL DURING THE INTERIM REMEDIAL MEASURE INVESTIGATION (IRMI), THE PHASE II AREA INVESTIGATION, THE MOHAWK RIVER INVESTIGATION, AND AFTER THE IRM. FOR CLARITY, THE LOCATIONS OF PSA AND IRMI BORINGS AND TEST PITS ARE NOT SHOWN FOR THE PHASE I AREA. ADDITIONALLY, TEST PITS LOCATED IN THE PHASE II AREA (EXCEPT FOR TP-25) WHICH WERE EXCAVATED DURING THE IRMI, ARE NOT INCLUDED.
6. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.
7. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.
8. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.
9. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL, 2000).
10. FOUR SURFACE-WATER SAMPLES WERE COLLECTED ALONG EACH TRANSECT, TWO DURING THE HIGH (SUMMER) RIVER-LEVEL SAMPLING EVENT AND TWO DURING THE LOW (WINTER) RIVER-LEVEL SAMPLING EVENT. THE PREFIX "SW2" INDICATES SAMPLES COLLECTED DURING THE SUMMER SAMPLING EVENT. DURING EACH EVENT ONE SAMPLE WAS COLLECTED 10 FEET FROM THE SHORE LINE AND THE OTHER SAMPLE WAS COLLECTED 50 FEET FROM THE SHORELINE. SAMPLES WITH THE HIGHER NUMERICAL I.D. ALONG EACH TRANSECT WERE COLLECTED FURTHER (50') FROM SHORE.
11. IRMI MONITORING WELL MW-8 WAS ABANDONED DURING THE IRM AND REPLACED WITH RECOVERY WELL RW-3. THE LOCATION OF MW-8 IS NOT SHOWN ON THIS FIGURE.
12. CATCH BASIN CB-7 WAS ABANDONED DURING THE IRM.

LEGEND:

- MW-3S — ABANDONED PSA/IRMI MONITORING WELL LOCATION
- MW-4 — MONITORING WELL LOCATION
- RW-3 — IRM RECOVERY WELL LOCATION
- SB-6A — SOIL BORING LOCATION
- SB-40 — GEOTECHNICAL BORING LOCATION
- M-12 — NYSDOT GEOTECHNICAL BORING LOCATION
- TP-21 — TEST PIT LOCATION
- RIVERBANK ASSESSMENT POINT
- SW-3 — SURFACE WATER SAMPLING TRANSECT (SEE NOTE 10)
- CB-1 — CATCH BASIN LOCATION
- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- EXISTING STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- WATER LINE

0 100' 200'
GRAPHIC SCALE

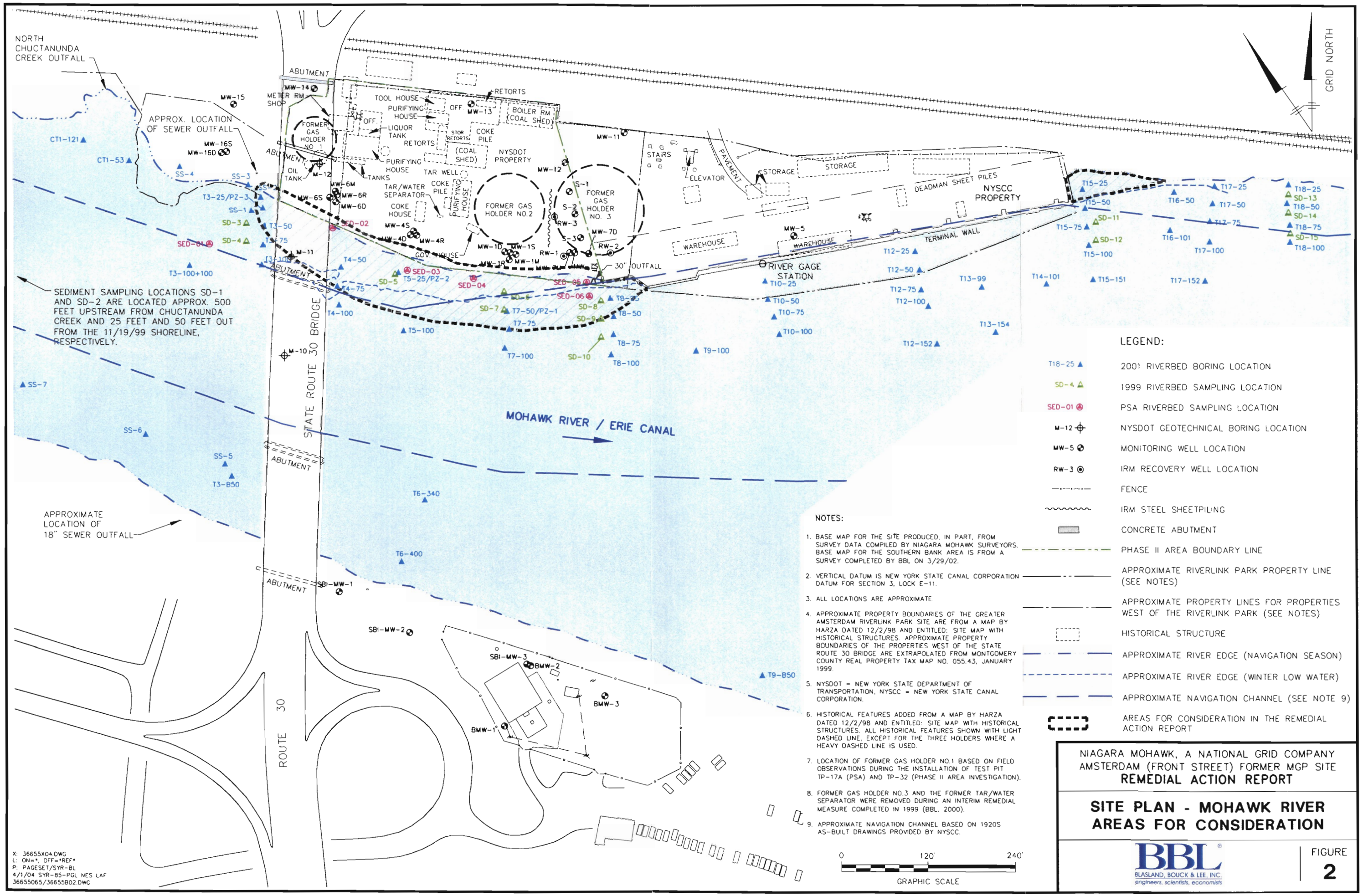
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

SITE PLAN - PHASE II AREA

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 1

X: 36655X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655065/36655B01.DWG

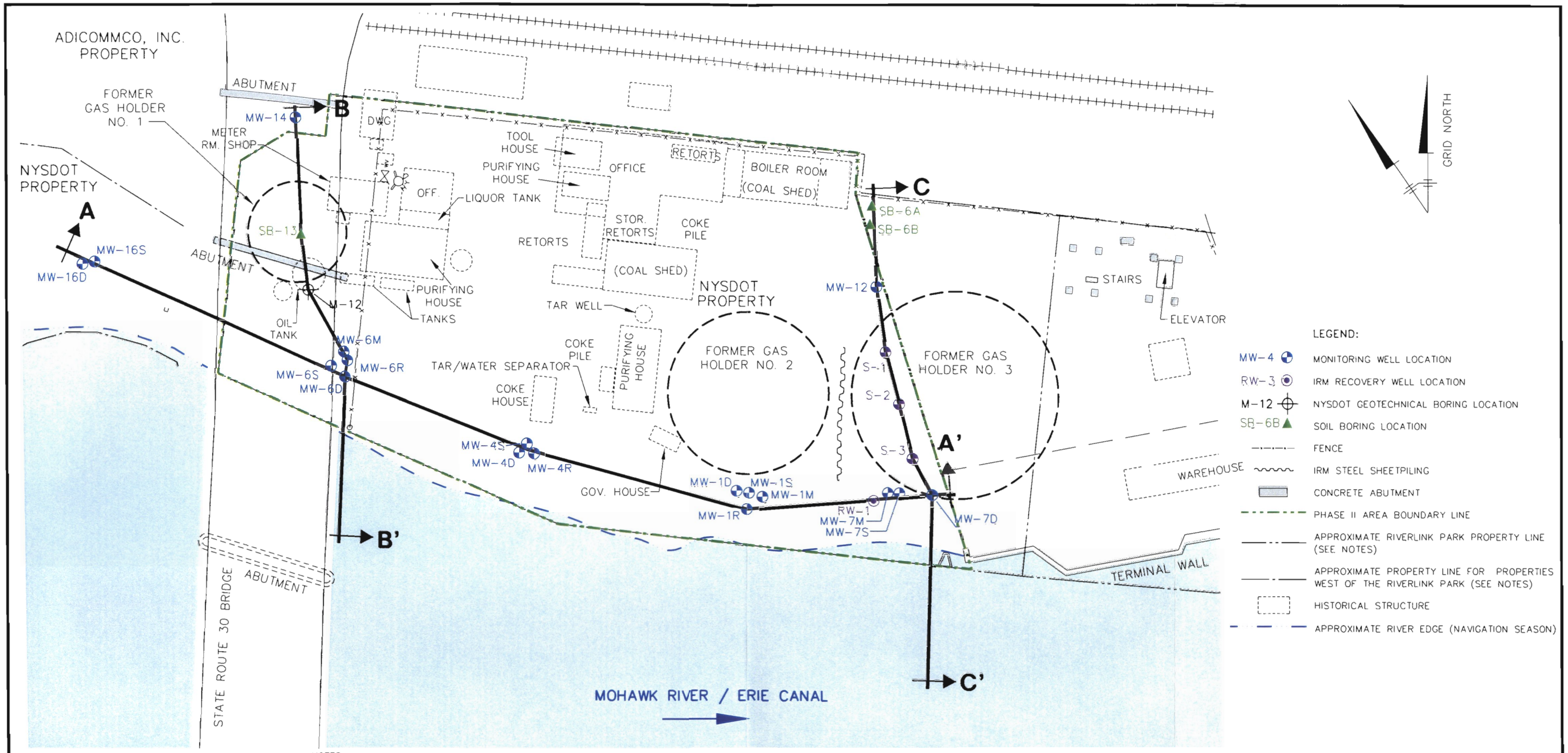


NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

SITE PLAN - MOHAWK RIVER AREAS FOR CONSIDERATION

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 2



NOTES:

1. BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.
5. GEOTECHNICAL BORING LOCATION M-12 WAS INSTALLED BY NYSDOT. SOIL BORINGS SB-6A/B THROUGH SB-15, TEST PITS TP-1 THROUGH TP-24 AND MONITORING WELLS MW-1D, MW-2S/D, MW-3D, MW-4D, MW-5D, MW-6D, AND MW-7D COMPLETED BY HARZA DURING THE PRELIMINARY SITE ASSESSMENT (PSA), FEBRUARY 1999. ALL OTHER SOIL BORINGS, TEST PITS, MONITORING WELLS, RECOVERY WELLS, AND RIVERBANK ASSESSMENT POINTS WERE INSTALLED BY BBL DURING THE INTERIM REMEDIAL MEASURE INVESTIGATION (IRMI), THE PHASE II AREA INVESTIGATION, THE MOHAWK RIVER INVESTIGATION, AND AFTER THE IRM. FOR CLARITY, THE LOCATIONS OF PSA AND IRMI BORINGS AND TEST PITS ARE NOT SHOWN FOR THE PHASE I AREA. ADDITIONALLY, TEST PITS LOCATED IN THE PHASE II AREA (EXCEPT FOR TP-25) WHICH WERE EXCAVATED DURING THE IRM, ARE NOT INCLUDED.
6. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.
7. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.
8. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.
9. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED BY BBL (BBL, 2000).
10. IRMI MONITORING WELL MW-8 WAS ABANDONED DURING THE IRM AND REPLACED WITH RECOVERY WELL RW-3. THE LOCATION OF MW-8 IS NOT SHOWN ON THIS FIGURE.
11. THIS FIGURE WAS ORIGINALLY FIGURE 4 OF THE PHASE II AREA INVESTIGATION REPORT. CROSS-SECTION B-B' DEVELOPED FOR THAT REPORT SUPERCEDED BY THE CROSS-SECTION DEVELOPED AS PART OF THE MOHAWK RIVER INVESTIGATION AND INCLUDED IN THIS RAR AS FIGURE 8.

