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NAPL Barrier Wall Interim Remedial Measure Engineering Certification Report

March 2007

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CERTIFICATION STATEMENT

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

NAPL BARRIER WALL INTERIM REMEDIAL MEASURE
ENGINEERING CERTIFICATION REPORT

I, Margaret A. Carrillo-Sheridan, P.E., certify that I am currently a registered Professional Engineer registered in the State of New York, and I certify that the *NAPL Barrier Wall Interim Remedial Measure Work Plan* (Remedial IRM Work Plan) was implemented and that all construction activities were completed in substantial conformance with the New York State Department of Environmental Conservation-approved Remedial IRM Work Plan.

27-June-2008

Margaret A. Carrillo-Sheridan, P.E.
New York State P.E. No. 082251

Date

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1. Introduction

1.1 General

This *Non-Aqueous Phase Liquid (NAPL) Barrier Wall Interim Remedial Measure (IRM) Engineering Certification Report* (Engineering Certification Report) describes the activities that were performed to construct a NAPL barrier wall at the former manufactured gas plant (MGP) site (the site) located in Binghamton, New York. This Engineering Certification Report was prepared by ARCADIS of New York, Inc. (ARCADIS BBL, formerly known as Blasland, Bouck & Lee, Inc.), on behalf of New York State Electric & Gas Corporation (NYSEG). The activities described herein were conducted in general conformance with the *NAPL Barrier Wall Interim Remedial Measure Work Plan* (NAPL Barrier Wall IRM Work Plan, ARCADIS BBL, July 2006), approved by the New York State Department of Environmental Conservation (NYSDEC) on July 13, 2006.

The NAPL barrier wall was constructed in compliance with the Order on Consent (Index #D7-001-96-03) between NYSEG and the NYSDEC. The purpose of the NAPL barrier wall IRM is to prevent the offsite migration of NAPL by intercepting and collecting mobile, in any, dense non-aqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL).

The majority of the NAPL barrier wall consists of a gravel-filled trench keyed into till, as well as four sections of a jet-grouted wall also keyed into till and integrated into the gravel filled wall on either end of each jet-grouted wall. The major components associated with the NAPL barrier wall construction consist of the following:

- Jet-Grouted Low-Permeability Walls: Due to the presence of a retaining wall, a former holder and underground 66-inch diameter storm sewer, two large underground natural gas pipes, and significant underground debris, there are four locations along the barrier wall alignment where installation of the gravel trench was not feasible. Therefore, at each of these locations, the barrier wall was jet grouted from the ground surface and keyed into the underlying till a minimum of 6 inches. The jet grouted walls serve as low permeability walls that will cause NAPL to migrate around the wall into the gravel-filled trench.

- Gravel-Filled Collection Trench: The gravel-filled portion of the NAPL barrier wall was constructed using biopolymer slurry, which was used to maintain the trench sidewall stability during trench excavation, installation of the NAPL collection systems, and placement of gravel backfill. The depth of the trench was between 43 and 58 feet below ground surface (bgs), and the trench was keyed into the underlying till a minimum of 6 inches.

- DNAPL Collection System: The gravel-filled portion of the NAPL barrier wall has a DNAPL collection system installed, which consists of 6-inch diameter high-density polyethylene (HDPE) slotted lateral collection pipe installed along the top of the till surface and 8-inch diameter 304 stainless steel vertical DNAPL recovery wells containing a 1 to 2 foot deep sump that extends below the lateral collection piping.

- LNAPL Collection System: The gravel-filled portion of the NAPL barrier wall also has a LNAPL collection system installed, which consists of 60-mil HDPE geomembrane installed vertically on the downgradient side of the trench to serve as a barrier for the potential offsite migration of mobile LNAPL, and 8-inch diameter 304 stainless steel vertical LNAPL recovery wells that were installed down to the bottom of the HDPE geomembrane.

1.2 Engineering Certification Report Organization

To present the required information associated with the NAPL barrier wall construction, this Engineering Certification Report is organized into the following sections:

Section	Purpose
Section 1 – Introduction	Provides relevant site background information, the basis of design for the NAPL barrier wall, and a description of the project team
Section 2 – Construction of NAPL Barrier Wall	Describes the activities associated with installation of the NAPL barrier wall, as well as documentation indicating that the acceptance criteria for the project were achieved
Section 3 – Offsite Transportation and Disposal	Describes the materials transported offsite for disposal
Section 4 – Post-Construction Monitoring Activities	Describes the anticipated post-construction monitoring activities to be implemented at the site

Section	Purpose
Section 5 – References	Identifies references cited in this Engineering Certification Report

This report is also supported by figures, drawings, tables and appendices as listed in the Table of Contents.

1.3 Site History

The site manufactured gas from approximately 1888 to about 1939, during which time operations gradually expanded westward from the eastern portion of the site and eventually covered the entire site. Various structures were located within the site, including four gas holders, seven oil tanks, a tar-separating well, machine shop, and a governor house. By about 1969, all aboveground structures associated with the MGP had been dismantled.