0 60' 120'
GRAPHIC SCALE

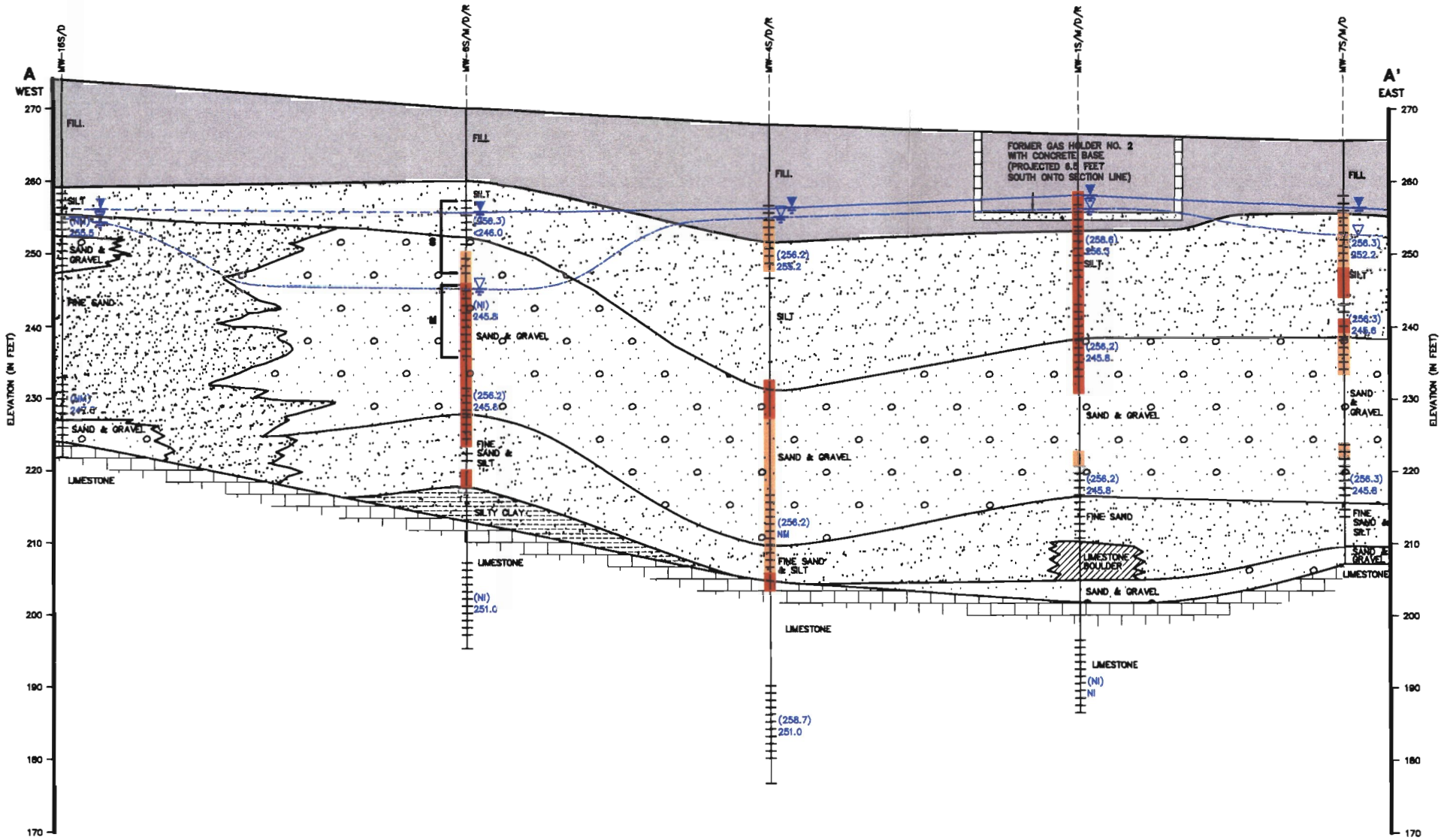
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

GEOLOGIC CROSS-SECTION LOCATION MAP - PHASE II AREA

BBL BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE 3

X: 36655X04.DWG
L: ON=*, OFF=REF
4/1/04 SYR-BS-MAD NES LAF
36655065/36655B03.DWG



LEGEND:

- MW-16S/D — WELL/SOIL BORING NUMBER
- GROUND SURFACE
- SCREENED INTERVAL
- BOTTOM OF BORING
- CONTACT BETWEEN GEOLOGIC UNITS
- WATER TABLE (11/18/99)
- WATER TABLE (12/14/99)
- (256.33) WATER LEVEL ELEVATION (11/18/99)
- 252.16 WATER LEVEL ELEVATION (12/14/99)
- NM NOT MEASURED
- NI NOT INSTALLED ON DATE OF MEASUREMENT
- SHEEN
- NAPL

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN BORINGS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.
4. MOHAWK RIVER/ERIE CANAL WATER SURFACE ON 11/18/99: 256.2 FT. AND ON 12/14/99: 245.7 FT.

0 60' 120'

HORIZONTAL GRAPHIC SCALE

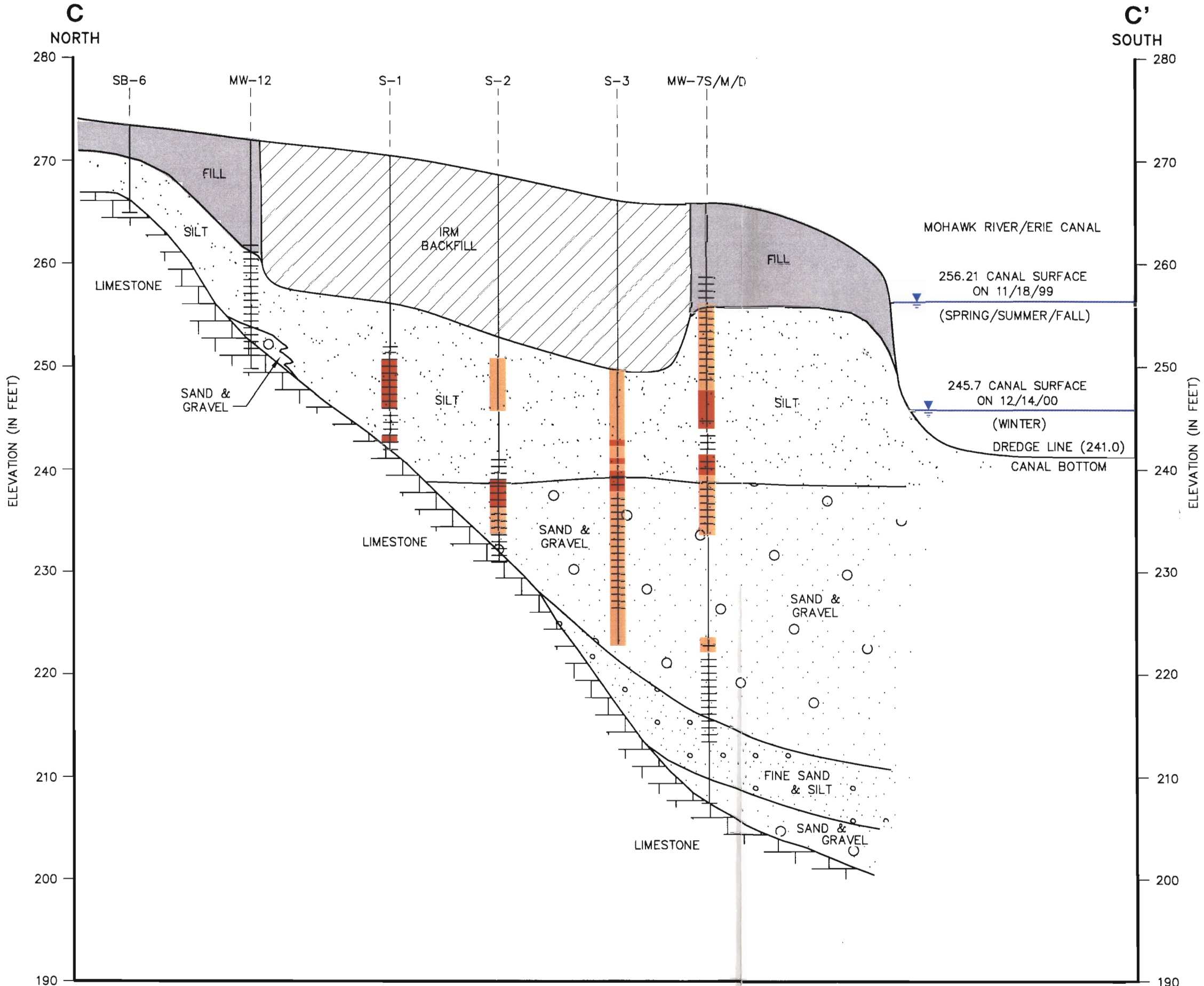
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REMEDIAL ACTION REPORT

PHASE II AREA GEOLOGIC CROSS-SECTION A-A'

BBL® BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **4**

L: ON=*, OFF=REF*
P: PAGESET/PLT-BL
3/30/04 SYR-85-PGL GMS LAF
36655065/36655V01.DWG



LEGEND:

- MW-14 — WELL/SOIL BORING NUMBER
- GROUND SURFACE
- SCREENED INTERVAL
- BOTTOM OF BORING
- CONTACT BETWEEN GEOLOGIC UNITS
- APPROXIMATE LIMITS OF IRM BACKFILL
- SHEEN
- NAPL

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN BORINGS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.
4. THE ELEVATION OF THE CANAL DREDGE LINE IS BASED ON: NEW YORK STATE CANAL CORPORATION (NYSCC) 1998. "ALBANY DIVISION PLANS FOR REPAIR OF THE CANAL TERMINAL WALL AT AMSTERDAM-STRIN 30014A ON THE ERIE CANAL IN MONTGOMERY COUNTY." TAA 97-64C, JULY 13, 1998.

0 30' 60'

HORIZONTAL GRAPHIC SCALE

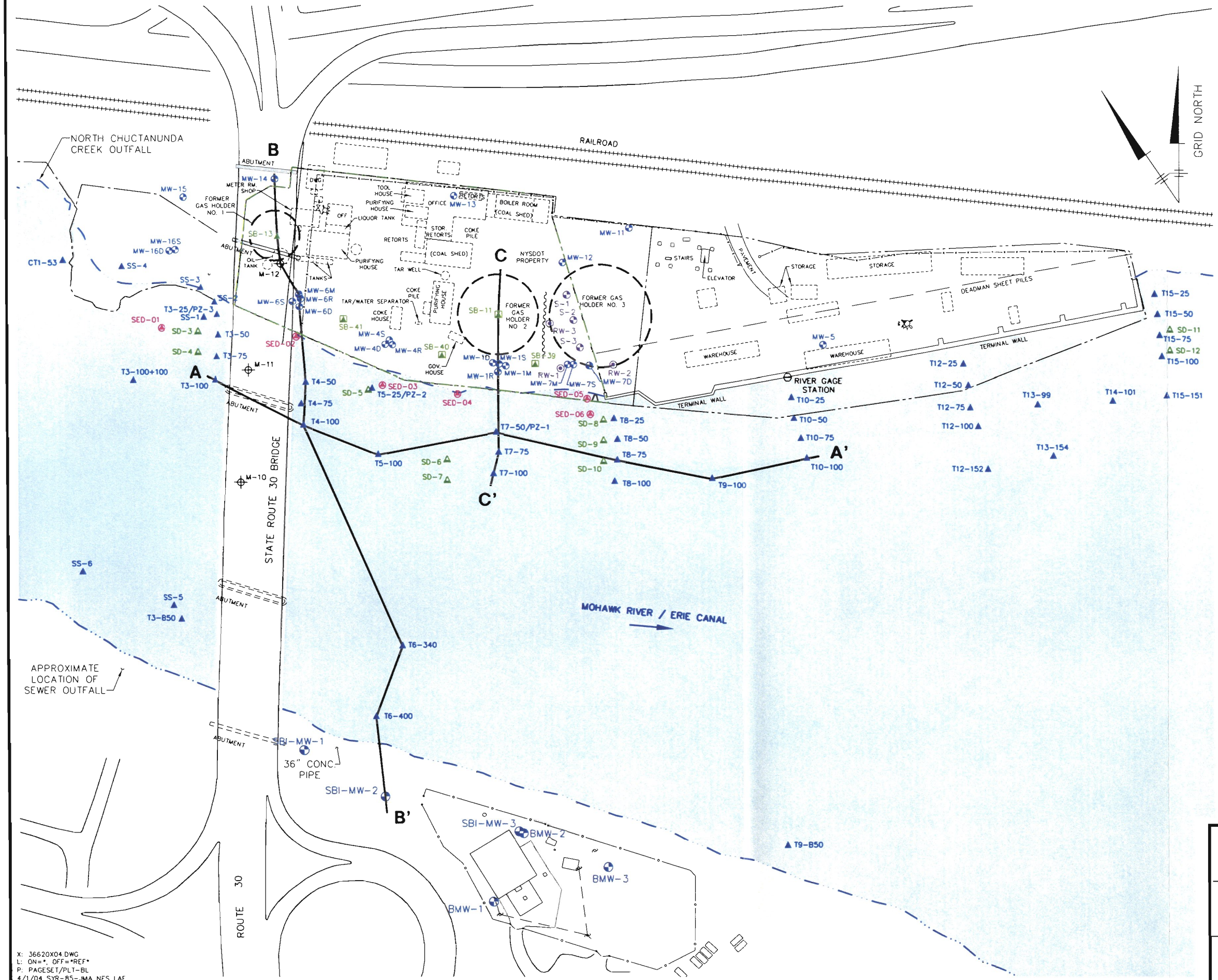
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

PHASE II AREA GEOLOGIC CROSS-SECTION C-C'

BBL® BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **5**

L: ON=*, OFF=*REF*
P: PAGESET/PLT-BL
3/30/04 SYR-85-PGL NES LAF
36655065/36655V03.DWG



LEGEND

- T18-25 ▲ 2001 RIVERBED BORING LOCATION
- SD-4 ▲ 1999 RIVERBED SAMPLING LOCATION
- SED-01 ◉ PSA RIVERBED SAMPLING LOCATION
- SB-39 ▲ GEOTECHNICAL BORING LOCATION
- MW-5 ◉ MONITORING WELL LOCATION
- RW-3 ◉ IRM RECOVERY WELL LOCATION
- M-12 ⊕ NYSDOT GEOTECHNICAL BORING LOCATION
- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- A —— A' LINE OF CROSS SECTION

NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS, AND IS LOCATED IN STATE PLANE COORDINATE SYSTEM (NAD 83 HORIZ.) NEW YORK EAST ZONE. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.
5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.
6. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.
7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.
8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED BY BBL (BBL, 2000).

0 120' 240'

GRAPHIC SCALE

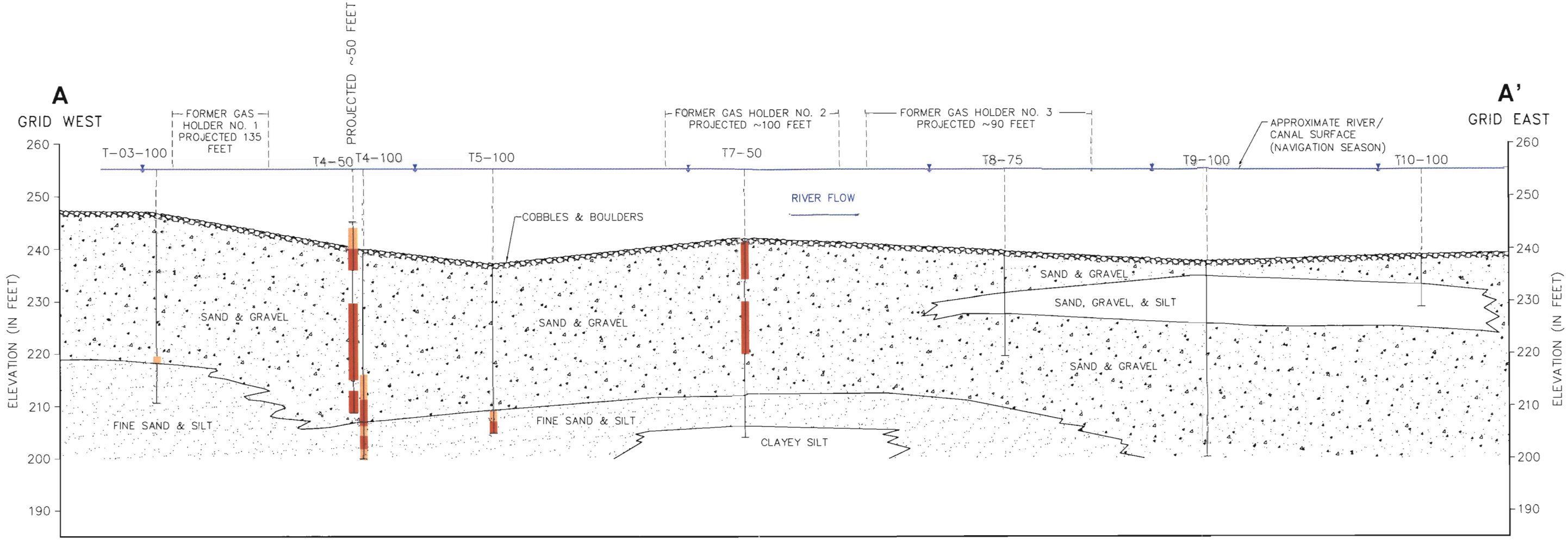
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

GEOLOGIC CROSS-SECTION LOCATION MAP - MOHAWK RIVER

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 6

X: 36620X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/PLT-BL
4/1/04 SYR-85-JMA NES LAF
36655065/36655B04.DWG



NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. LOCATIONS IN THE RIVER PRODUCED FROM SURVEY COMPLETED BY BBL DURING THE SUPPLEMENTAL RIVERBED INVESTIGATION.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.

LEGEND:

- MW-14 — SOIL BORING NUMBER
- GROUND OR SEDIMENT SURFACE
- BOTTOM OF BORING
- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- RIVER/CANAL LEVEL
- SHEEN
- NAPL

0 60' 120'

HORIZONTAL GRAPHIC SCALE

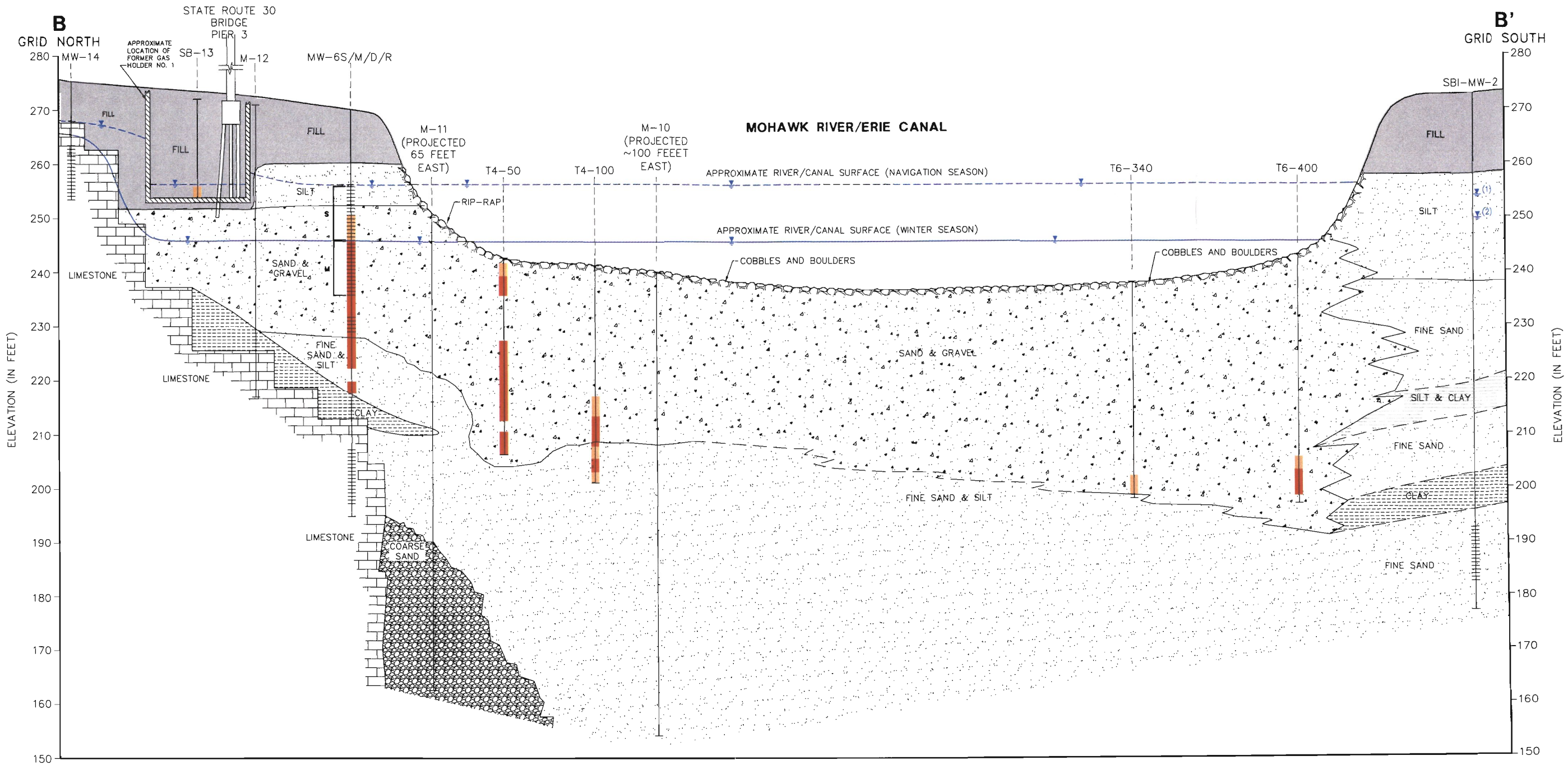
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

MOHAWK RIVER GEOLOGIC CROSS-SECTION A-A'

BBL® BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 7

L: ON=*, OFF=REF
P: PAGESET/SYR-DL
3/30/04 SYR-BS-PGL NES LAF
36555065/36555V04.DWG



NOTES:

1. SITE LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS, SOUTHERN BANK AND RIVERBED BORING LOCATIONS FROM BASE MAP PRODUCED BY BBL SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED
4. GEOTECHNICAL BORING M-10, M-11, AND M-12 FROM: AMSTERDAM NORTH-SOUTH ARTERIAL, MOHAWK RIVER TO GROVE STREET, MONTGOMERY COUNTY, SHEET NO. 89, STATE OF NEW YORK, (CIRCA 1957).
5. DESIGN OF STATE ROUTE 30 BRIDGE, PIER 3, FROM: AMSTERDAM NORTH-SOUTH ARTERIAL, MOHAWK RIVER TO GROVE STREET, MONTGOMERY COUNTY, SHEET NO. 105, DRAWING NO. 17 OF 113, STATE OF NEW YORK, (UNKNOWN DATE). PILING LENGTHS VARY FROM 14.5 FEET TO 36 FEET LONG. INDIVIDUAL PILE LENGTHS ARE UNKNOWN.
6. BOTTOM OF FORMER GAS HOLDER NO. 1 BASED ON A BORING LOG FOR SOIL BORING SB-13 INCLUDED IN THE PRELIMINARY SITE ASSESSMENT (HARZA, 1999). BBL DOES NOT HAVE INFORMATION REGARDING THE CONSTRUCTION OF GAS HOLDER NO. 1. FOR SIMPLICITY THE BOTTOM OF THIS GAS HOLDER IS ASSUMED TO BE FLAT.

LEGEND:

- MW-14 — WELL/SOIL BORING NUMBER
- GROUND OR RIVERBED SURFACE
- SCREENED INTERVAL
- BOTTOM OF BORING
- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- WATER TABLE AND RIVER/CANAL LEVEL (11/18/99)
- WATER TABLE AND RIVER/CANAL LEVEL (12/14/00)
- SHEEN
- NAPL
- (1) WATER LEVEL MEASURED IN WATER TABLE MONITORING WELL B-MW-3 LOCATED APPROXIMATELY 120 FEET EAST OF SB1-MW-2 ON 4/4/02.
- (2) WATER LEVEL MEASURED IN SB1-MW-2 ON 4/4/02.

0 60' 120'

HORIZONTAL GRAPHIC SCALE

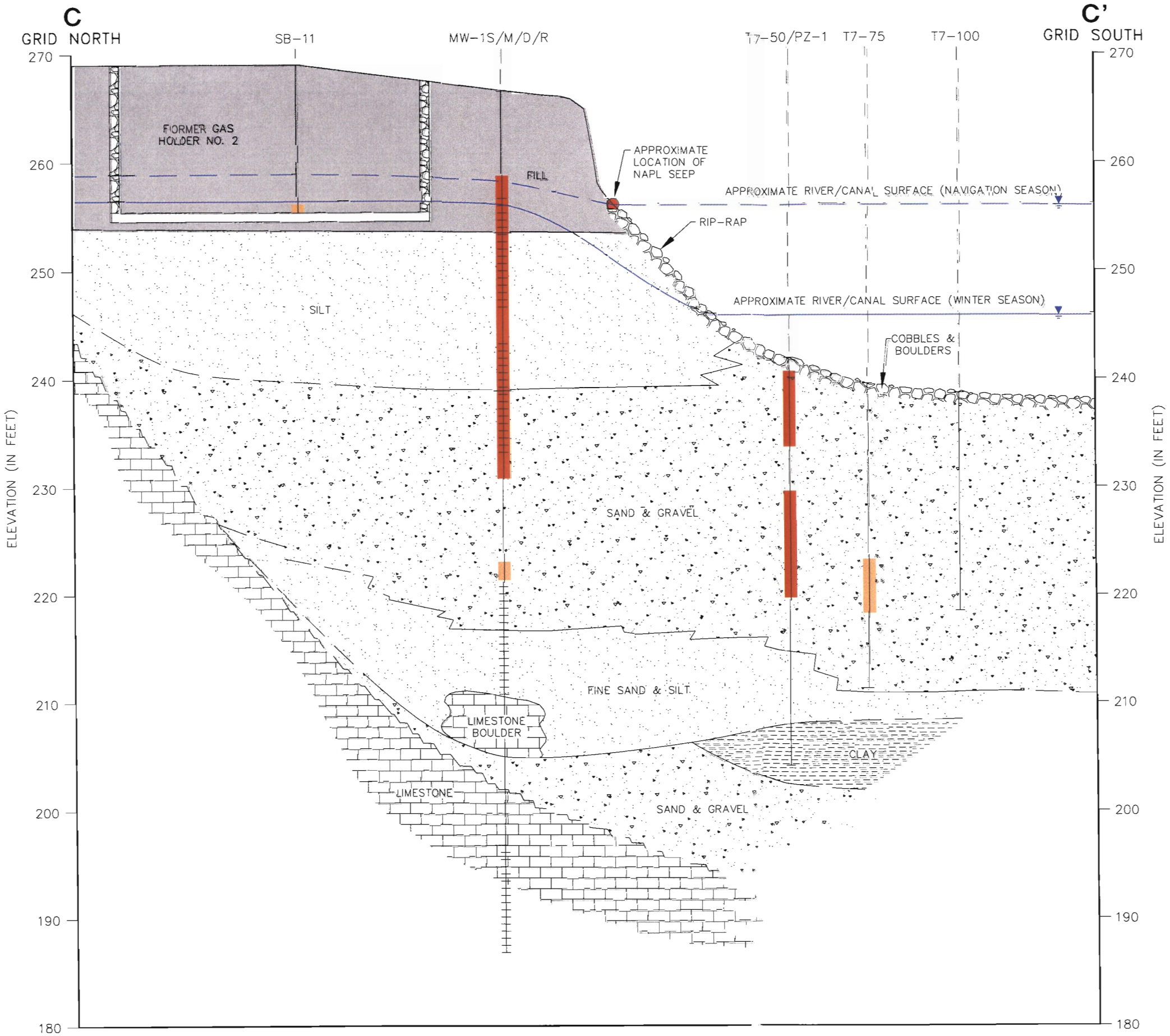
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AMSTERDAM (FRONT STREET) FORMER MGP SITE
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MOHAWK RIVER GEOLOGIC CROSS-SECTION B-B'