In 1836, the site appeared undeveloped and contained a canal identified as "Side Cut to Chenango Canal," referred to hereafter as the "Brandywine Canal." The Brandywine Canal was aligned roughly north-south and passed through the western portion of the site before passing beneath Court Street and joining the Susquehanna River (Tower, 1836). Historical information suggests that the path of a tributary to the Susquehanna, Brandywine Creek, followed the approximate route of the Brandywine Canal. At some point, Brandywine Creek was diverted into a culvert that still crosses the site as a 66-inch diameter storm sewer. The Final Remedial Investigation (RI) Report (BBL, 2002) indicates that the Brandywine Canal was abandoned between 1876 and 1885.

1.4 Location and Physical Setting

The site is located in an industrial section of Binghamton, in Broome County, New York, and is identified as 271-291 and 293 Court Street, which is now owned by NYSEG. The 293 Court Street property was used as a natural gas service center by Columbia Gas Transmission Corporation (Columbia Gas). The remaining portion of the site is now a gravel lot and is used as an equipment storage and parking area for NYSEG.

To the south, the site borders Court Street, which runs parallel to the Susquehanna River. East of the site is the 295 Court Street property, which contains a warehouse owned by the 295 Court Street Associates, L.L.C. (referred to hereafter as the Binghamton Materials Handling warehouse, or simply the "BMH warehouse"). Immediately north of the site is a major Norfolk and Southern Railroad line and yard (formerly CSX), an asphalt works plant, and a scrap yard.

1.5 Site Geology and Hydrogeology

The site occupies a small parcel of land (approximately 4.3 acres) by the north bank of the Susquehanna River, approximately 1.4 miles upstream of its junction with the Chenango River. Based on subsurface conditions encountered during site investigations, the general stratigraphy can be described as a fill unit underlain by post-glacial alluvial silt and clay, outwash sand and gravel, and dense basal till on top of shale bedrock. These units show a sequence of events specific to the site's geologic history, which include:

- Shale bedrock deposited as silt and clay in the Devonian Period
- Dense basal till deposited by the Pleistocene glacier(s)
- Outwash sand and gravel deposited by meltwater rivers as the Pleistocene glacier(s) receded
- Post-glacial alluvial silt and clay, probably deposited in an abandoned river channel, left as the Susquehanna and Chenango Rivers meandered across the valley
- Fill and an assortment of man-made structures, originating in the site's industrial history

Currently, nearly all precipitation that falls on the site infiltrates to become groundwater. On the streets and properties adjacent to the site, much of the runoff enters storm drains that discharge directly to the Susquehanna River via the 66-inch diameter storm sewer. The Susquehanna River (where it passes the site and through the City of Binghamton) forms a drainage basin, extending to the north and east. At a gauging station upstream of the site (thus excluding the Chenango River's contribution) the average flow of the Susquehanna River is approximately 3,500 cubic feet per second (USGS, 2001). The outwash sand-and-gravel unit filling much of the Susquehanna

River valley (as it runs east to west across central New York) forms the Clinton Street Ballpark Sole Source Aquifer, which is a United States Environmental Protection Agency (USEPA) designation (USEPA, 2002).

1.6 Summary of Relevant Environmental Conditions at the Site

Based on the findings of previous investigations, NAPL has been observed in subsurface soils onsite, primarily coal-tar DNAPL. NAPL is present in both unsaturated and saturated soils beneath the site.

To address the potentially mobile NAPL, an IRM (i.e., NAPL Barrier Wall) for the site was designed and presented in the NAPL Barrier Wall IRM Work Plan (BBL, 2006). Additional details related to the NAPL barrier wall design are provided below.

1.7 Basis of NAPL Barrier Wall Design

<u>Gravel-Filled Trench</u>

The gravel-filled trench was designed to collect both LNAPL and DNAPL, as discussed in the NAPL Barrier Wall IRM Work Plan. The conceptual design of the DNAPL portion of the NAPL barrier wall was based on the gravimetric properties of DNAPL, as well as the hydraulic properties of the gravel-filled trench. As groundwater enters the gravel-filled trench, the groundwater velocity decreases due to the increased hydraulic conductivity of the trench (as compared with the surrounding native materials). DNAPL entering the trench with the groundwater settles by gravity to the trench bottom, where it is collected and removed. Horizontal drain pipes were installed along the bottom of the trench and sloped to sumps. The DNAPL settles into the drain pipes and collects in the sumps.

The gravel-filled trench was also designed to have a low permeability HDPE geomembrane installed at the downgradient face of the barrier wall to facilitate the collection of LNAPL. LNAPL collection wells were placed along the HDPE geomembrane, and LNAPL (if present) will collect on the upgradient side of the HDPE geomembrane. The depth of the HDPE geomembrane was set between 16 and 20 feet below grade based on the mean low and high groundwater table elevations.

The trench width and gravel backfill were evaluated as part of the multiphasic flow model presented to the NYSDEC in the “NAPL Barrier Conceptual Design Letter Report” (BBL, 2005). The depth of the trench and the location of the DNAPL collection wells and sumps were based the depth of the till layer. The locations of the DNAPL collection wells and sumps were selected based on locations of the low points within the till layer along the barrier wall alignment.

<u>Jet-Grouted Sections</u>

As previously discussed, portions of the NAPL barrier wall were constructed with jet-grouted sections due to underground obstructions, which prohibited installation of the gravel trench. The jet-grouting consisted of injecting ultra high-pressure fluids into the soil at high velocities (approximately 800 to 1,000 feet per second). In general the jet-grouting process breaks down the soil structure and mixes soil particles in-situ with a binder to create a homogeneous mass, which in time solidifies and forms a low permeability barrier.

1.8 Project Team

NYSEG retained ARCADIS BBL's remedial management and construction affiliate, ARCADIS BBLES (formerly known as BBL Environmental Services, Inc.), as the general contractor for the NAPL barrier wall construction. ARCADIS BBLES contractually served as the general contractor to NYSEG, and ARCADIS BBLES retained Geo-Solutions, Inc. (Geo-Solutions), Royal Environmental (Royal), Parratt-Wolff, Inc. (Parratt-Wolff), Boart Longyear Company (Boart Longyear), and Lash Contracting, Inc. (Lash) as the remedial subcontractors for the project. The roles and responsibilities for ARCADIS BBLES and its subcontractors include the following:

- ARCADIS BBLES provided overall project management and provided an onsite representative for the duration of the project. ARCADIS BBLES was responsible for overall schedule, air monitoring, documenting the completed construction activities and obtaining the appropriate documentation indicating that the acceptance criteria for the project were achieved, scheduling and coordinating the offsite transportation and disposal of materials, procuring and scheduling the delivery of 8-inch diameter 304 stainless steel pipe (i.e., DNAPL and LNAPL collection wells) and pea gravel, performing waste characterization sampling and coordinating with the offsite laboratory for analysis, air monitoring during excavation, and coordinating with the adjacent property owner (i.e., 295 Court Street) and public entities that were associated with the project (NYSEG, NYSDEC, City of Binghamton, New York State Department of Transportation [NYSDOT], Verizon).

- Geo-Solutions was the primary installer of the jet-grouted and gravel-filled portions of the NAPL barrier wall. This included furnishing the appropriate construction equipment, labor, and materials (i.e., 6-inch diameter slotted lateral collection pipe, 60-mil HDPE geomembrane) to construct the NAPL barrier wall in accordance with the NAPL Barrier Wall IRM Work Plan.

- Royal Environmental provided overall site support activities during the construction of the NAPL barrier wall, which included setting up site facilities, providing site security, constructing a temporary soil staging area and decontamination pad, installing a temporary access road, site clearing, removing a section of the concrete retaining wall (aboveground portion only), installing temporary erosion control measures, installing temporary lane or sidewalk closures, performing pre-trenching excavation activities and capping underground utilities, transporting jet-grout spoils and excavated materials to the temporary staging area and covering the stockpiled materials with polyethylene, loading transport vehicles for offsite transportation and disposal, assisting with the placement of the pea gravel backfill, decontaminating construction equipment, and restoring surfaces.

- Parratt-Wolff decommissioned the nine groundwater monitoring wells that were located within or adjacent to the NAPL barrier wall alignment (and installed several NAPL recovery wells following barrier wall construction).

- Boart Longyear provided sonic drilling services to predrill between approximate Stations 200+05 and 200+43 to a depth of approximately 20 feet bgs to remove underground debris and facilitate jet grouting and excavation activities.

- Lash performed various repair work inside the existing 66-inch diameter storm sewer.

In addition to the above-referenced remedial subcontractors, ARCADIS BBLES also retained the following companies to provide support services:

- Life Sciences Laboratory (Life Sciences) to provide analytical services for waste characterization samples collected during the project.

- Riccelli Enterprises, Inc. (Riccelli) to provide transportation of nonhazardous materials generated during the project to Seneca Meadows for landfill disposal.

- IESI Seneca Meadows Landfill (Seneca Meadows) to provide landfill disposal of nonhazardous materials generated during the project.

- Casie Protank to provide offsite transportation and recycling for metal materials generated during the project.

- Clean Harbors Environmental Services, Inc. (Clean Harbors) to provide offsite transportation and disposal of wastewater generated during the project.

2. Construction of NAPL Barrier Wall

2.1 General

This section presents a detailed description of the IRM activities performed in connection with the installation of the NAPL barrier wall at the site. ARCADIS BBLES and its remedial subcontractors installed the NAPL barrier wall between July 10, 2006 and November 22, 2006. The Record Drawing prepared by ARCADIS BBL to document the NAPL barrier wall installation is provided in Appendix A. Weekly Construction Reports and photographs of the NAPL barrier wall installation are provided in Appendices B and C, respectively. The NAPL barrier wall installation activities, as well as the design modifications due to unforeseen conditions that were encountered during construction, are documented in the appropriate subsections below.