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 8

L: ON=*, OFF=REF
P: PAGESET/SYR-DL
3/30/04 SYR-85-PGL NES LAF
36655065/36655V05.DWG



LEGEND:

- MW-1S/M/D/R — WELL/SOIL BORING NUMBER
- GROUND OR SEDIMENT SURFACE
- SCREENED INTERVAL
- BOTTOM OF BORING
- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- WATER TABLE AND RIVER/CANAL LEVEL (11/18/99)
- WATER TABLE AND RIVER/CANAL LEVEL (12/14/00)
- SHEEN
- NAPL

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. RIVERBED LOCATIONS FROM BASEMAP PRODUCED BY BBL SURVEYORS.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.

0 30' 60'

HORIZONTAL GRAPHIC SCALE

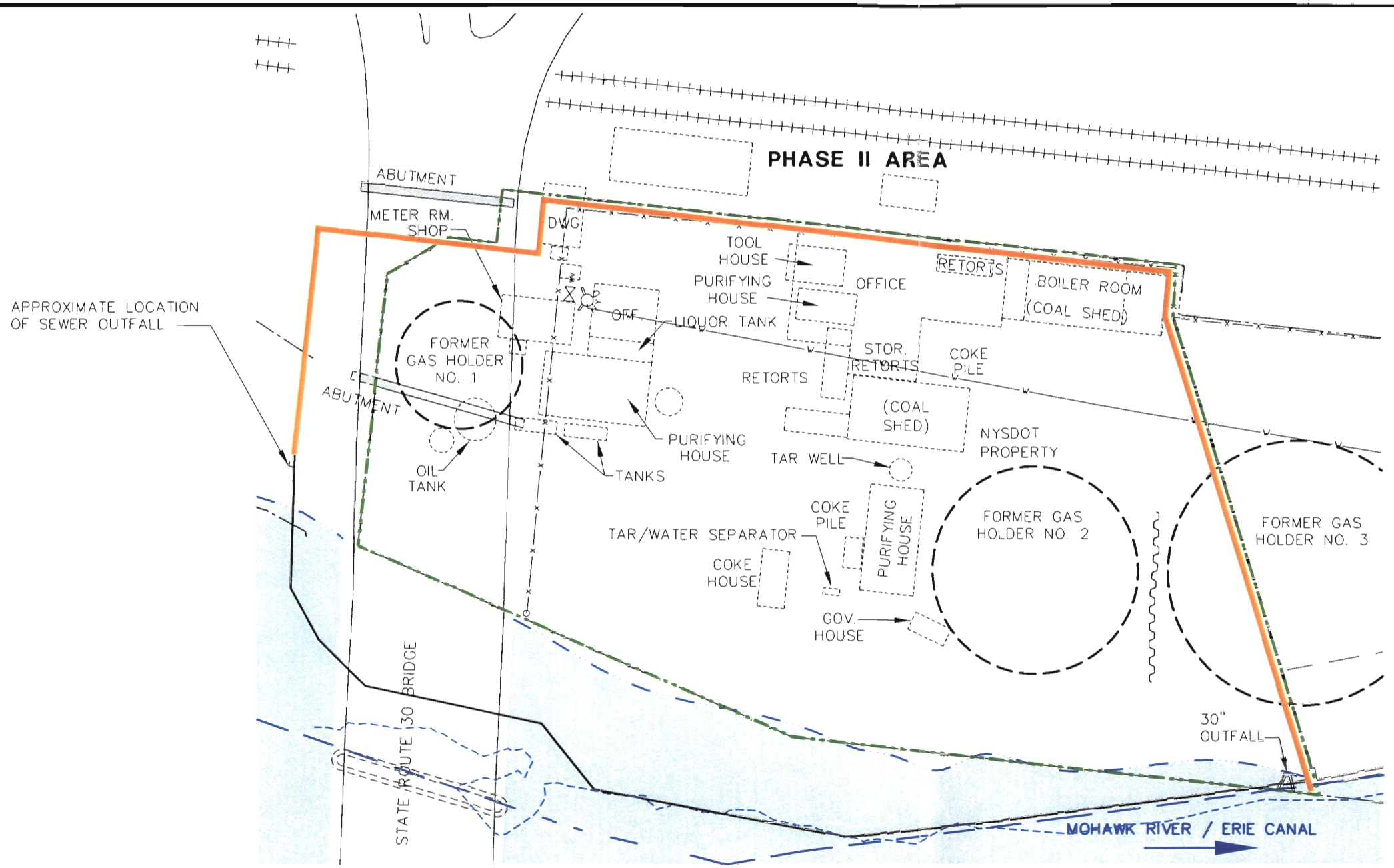
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MOHAWK RIVER GEOLOGIC CROSS-SECTION C-C'

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FIGURE 9

L: ON=*, OFF=REF
P: PAGESET/SYR-DL
3/30/04 SYR-85-PGL NES LAF
36655065/36655V06.DWG



LEGEND:

- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE RIVER EDGE (WINTER LOW WATER)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 9)
- WATER LINE
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION – WINTER LOW WATER
- CONCEPTUAL UPLAND BARRIER WALL LOCATIONS

0 60' 120'
GRAPHIC SCALE

NOTES:

1. BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. ALL LOCATIONS ARE APPROXIMATE.

4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.

5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.

6. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.

7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.

8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL, 2000).

9. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.

10. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

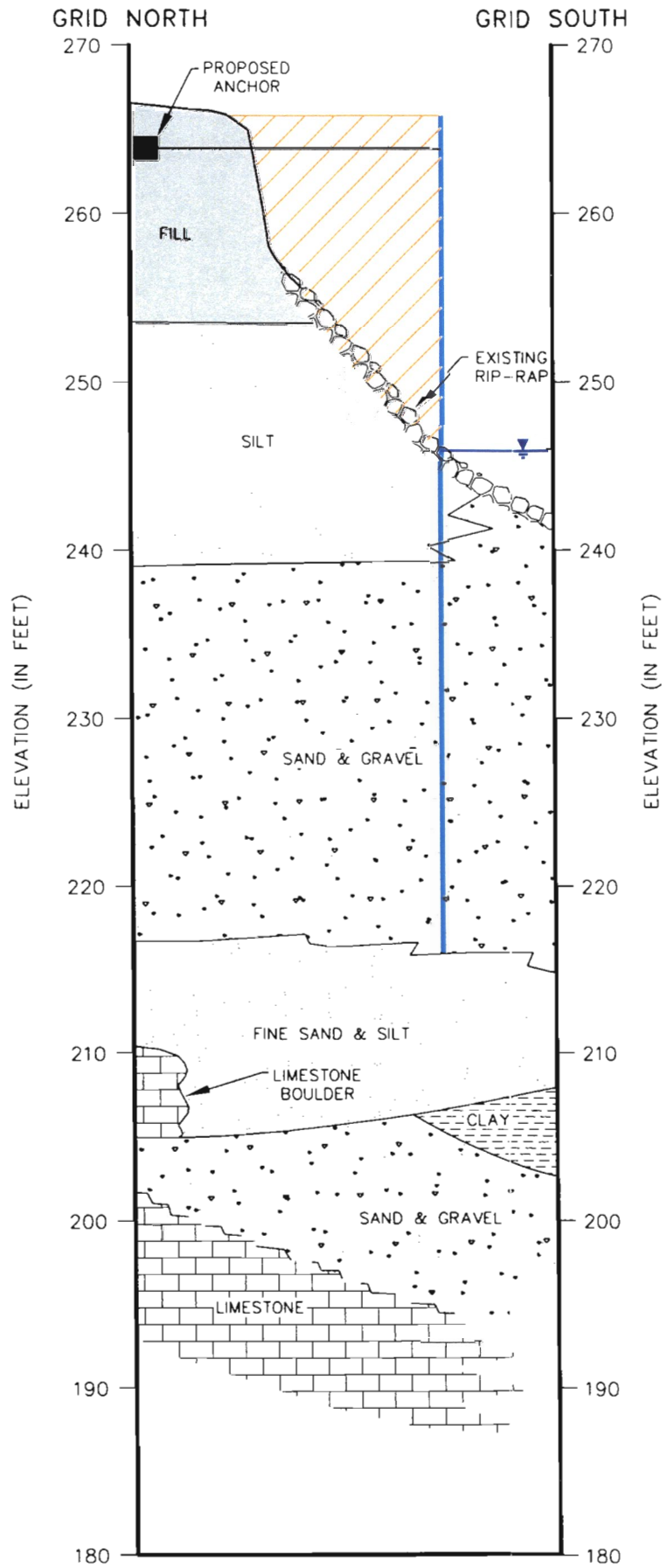
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L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-BS-PGL NES LAF
36655066/36655B01.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
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BARRIER WALL ALTERNATIVE A - CONCEPTUAL PLAN VIEW

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FIGURE **10A**



MOHAWK RIVER GEOLOGIC CROSS SECTION C-C'

LEGEND:

- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- APPROXIMATE RIVER/CANAL SURFACE (WINTER LOW WATER)
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION
- PROPOSED AREA TO BE BACKFILLED TO CREATE PLATEAU FOR PARK EXPANSION. BACKFILL VOLUME AND BARRIER WALL ELEVATION SUBJECT TO CHANGE DURING REMEDIAL DESIGN.

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. RIVERBED LOCATIONS FROM BASEMAP PRODUCED BY BBL SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.

4. ALL LOCATIONS ARE APPROXIMATE.

5. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

0 30' 60'

HORIZONTAL GRAPHIC SCALE

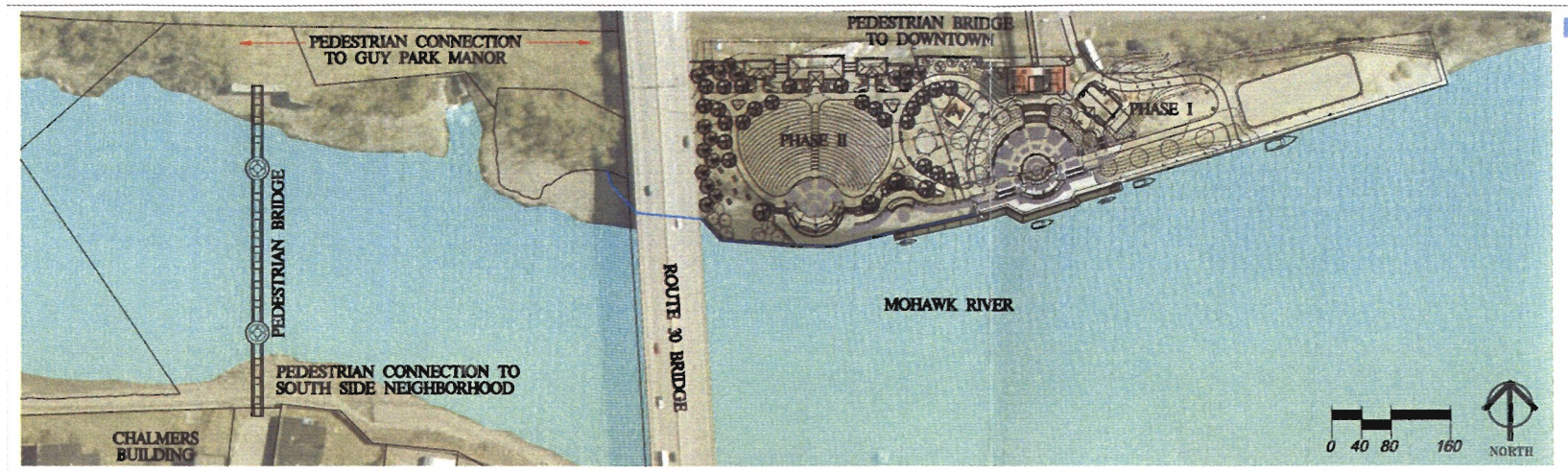
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

BARRIER WALL ALTERNATIVE A - CONCEPTUAL CROSS-SECTION VIEW

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

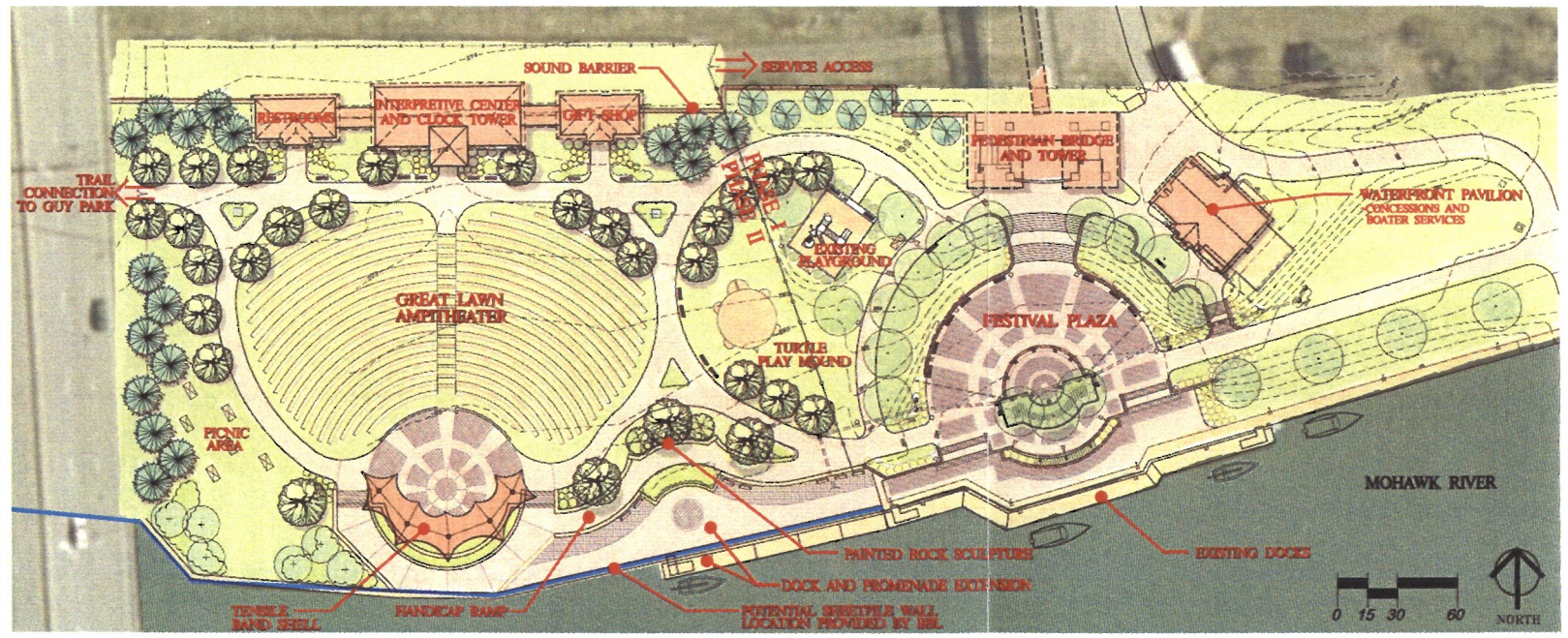
FIGURE **10B**

X: 36655X00.DWG
L: ON=*; OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655V01.DWG



NORTH SHORE SCHEMATIC MASTER PLAN

SCALE: 1"=80'-0"



PHASE II PRELIMINARY SCHEMATIC DESIGN

SCALE: 1"=30'-0"

AMSTERDAM WATERFRONT REVITALIZATION PROGRAM

DECEMBER 2003

THE SARATOGA ASSOCIATES

LANDSCAPE ARCHITECTS, ARCHITECTS, ENGINEERS AND PLANNERS, P.C.
SARATOGA SPRINGS • NEW YORK CITY • BOSTON, MA

CITY OF AMSTERDAM
NEW YORK

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NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE

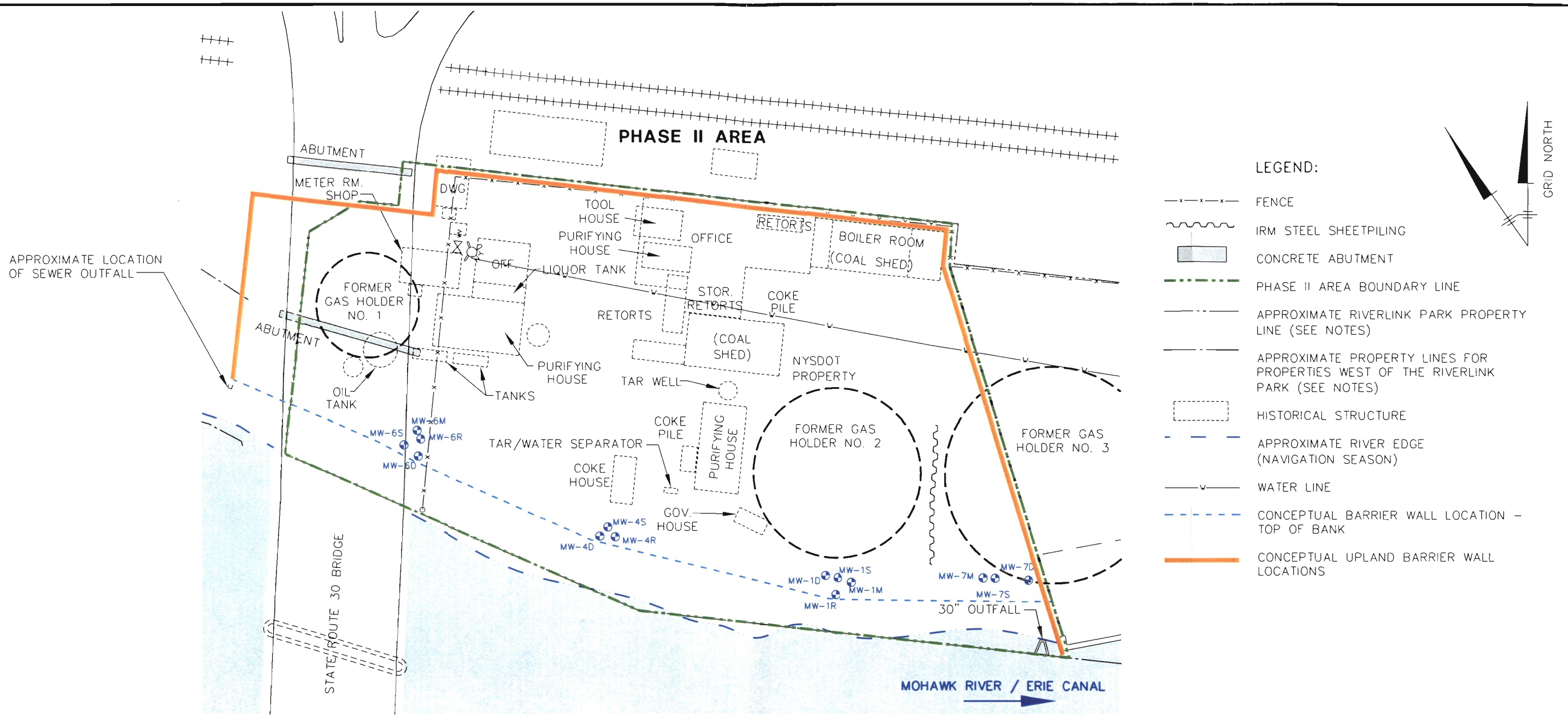
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SARATOGA ASSOCIATES RIVERLINK PARK CONCEPTUAL FIGURE

BBL BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE 11

03/26/04 SYR-D85 KFS
36655066/36655F02.CDR



NOTES:

1. BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. ALL LOCATIONS ARE APPROXIMATE.

4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.

5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.

6. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.

7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.

8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL, 2000).

9. TOP OF BANK IS ASSUMED, AND WOULD BE DEFINED DURING THE REMEDIAL DESIGN.

10. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

0 60' 120'
GRAPHIC SCALE

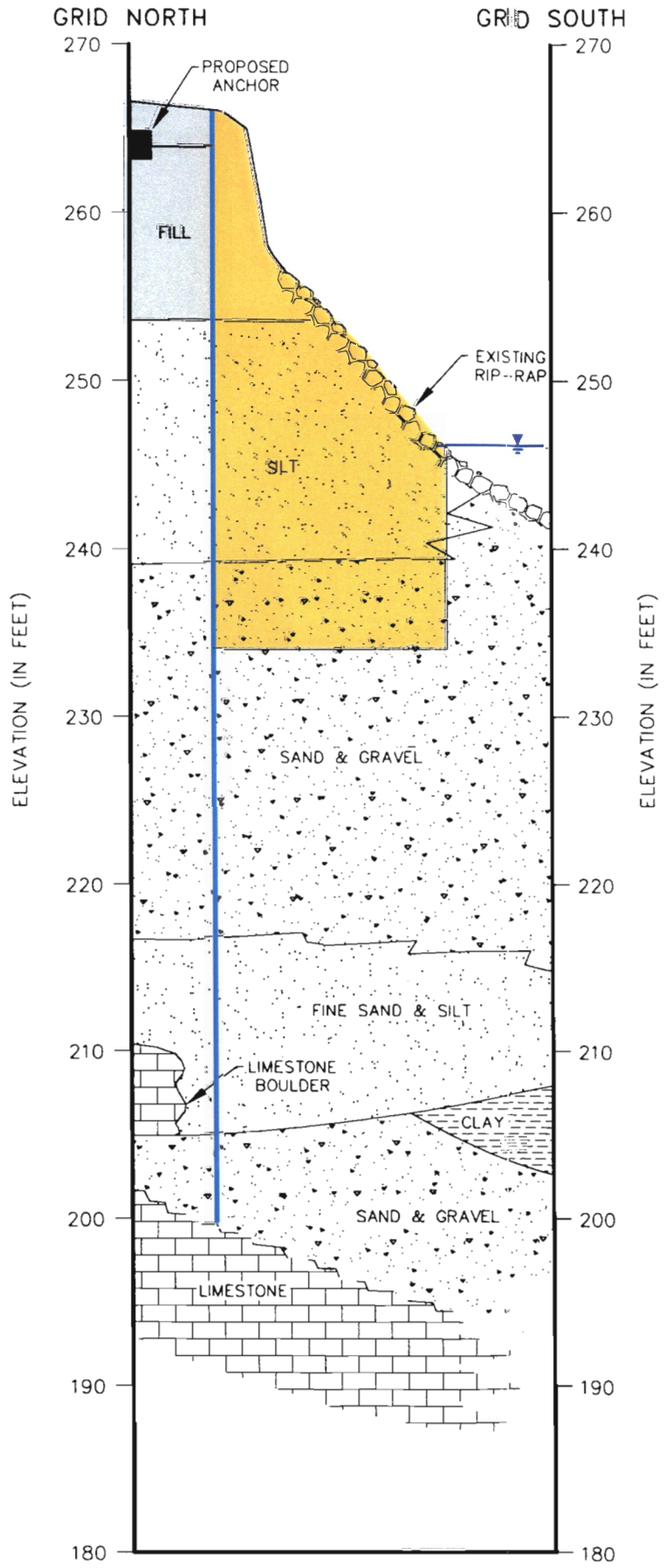
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4/1/04 SYR-85-PGL NES LAF
36655066/36655B02.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

BARRIER WALL ALTERNATIVE B - CONCEPTUAL PLAN VIEW

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **12A**



MOHAWK RIVER GEOLOGIC CROSS SECTION C-C'

LEGEND:

- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- APPROXIMATE RIVER/CANAL SURFACE (WINTER LOW WATER)
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION
- PROPOSED AREA TO BE REMOVED AND BACKFILLED

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. RIVERBED LOCATIONS FROM BASEMAP PRODUCED BY BBL SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.