2.2 Pre-Mobilization Activities

Prior to mobilizing to the site, the following activities were performed to prepare for the NAPL barrier wall construction:

- Obtaining a street work permit for sidewalk and/or street closures from the City of Binghamton Engineering Department. This permit and a copy of the Maintenance and Protection of Traffic Plan (Appendix G to the NAPL Barrier Wall IRM Work Plan) were submitted to the City of Binghamton Engineering Department for approval of the proposed sidewalk/street closures. In addition, a permit was submitted to the NYSDOT for approval of the proposed sidewalk/street closures.

- Obtaining a hydrant permit from the City of Binghamton to allow the use of municipal water during the NAPL barrier wall construction. Approximately 1 million gallons of municipal water were used during the NAPL barrier wall construction.

- ARCADIS BBLES retained Parratt Wolff to decommission nine groundwater monitoring wells that were within or adjacent to the NAPL barrier wall alignment. Parratt-Wolff decommissioned a total of 9 wells (MW97-9S, NCW-1, MW93-1D, MW93-2S, MW93-2D, MW93-3S, MW93-3D, NMW-3, and NMW-5) by filling the casings from the bottom up (using a tremie pipe) with a bentonite-cement grout mixture (96% neat Portland Type II cement and 4% powdered bentonite, by weight). After grouting the wells, the protective casings and aboveground portions of the well casings were removed.

- Dig Safely New York was contacted to mark out underground utilities in areas where excavation activities were scheduled to be performed during the NAPL barrier wall IRM. The underground utilities that were anticipated to be within the NAPL barrier wall alignment included water, natural gas, electric, storm sewers, and sanitary sewers. ARCADIS BBLES worked closely with NYSEG and the City of Binghamton during the construction project to verify and locate underground utility lines and to temporarily shut down natural gas, electrical, and water services, as well as to determine if various underground utility lines were abandoned.

2.3 Mobilization and Site Preparation

Mobilization and site preparation activities commenced at the site during the week of July 10, 2006 and consisted of the following:

- Coordinating with NYSEG, City of Binghamton, and Verizon to address natural gas (underground), electric (both underground and aboveground), water (underground), cable (aboveground), and telephone (both underground and aboveground) utility lines to facilitate the NAPL barrier wall construction activities.

- Documenting existing site conditions including identifying aboveground and underground utilities, equipment, and structures, as necessary to implement the IRM activities.

- Mobilizing manpower, equipment, services, and materials to the site, as necessary to implement the IRM.

- Constructing support areas including, but not limited to, waste material staging areas; onsite storage areas; and equipment, material, and personnel decontamination area.

- Installing temporary erosion controls along the west and south sides of the site, which consisted of silt fence and hay bales.

- In accordance with the Health and Safety Plan (HASP, Appendix C in the NAPL Barrier Wall IRM Work Plan), site-specific training was accomplished by each site worker reading the HASP or through a site briefing on the contents of the HASP. In addition, daily safety meetings were held to cover the work to be accomplished for that day, the protective clothing and procedures required to minimize site hazards, and emergency procedures. As discussed in Section 2.7 below, ARCADIS BBLES implemented air monitoring activities in accordance with the HASP and the Community Air Monitoring Plan (CAMP, Appendix A of the NAPL Barrier Wall IRM Work Plan).

- Mobilizing a 20,000-gallon frac tank to containerize water removed from abandoned natural gas lines. As per NYSEG's procedures, abandoned natural gas lines that were encountered were evaluated by a NYSEG representative, and if water was present in the gas line, it was pumped from the pipe to the frac tank. Abandoned natural gas lines that interfered with the NAPL barrier wall alignment were removed from the trench and both ends of the pipe remaining underground were filled with commercial-grade foam.

2.4 Pretrench Excavation

Pretrenching excavation activities were performed prior to initiating the jet grout and trench excavation activities to locate or remove underground utilities or obstructions along the alignment of the NAPL barrier wall. The pretrenching excavation activities were performed using either a rubber tire backhoe or trackhoe and was excavated to a depth of approximately 6 feet below ground surface (bgs). During the performance of pretrenching, the following obstructions were observed:

- At approximate Station 205+00, an underground steel structure was exposed within the trench alignment. Based on the location of this underground structure and the inability to change the alignment of the NAPL barrier wall in this area, the structure was removed and placed in the onsite waste material staging area. As discussed further in Section 3, this structure was later transported to Casie Protank for recycling.

- Between approximate Stations 204+75 and 204+35, an underground cast iron structure was exposed within the trench alignment at approximate Station 204+60. Based on the location of this underground structure and because there were no visual or olfactory indications of NAPL, BBLES decided to leave this structure in place and shift the NAPL barrier wall alignment approximately 1.5 feet in this area to avoid the obstruction. As discussed further in Section 2.6.1, this structure was subsequently removed during the excavation of the gravel-filled trench because a 30-inch diameter steel pipe was connected to this structure at a depth of approximately 10 feet bgs. The steel pipe was located perpendicular to the trench alignment and had to be removed to install the gravel trench.

- Several underground pipelines were exposed, removed from the trench alignment, and plugged with foam. A summary of the underground pipelines that were exposed, removed, and plugged is provided below:

  - 30-inch diameter refined natural gas line was exposed at approximate Station 204+10
  - 4-inch diameter nitrified clay pipe at approximate Station 203+75
  - 1-inch diameter natural gas line at Station 203+55
  - 30-inch diameter natural gas line at Station 202+90
  - 20-inch diameter natural gas line at Station 202+88
  - 1 ½-inch diameter polypropylene polyvinyl chloride (PVC) pipe at Station 202+96
  - 1 ½-inch diameter PVC pipe at Station 202+95
  - 20-inch diameter steel active natural gas main at Station 202+30
  - 8-inch diameter steel abandoned natural gas main at Station 202+222
  - Two 1 ½-inch diameter steel abandoned natural gas mains at Station 202+19
  - 16-inch diameter steel pipe encased in approximately ½-inch thick concrete from Station 207+62 to 207+45
  - 30-inch diameter retired natural gas main and a 10-inch diameter pipe at Station 204+10
  - 20-inch diameter pipe at Station 202+86
  - 30-inch diameter pipe at Station 202+95
  - 8-inch diameter pipe at Station 200+96

- Two 2-inch diameter abandoned natural gas lines at Station 201+19
- 6-inch diameter steel pipe on the Binghamton Materials Handling property
- 30-inch diameter pipe at Station 204+29
- 30-inch diameter retired natural gas main at Station 200+25
- Two 8-inch diameter natural gas lines (one retired and one active) at Station 201+50
- One 8-inch diameter clay tile pipe at Station 201+53
- 4-inch clay tile pipe at Station 200+36

Liquids that were drained from former natural gas lines that were removed and plugged within the alignment of the NAPL barrier wall were placed in an onsite frac tank for subsequent characterization, offsite transportation and disposal by NYSEG. Additional details related to the offsite transportation and disposal of these liquids are included in Section 3.

- During the pretrenching excavation between approximate Stations 201+00 and 200+00 (within the Binghamton Materials Handling property), a large amount of construction material debris and four buried concrete foundation walls were encountered at approximate Stations 200+00, 200+07, 200+21, and 200+43. These walls were up to 4-feet-thick and varied in depth. The concrete wall at approximate Station 200+43 extended from approximately 7 feet bgs to 17 feet bgs, and the concrete wall at approximate Station 200+21 extended from approximately 1 foot bgs to at least 14 feet bgs. The fill material around these concrete foundation walls comprised primarily of masonry materials (bricks and large sections of reinforced concrete) and structural steel. There was very little soil and the fill materials had little to no cohesiveness; therefore, imported cohesive soil (saw clay) was used to backfill these pretrenched areas to facilitate excavation of the gravel-filled trench.

  To install the gravel-filled trench in this area, the existing concrete foundation walls required removal from the trench alignment. Due to the integrity of the concrete foundation walls and the lack of cohesion in the surrounding fill materials, the NYSDEC agreed that removal of the four concrete foundation walls and installation of the gravel-filled trench as originally proposed would not be feasible. As a result, the design of the NAPL barrier wall was modified as follows:

- A sonic drill was used to predrill between approximate Stations 200+05 and 200+43 to a depth of approximately 20 feet bgs to facilitate jet grouting and excavation activities. In addition, a sonic drill was used to drill up to 20 boreholes through the existing concrete foundation at approximate Station 200+43 to facilitate removal. This is discussed further in Section 2.4.1

- The NAPL barrier wall ended at approximate Station 200+05

- The NAPL barrier wall between approximate Stations 200+05 and 200+27 was jet grouted to form a low permeable barrier, as discussed further in Section 2.5

- The existing concrete foundation wall at approximate Station 200+43 was removed

These design modifications to the NAPL barrier wall were documented and submitted to the NYSDEC in a letter dated August 15, 2006 (Appendix D).

Following pretrenching, the excavation was backfilled and the surface was graded sufficiently to provide a smooth and level work surface for the jet grout and trench excavation activities. Significant regrading was performed along the NAPL barrier wall alignment adjacent to Brandywine Avenue, which required the placement of additional fill material to provide a level surface for the trench excavation activities. In addition, two above-grade portions of the existing concrete retaining wall along Brandywine Avenue were removed to facilitate construction of the NAPL barrier wall and access for construction equipment.

2.4.1 Sonic Drilling Between Stations 200+05 and 200+43

Between August 9 and August 15, 2006, Boart Longyear mobilized to the site and utilized a sonic drill rig to predrill between approximate Stations 200+05 and 200+43 to facilitate jet grouting and excavation activities as previously discussed. Within the alignment of the jet grout wall (between approximate Stations 200+05 and 200+27), drill holes were advanced along the jet grout wall alignment. In addition, to facilitate the removal of existing concrete foundation wall at approximate Station 200+43, approximately 20 drill holes were advanced through the concrete foundation wall.