4. ALL LOCATIONS ARE APPROXIMATE.

5. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

0 30' 60'

HORIZONTAL GRAPHIC SCALE

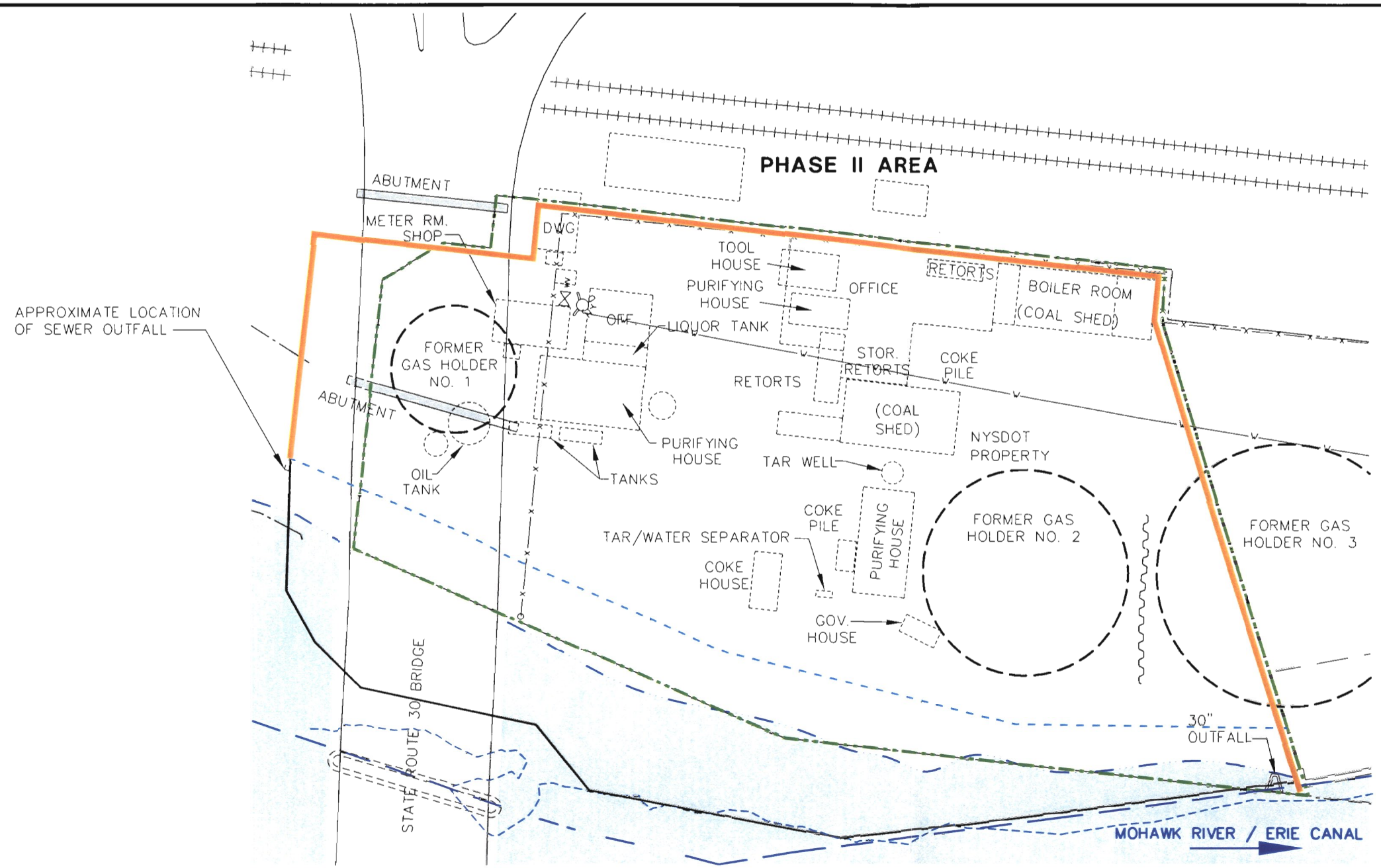
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

BARRIER WALL ALTERNATIVE B - CONCEPTUAL CROSS-SECTION VIEW

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **12B**

X: 36655X00.DWG
L: ON=*; OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655V02.DWG



LEGEND:

- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE RIVER EDGE (WINTER LOW WATER)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 9)
- WATER LINE
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION – TOP OF BANK
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION – WINTER LOW WATER
- CONCEPTUAL UPLAND BARRIER WALL LOCATIONS

0 60' 120'
GRAPHIC SCALE

NOTES:

1. BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. ALL LOCATIONS ARE APPROXIMATE.

4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.

5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.

6. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.

7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A DURING THE PSA AND TP-32 DURING THE PHASE II AREA INVESTIGATION.

8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL, 2000).

9. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.

10. TOP OF BANK IS ASSUMED, AND WOULD BE DEFINED DURING THE REMEDIAL DESIGN.

11. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

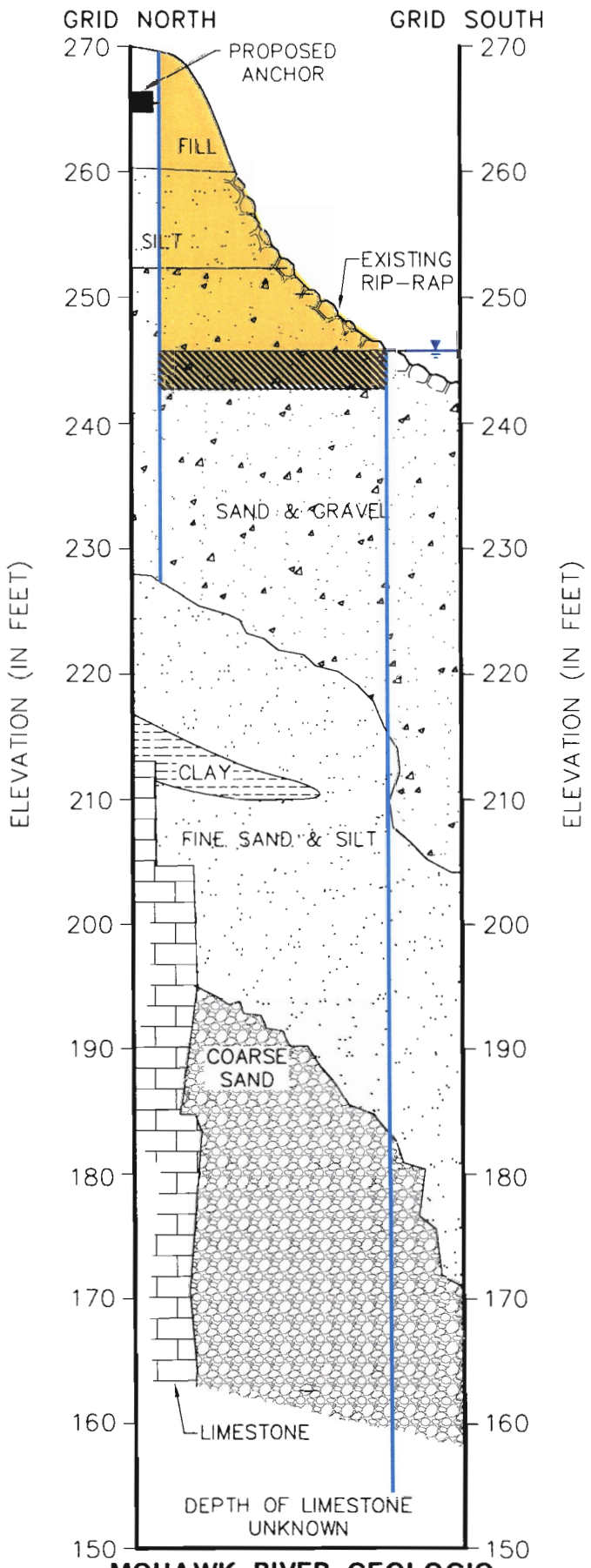
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4/1/04 SYR-85-PGL NES LAF
36655066/36655B03.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

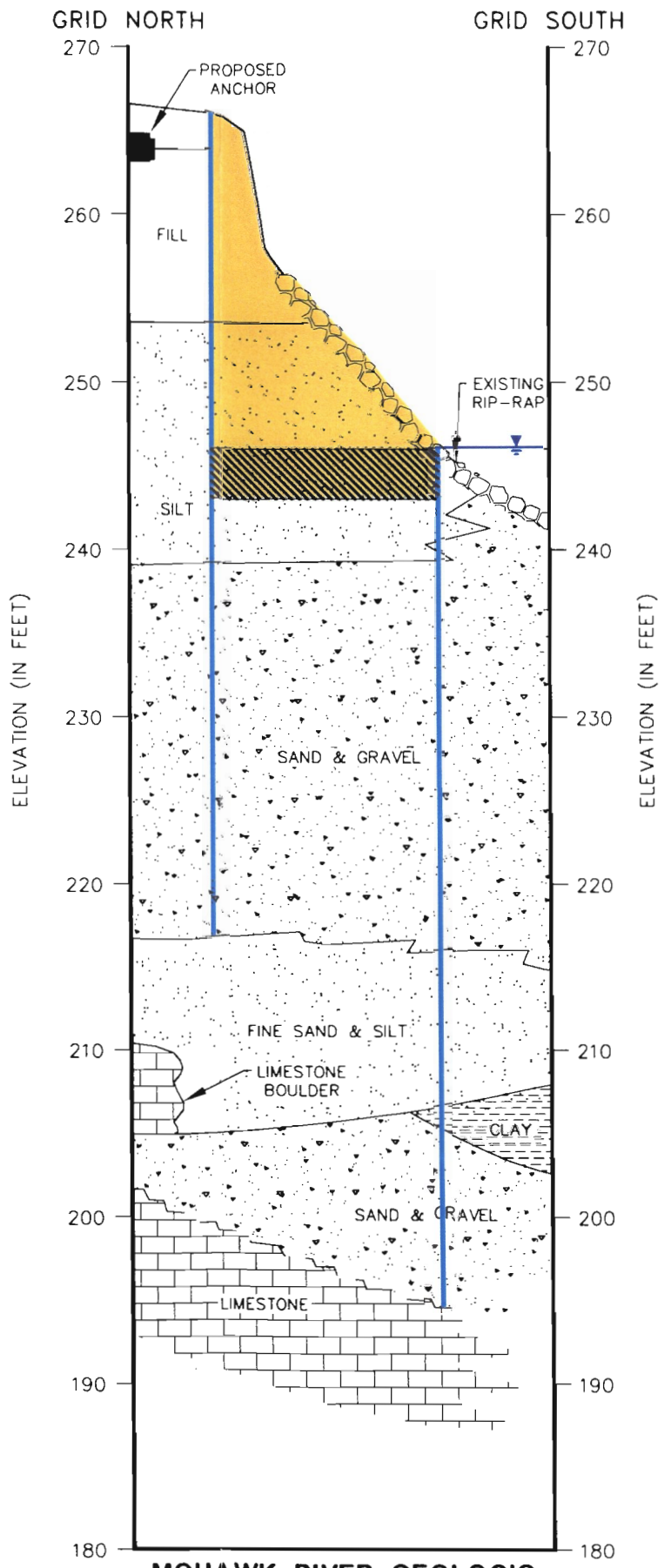
BARRIER WALL ALTERNATIVE C - CONCEPTUAL PLAN VIEW

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **13A**



MOHAWK RIVER GEOLOGIC CROSS SECTION B-B'



MOHAWK RIVER GEOLOGIC CROSS SECTION C-C'

LEGEND:

- INFERRED CONTACT BETWEEN GEOLOGIC UNITS
- APPROXIMATE RIVER/CANAL SURFACE (WINTER LOW WATER)
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATIONS
- PROPOSED AREA TO BE REMOVED AND BACKFILLED
- PROPOSED AREA TO BE REMOVED THEN BACKFILLED/CAPPED

NOTES:

1. LOCATIONS FROM BASE MAP PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. RIVERBED LOCATIONS FROM BASEMAP PRODUCED BY BBL SURVEYORS.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. CONTACTS ARE APPROXIMATE AND ARE INFERRED BETWEEN SUBSURFACE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS HAVE BEEN GENERALIZED.