2.5 Jet Grout Wall

The jet grout wall installation activities were performed between July 19 and August 25, 2006. The sequencing of the jet grout wall installation activities commenced between approximate Stations 204+75 and 205+29 (in the area of the former holder and 66-inch diameter storm sewer), and then progressed to between approximate Stations 205+91 and 206+29 (in the area where the NAPL barrier wall alignment deflects adjacent to Brandywine Avenue), Stations 201+98 and 202+37 (in the area of active underground natural gas mains), and Stations 200+05 and 200+27 (in the area within the Binghamton Materials Handling property, which was not included in the original NAPL barrier wall design).

The jet grout walls were installed along the NAPL barrier wall alignment in areas where trench excavation was not feasible due to underground obstructions. The grout walls were installed using a track-mounted rotary drill rig, a grout batch plant, and jet-grout pump. Once the holes were drilled to the appropriate depth (at least 6 inches into the top of the underlying till layer), the jet-grouted columns were formed by rotating and lifting the drill string while a high pressure stream of grout was forced out of the side nozzles using pressures of at least 3,000 pounds per square inch (psi). The jet-grouted sections were formed by installing two rows of overlapping jet grout columns.

During the performance of the jet grout wall installation activities, grout spoil material (i.e., excess grout) was collected within a trench along the alignment of the NAPL barrier wall. The grout spoil material was allowed to solidify within the trench and was then removed from the trench at the beginning of each day, and was stockpiled in the waste material staging area for subsequent offsite transportation and disposal.

During the jet grout wall installation, quality control testing was performed on the jet grout mixture and included the following:

- Fresh grout slurry was tested onsite for unit weight and viscosity Marsh Funnel twice per shift in accordance with ASTM D-4380 and API RP 13B-1, respectively.

- Insitu soilcrete (created during the jet grouting application) samples were collected using an insitu sampler, before the soilcrete began to cure, at frequency of one sample per 1,000 vertical feet of jet grout column. The soilcrete samples were collected, handled, packaged, and tested for unconfined compressive strength (UCS) (in accordance with ASTM D1633) and permeability (in accordance with ASTM D5084). The unconfined compressive strength and permeability testing results are included in Appendix E. The testing results indicate that the permeability of the jet grout wall ranged from 7 x 10^{-7} to 2.4 x 10^{-8} cm/sec, which was approximately two orders of magnitude lower than the design objective of 1 x 10^{-6} cm/sec. The UCS ranged from 272 pounds per square-inch (PSI) to 842 PSI. Although UCS was not a specified performance criteria, the associated results are consistent with UCS of controlled low-strength material (e.g., flowable fill). For comparison, cohesive soils, such as clay, typically have compressive strengths in the vicinity of 20 PSI.

During the jet grout wall installation adjacent to the existing 66-inch diameter storm sewer (approximate Stations 204+85), BBLES and their subcontractors suspected that the drill rig had struck the storm sewer. As a result, ARCADIS BBLES performed an inspection inside the 66-inch diameter storm sewer on August 24, 2006 to assess the suspected area where the drill rig struck the storm sewer. Based on this inspection, BBLES observed that the drill rig struck the 66-inch diameter storm sewer at three isolated locations. The interior of the 66-inch diameter storm sewer was lined with a polyvinyl chloride (PVC) liner system consisting of the Danby Pipe Renovation System (Danby). Because the drilling operation affected the integrity of the Danby PVC liner system, appropriate repairs were required. A summary of the repair work that was performed for the existing 66-inch diameter storm sewer is included in Section 2.8.1.

2.6 Gravel-Filled Trench

Upon the completion of the jet grout wall installation activities, the gravel-filled trench sections of the NAPL barrier wall were constructed between August 28 and October 20, 2006. The sequencing of the gravel-filled trench construction activities commenced between approximate Stations 205+29 and 205+91 (between the jet grout walls installed near the former holder area and adjacent to Brandywine Avenue, and then progressed to between approximate Stations 206+29 and 207+62 (along Brandywine Avenue), Stations 200+27 and 201+30 (in the area within Binghamton Materials Handling property), Stations 204+75 and 202+37 (between the jet grout walls installed near the former holder area and adjacent to the existing gas control building), and Stations 201+30 and 201+98 (in the area within the Binghamton Materials Handling property and east of the jet grout wall installed near the existing natural gas control building).

The gravel-filled trench sections of the NAPL barrier wall were constructed to facilitate the collection and removal of mobile or potentially mobile NAPL along the trench alignment. The trench excavation was performed using biopolymer slurry to allow for the placement of DNAPL and LNAPL collection systems and pea gravel. Upon the placement of pea gravel within the trench, the biopolymer slurry was degraded to promote the free flow of groundwater through the trench. Additional details related to the construction of the gravel-filled trench are provided below.

2.6.1 Trench Excavation

The trench was excavated using an extended-reach excavator and was keyed a minimum of 6 inches into the top of the till unit located approximately 40 to 60 feet bgs, and the average width of the trench was approximately 30 inches. The anticipated depth of the trench was based on Design Drawing No. 2 in the NAPL Barrier Wall IRM Work Plan, and the actual top of till elevation was measured and documented during the trench excavation activities. Once the top of till elevation was measured and documented, additional till material was excavated to attain a minimum key of 6 inches into the top of the till unit to confirm the proper placement of the DNAPL collection system. Documentation related to the bottom elevation of the excavated trench and confirmation of a minimum key of 6 inches into the top of the till unit is included in Appendix A (Record Drawings) and Table 1.

During the trench excavation, the trench stability was maintained using biopolymer slurry, which was mixed onsite through the use of a venturi mixing device and holding tanks. As the excavation progressed, the biopolymer slurry was pumped from the onsite holding tanks to the trench, and the level of the biopolymer slurry was maintained at least 3 feet above the groundwater table elevation and no more than 2 feet bgs. During the use of biopolymer slurry, quality control testing was performed on the biopolymer slurry and included the following:

- pH testing (minimum pH of 9) and viscosity testing (minimum viscosity of 60 seconds Marsh Funnel Viscosity) was performed on the plant-mixed biopolymer slurry at a minimum of two times daily

- pH testing (minimum pH of 8) and viscosity testing (minimum viscosity of 50 seconds Marsh Funnel Viscosity) was performed on the active biopolymer slurry (i.e., insitu prior to degradation) at a minimum of two times daily

Materials excavated from the trench were drained with the excavator bucket (to remove excess biopolymer slurry/groundwater to the extent feasible) and placed in a waste material staging area either directly from the excavator bucket or by using a dump truck to transport the material from the excavation to the staging area. The excavated materials in the waste material staging area were dewatered via gravity drainage, and the collected water was placed in an onsite storage tank for subsequent offsite transportation and disposal. In addition to gravity dewatering, some excavated materials required the addition of cement to properly solidify the material for offsite transportation and disposal.

Once the excavated materials were placed in a waste material staging area, waste characterization soil samples were collected at a frequency of approximately one sample for every 500 tons and were analyzed by Life Sciences to confirm that the excavated materials were a nonhazardous waste and acceptable for land disposal at Seneca Meadows Landfill. Additional details related to the collection and analysis of waste characterization soil samples, the offsite transportation and disposal of excavated materials, and the offsite transportation and disposal of wastewater are included in Section 3.

During the trench excavation activities adjacent to Brandywine Avenue, the adjacent sidewalk and a portion of the roadway were closed off to vehicular and pedestrian traffic to facilitate construction of the NAPL barrier wall. In addition, temporary orange construction fencing and portable chain link fence sections were installed adjacent to the excavated trench for security purposes.

During the performance of the trench excavation activities, several unforeseen conditions were encountered and are summarized below.

- During the trench excavation between approximate Stations 204+75 and 204+35, an underground 30-inch diameter steel pipe was found at a depth of approximately 10 feet bgs. Due to the depth of this pipe, this pipe was not revealed during the pretrenching excavation activities and had to be removed because the pipe was located perpendicular to the trench alignment. To access and remove a section of this pipe, the biopolymer slurry in the trench had to be removed via pumping and placed in a frac tank. A trench box was then installed in the trench to protect workers from a potential trench collapse. During the removal of a section of this pipe, the pipe was determined to be connected to the existing cast iron structure that was exposed during the pretrenching activities. The 30-inch diameter pipe contained NAPL material that was pumped into a 1,500-gallon polyethylene tank for subsequent offsite transportation and disposal. As a result, a section of the 30-inch diameter steel pipe was removed and the ends of the pipe remaining in the ground were plugged with foam, the existing cast iron structure was removed and placed within the waste material staging area for subsequent offsite transportation and disposal, and the excavated area was backfilled with an imported cohesive soil to facilitate future trench excavation activities and use of biopolymer slurry.

During the placement of backfill in this area, the trench contained water and the site received a significant amount of rain, which resulted in the backfilled area becoming completely saturated. The extended-reach excavator was repositioned in this area to resume excavation activities; however, because of the saturated ground surface conditions, the excavator began to sink and the area was unable to adequately support the weight of the excavator. Wood crane mats were mobilized and used in an attempt to support the excavator; however, even with the crane mats, the conditions continued to result in an unstable work platform for the excavator. Finally, two truckloads of powdered cement and a pallet of Portland cement were used and mixed within the trench to stabilize the saturated soil, and following stabilization of the saturated soil with cement, this area was able to support the weight of the excavator and excavation activities resumed.