4. ALL LOCATIONS ARE APPROXIMATE.

5 ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

0 30' 60'

HORIZONTAL GRAPHIC SCALE

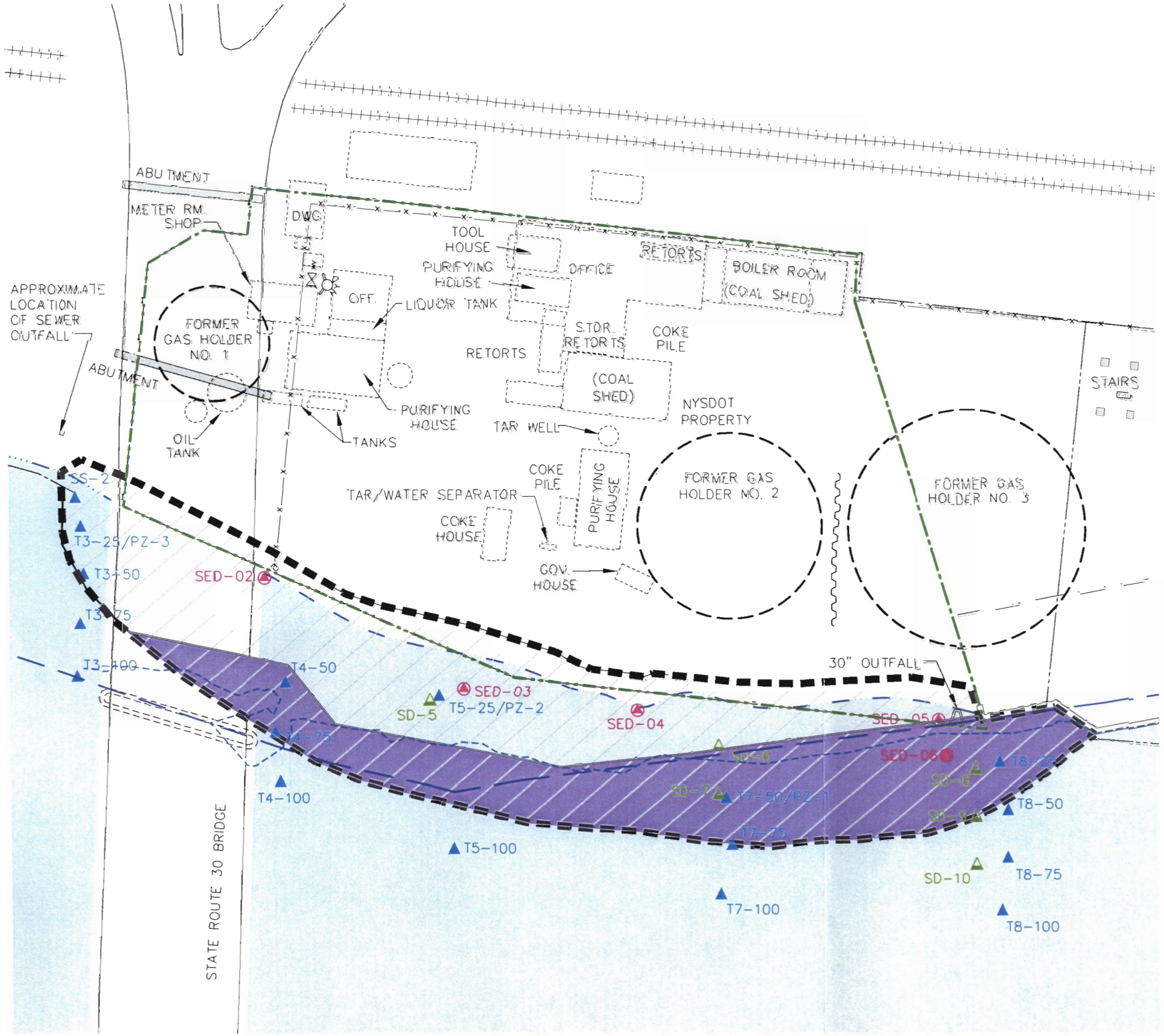
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L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655V03.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

BARRIER WALL ALTERNATIVE C - CONCEPTUAL CROSS-SECTION VIEW

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **13B**



LEGEND:

- T18-25 ▲ 2001 RIVERBED BORING LOCATION
- SD-4 △ 1998 RIVERBED SAMPLING LOCATION
- SED-01 PSA RIVERBED SAMPLING LOCATION
- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE RIVER EDGE (WINTER LOW WATER)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 9)
- AREA FOR CONSIDERATION IN THE REMEDIAL ACTION REPORT
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION
- PROPOSED AREA TO BE ADDRESSED VIA MONITORED NATURAL RECOVERY

GRID NORTH

NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.
5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.
6. HISTORICAL FEATURES ADDED FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. ALL HISTORICAL FEATURES SHOWN WITH LIGHT DASHED LINE, EXCEPT FOR THE THREE HOLDERS WHERE A HEAVY DASHED LINE IS USED.
7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A (PSA) AND TP-32 (PHASE II AREA INVESTIGATION).
8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL 2000).
9. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.
10. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

0 60' 120'
GRAPHIC SCALE

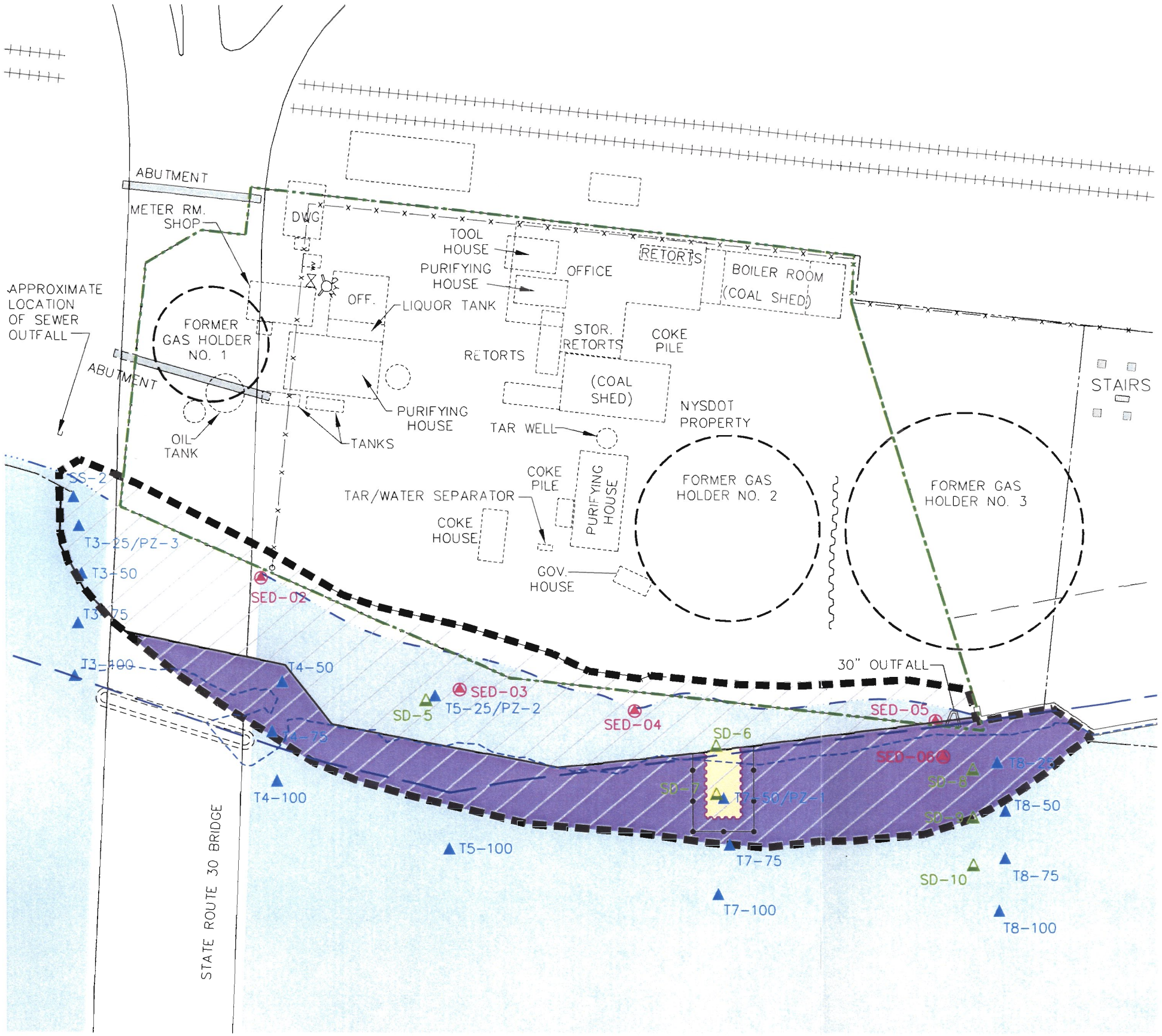
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

REMEDIAL ALTERNATIVE 3A

BBL® BLASLAND, BOUCK & LEE, INC. engineers: scientists, economists

FIGURE **14**

X: 36655X00.DWG, 36655X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655B04.DWG



LEGEND:

- T18-25 ▲ 2001 RIVERBED BORING LOCATION
- SD-4 △ 1999 RIVERBED SAMPLING LOCATION
- SED-01 ⊙ PSA RIVERBED SAMPLING LOCATION
- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE RIVER EDGE (WINTER LOW WATER)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 9)
- AREA FOR CONSIDERATION IN THE REMEDIAL ACTION REPORT
- PROPOSED TEMPORARY SHEETPILING
- PROPOSED SILT CURTAINS
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION
- PROPOSED AREA TO BE ADDRESSED VIA MONITORED NATURAL RECOVERY
- PROPOSED AREA TO BE REMOVED

GRID NORTH

NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999
5. NYSDOT = NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NYSCC = NEW YORK STATE CANAL CORPORATION.
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8. FORMER GAS HOLDER NO.3 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL 2000).
9. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.
10. THE AREA AROUND T7-50 WILL BE REMOVED TO A DEPTH OF 8 FEET, OR TO THE EXTENT PRACTICABLE.
11. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN

0 60' 120'
GRAPHIC SCALE

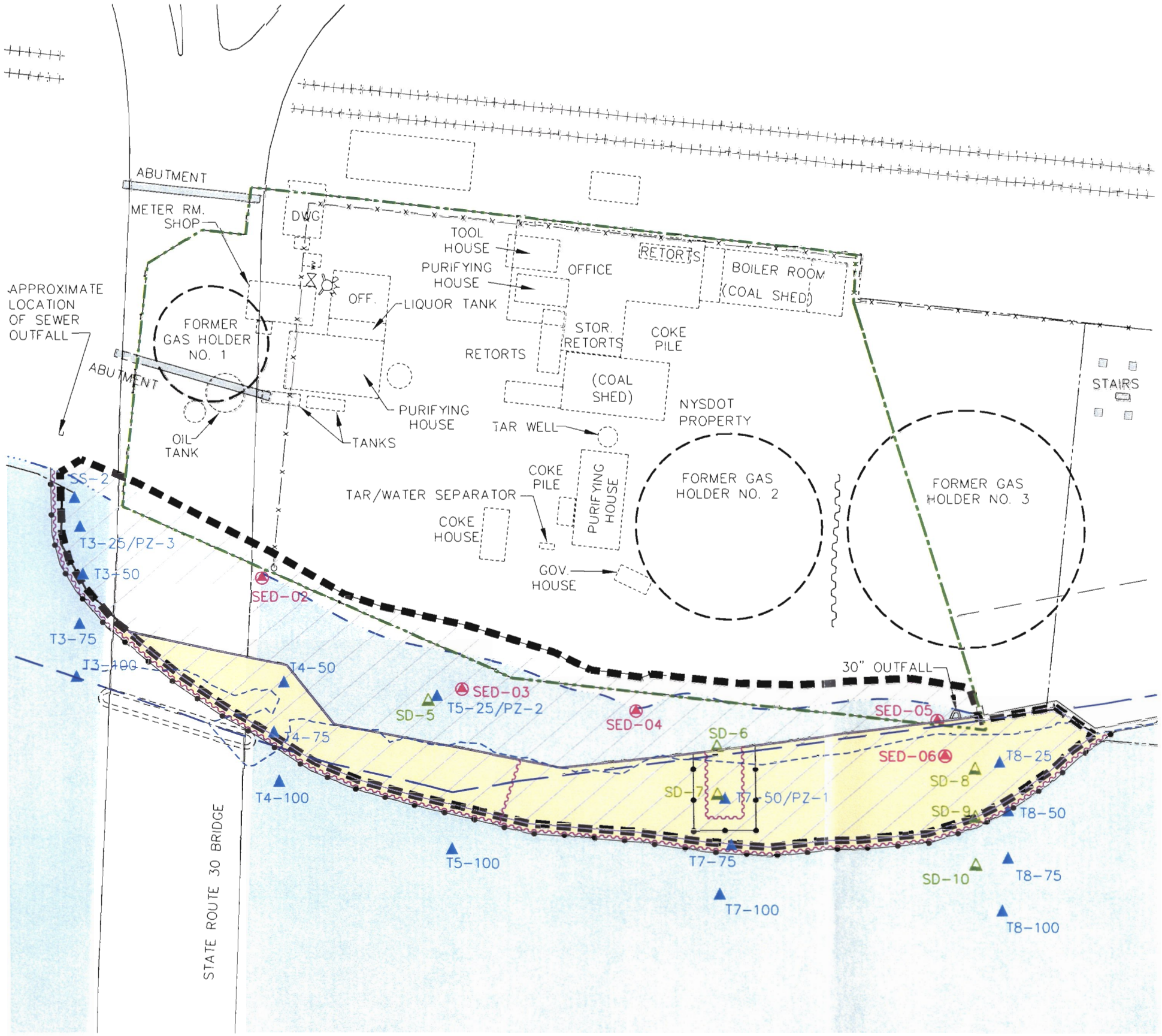
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

REMEDIAL ALTERNATIVE 3B

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **15**

X: 36655X00.DWG, 36655X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655B05.DWG



LEGEND:

- T18-25 ▲ 2001 RIVERBED BORING LOCATION
- SD-4 △ 1999 RIVERBED SAMPLING LOCATION
- SED-01 ⊙ PSA RIVERBED SAMPLING LOCATION
- FENCE
- IRM STEEL SHEETPILING
- CONCRETE ABUTMENT
- PHASE II AREA BOUNDARY LINE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE PROPERTY LINES FOR PROPERTIES WEST OF THE RIVERLINK PARK (SEE NOTES)
- HISTORICAL STRUCTURE
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE RIVER EDGE (WINTER LOW WATER)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 9)
- AREA FOR CONSIDERATION IN THE REMEDIAL ACTION REPORT
- PROPOSED TEMPORARY SHEETPILING
- PROPOSED SILT CURTAINS
- CONCEPTUAL RIVERSIDE BARRIER WALL LOCATION
- PROPOSED AREA TO BE REMOVED

GRID NORTH

NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.
2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.
3. ALL LOCATIONS ARE APPROXIMATE.
4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES. APPROXIMATE PROPERTY BOUNDARIES OF THE PROPERTIES WEST OF THE STATE ROUTE 30 BRIDGE ARE EXTRAPOLATED FROM MONTGOMERY COUNTY REAL PROPERTY TAX MAP NO. 055.43, JANUARY 1999.
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7. LOCATION OF FORMER GAS HOLDER NO.1 BASED ON FIELD OBSERVATIONS DURING THE INSTALLATION OF TEST PIT TP-17A (PSA) AND TP-32 (PHASE II AREA INVESTIGATION).
8. FORMER GAS HOLDER NO. 2 AND THE FORMER TAR/WATER SEPARATOR WERE REMOVED DURING AN INTERIM REMEDIAL MEASURE COMPLETED IN 1999 (BBL 2000).
9. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.
10. THE AREA AROUND T7-50 WILL BE REMOVED TO A DEPTH OF 8 FEET, OR TO THE EXTENT PRACTICABLE. THE REMAINING AREA WILL BE REMOVED TO A DEPTH OF 2 FEET WITHIN THE NAVIGATION CHANNEL RIVERBED MATERIALS WILL BE REMOVED TO ELEVATION 239 TO PROVIDE MINIMUM DEPTH REQUIRED TO MAINTAIN THE NAVIGATION CHANNEL.
11. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN

0 60' 120'
GRAPHIC SCALE

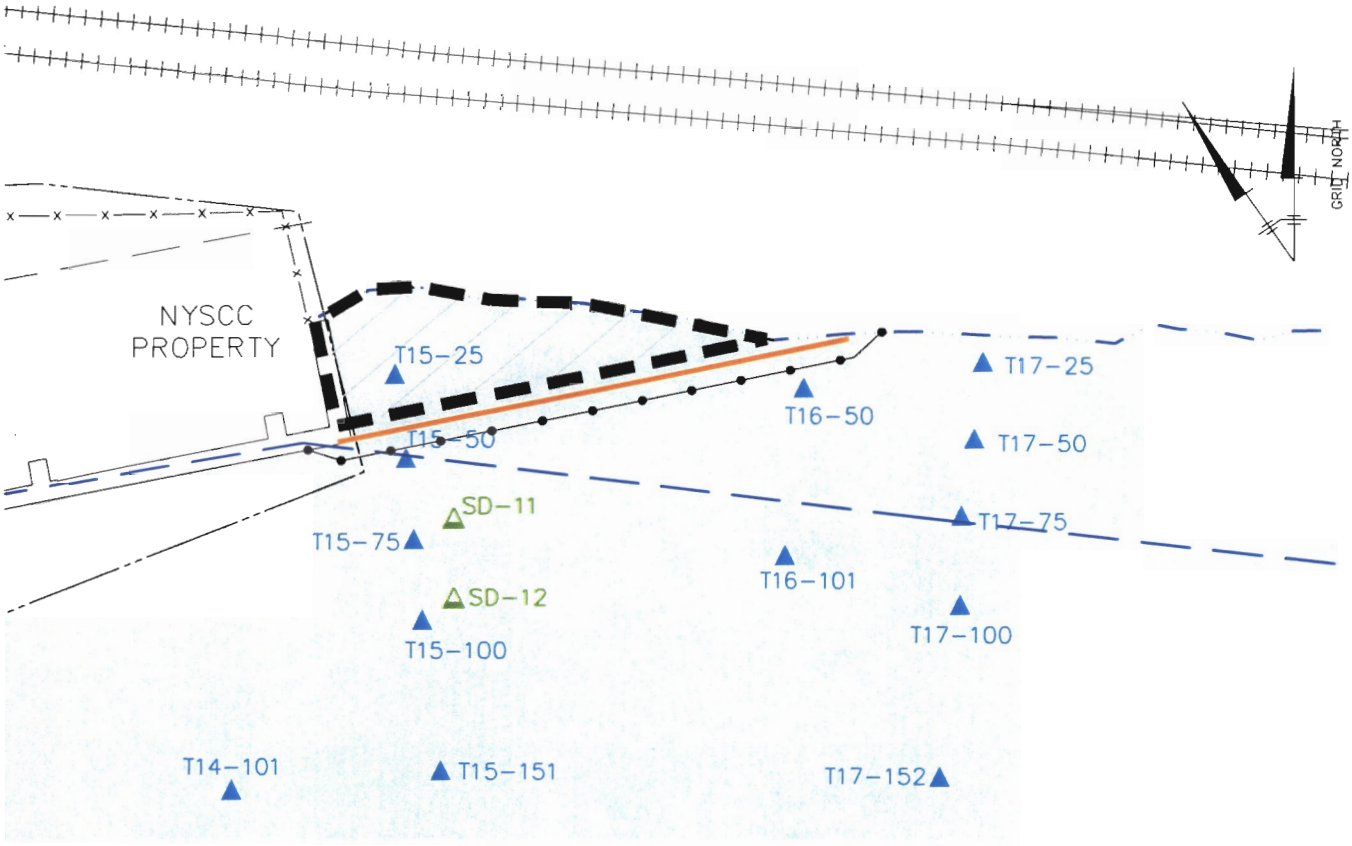
NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

REMEDIAL ALTERNATIVE 3C

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **16**

X: 36655X00.DWG, 36655X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655B06.DWG



NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

3. ALL LOCATIONS ARE APPROXIMATE.

4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES.

5. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.

6. ENTIRE 0.1-ACRE AREA WILL BE REMOVED TO A DEPTH OF 4 FEET.

7. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

LEGEND:

- T18-25 ▲ — 2001 RIVERBED BORING LOCATION
- SD-4 △ — 1999 RIVERBED SAMPLING LOCATION
- FENCE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 5)
- 0.1-ACRE AREA FOR CONSIDERATION
- PROPOSED JERSEY BARRIERS
- PROPOSED SILT CURTAINS

0 60' 120'

GRAPHIC SCALE

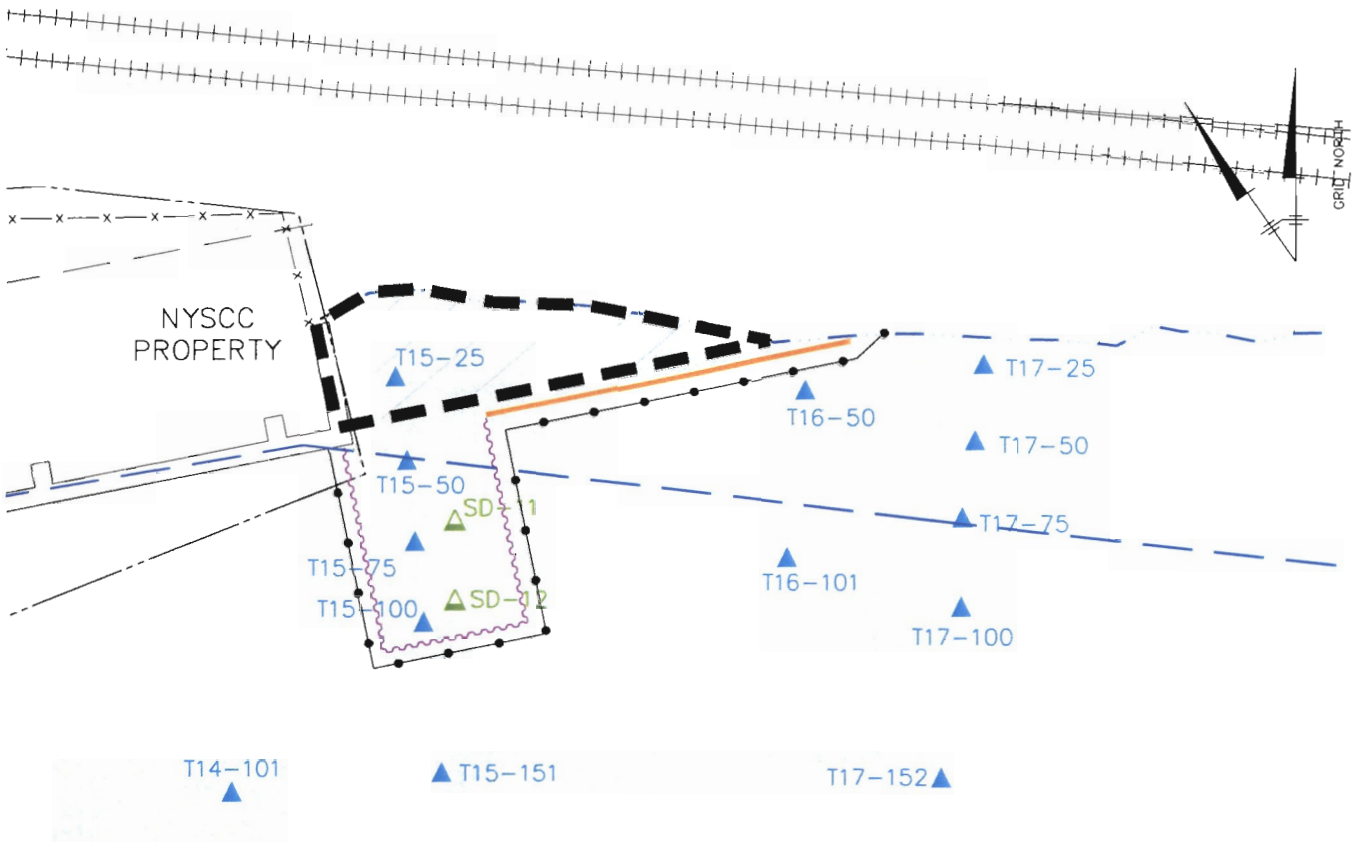
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4/1/04 SYR-85-PGL NES LAF
36655066/36655807.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

REMEDIAL ALTERNATIVE 4A

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 17



NOTES:

1. BASE MAP FOR THE SITE PRODUCED, IN PART, FROM SURVEY DATA COMPILED BY NIAGARA MOHAWK SURVEYORS. BASE MAP FOR THE SOUTHERN BANK AREA IS FROM A SURVEY COMPLETED BY BBL ON 3/29/02.

2. VERTICAL DATUM IS NEW YORK STATE CANAL CORPORATION DATUM FOR SECTION 3, LOCK E-11.

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4. APPROXIMATE PROPERTY BOUNDARIES OF THE GREATER AMSTERDAM RIVERLINK PARK SITE ARE FROM A MAP BY HARZA DATED 12/2/98 AND ENTITLED: SITE MAP WITH HISTORICAL STRUCTURES.

5. APPROXIMATE NAVIGATION CHANNEL BASED ON 1920S AS-BUILT DRAWINGS PROVIDED BY NYSCC.

6. ENTIRE 0.1-ACRE AREA WILL BE REMOVED TO A DEPTH OF 4 FEET. THE AREA AROUND SD-11 AND SD-12 WILL BE REMOVED TO A DEPTH OF 2 FEET.

7. ALL REMEDIAL COMPONENT INFORMATION PRESENTED IS CONCEPTUAL AND HAS BEEN IDENTIFIED FOR THE PURPOSES OF THE RAR. ACTUAL DETAILS AND SPECIFICATIONS FOR THE REMEDIAL COMPONENTS WOULD BE DETERMINED DURING THE REMEDIAL DESIGN.

LEGEND:

- T18-25 ▲ — 2001 RIVERBED BORING LOCATION
- SD-4 △ — 1999 RIVERBED SAMPLING LOCATION
- FENCE
- APPROXIMATE RIVERLINK PARK PROPERTY LINE (SEE NOTES)
- APPROXIMATE RIVER EDGE (NAVIGATION SEASON)
- APPROXIMATE NAVIGATION CHANNEL (SEE NOTE 5)
- 0.1-ACRE AREA FOR CONSIDERATION
- PROPOSED JERSEY BARRIERS
- PROPOSED TEMPORARY SHEETPILING
- PROPOSED SILT CURTAINS

0 60' 120'

GRAPHIC SCALE

X: 36655X04.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-BL
4/1/04 SYR-85-PGL NES LAF
36655066/36655B08.DWG

NIAGARA MOHAWK, A NATIONAL GRID COMPANY
AMSTERDAM (FRONT STREET) FORMER MGP SITE
REMEDIAL ACTION REPORT

REMEDIAL ALTERNATIVE 4B

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 18