- During the trench excavation between approximate Stations 200+27 and 201+30, BBLES and its subcontractor, GeoSolutions, observed that the biopolymer slurry level dropped significantly (approximately 8 to 10 feet bgs) within a short time period (approximately 10 to 20 minutes). The trench was visually reviewed to determine the reason for the slurry loss, but the cause could not be determined. After the significant drop in the biopolymer slurry level, cracks began to develop in the Court Street asphalt pavement approximately 25 feet away from the excavated trench. As a result of this condition, the trench was immediately backfilled with pea gravel to prevent a potential catastrophic event. This effort required working around the clock to backfill the trench as quickly as feasible to prevent additional damage, as well as closing a portion of Court Street to prevent vehicular traffic from traveling over the cracked area. Once the trench was backfilled with pea gravel, the area was stabilized and no further movement of the asphalt pavement was observed.

  Additional efforts were made to determine the cause of the biopolymer slurry loss; however, these efforts were unsuccessful and the cause of this biopolymer slurry loss could not be determined. These efforts included re-excavating areas along the trench to locate potential voids or pipelines, as well as observing areas along the north bank of the Susquehanna River adjacent to the site. Based on these efforts, there were no observations of voids or pipelines within the trench, and there were no observations that the biopolymer slurry drained to the river.

- As a result of quickly backfilling the trench with pea gravel, various components of the DNAPL and LNAPL collection systems were not installed (this included an LNAPL collection well at approximate Station 200+30, the HDPE geomembrane between approximate Stations 200+28 and 201+20, and the 6-inch diameter HDPE slotted lateral collection pipe along the top of the till surface), and the remaining trench excavation activities between approximate Stations 201+30 to 201+98 could not be completed. In order to complete the excavation activities between approximately Stations 201+30 and 201+98, a grout plug was installed for the entire depth of the trench between approximate Stations 201+20 and 201+30 to create a vertical wall that would retain the area backfilled with pea gravel and allow the remaining area to be excavated (thus preventing the pea gravel from sloughing into the excavated area).

- Additional efforts were initiated to re-excavate the trench under slurry between approximate Stations 200+28 and 201+20 and install the LNAPL collection system components in this area; however, this effort was unsuccessful because the trench was unable to hold the biopolymer slurry and the trench walls were collapsing at an excavation depth of 10 feet bgs. Based on this condition, installing the HDPE geomembrane, LNAPL collection well, and 6-inch diameter HDPE slotted lateral collection pipe within an open excavation was not feasible and there was a risk of creating further damage to the adjacent Court Street asphalt pavement. As a result, the 6-inch diameter HDPE slotted lateral collection pipe was not installed in this area and flat steel sheeting with an Adeka sealant for the interlocking joints was installed in this area in lieu of the HDPE geomembrane (discussed further in Section 2.6.3.1). In addition, a new DNAPL and LNAPL collection well were installed using a drill rig at approximate Station 201+20 (at the east side of the grout plug) as this was a low point for the underlying till unit, and a new LNAPL collection well was installed using a drill rig at approximate Station 200+30 (discussed further in Sections 2.6.2.1 and 2.6.3.2).

  Based on discussions with the NYSDOT, the NYSDOT requested that the cracked asphalt pavement (Court Street) be repaired within an area approximately 130 feet long by 16 feet wide. As a result, a portion of Court Street was closed to vehicular traffic until the asphalt repair work was completed, and an additional street closure permit was submitted to the NYSDOT. Additional details related to reparation of the cracked asphalt pavement along Court Street are included in Section 2.8.2.

2.6.2 Installation of DNAPL Collection System

The DNAPL collection system consists of lateral collection piping and vertical collection wells. The lateral collection piping consists of 6-inch diameter, 90-slot (0.090-inch slot size) HDPE piping, and was placed along the top of the till surface (that was keyed a minimum of 6 inches into the surrounding till). The vertical collection wells consist of 8-inch diameter, 304 stainless steel well screen (90-slot) and solid riser pipe. The concept of the DNAPL collection system is to convey DNAPL through the pea gravel and lateral collection piping (along the top of till) into the DNAPL collection wells.

The installation of the DNAPL collection system was constructed once the trench was excavated (under biopolymer slurry) a minimum of 6 inches into the top of till layer to create a positive slope. At the DNAPL collection well locations, the trench was excavated at least one foot deeper below the lateral collection piping elevation to form a sump. A critical factor during the trench excavation activities was to maintain a positive slope along the top of till into the DNAPL collection well sumps. The lateral collection piping was assembled (butt fusion welded) on the ground surface and was lowered into the trench using concrete weights as ballasts to counteract the buoyancy forces of the piping. The DNAPL collection wells were assembled (thread connections) on the ground surface and were lowered into the trench within the excavated sump. The DNAPL collection wells contained a 10-foot-long well screen at the bottom of the well, and the remainder of the well consisted of solid riser sections.

As indicated in Section 2.6.1, documentation related to the bottom elevation of the excavated trench and confirmation of a minimum key of 6 inches into the top of the till unit are included in Appendix A (Record Drawing) and Table 1. Documentation related to the location and elevation of the lateral collection piping and DNAPL collection wells is included in Appendix A (Record Drawing) and Tables 1 and 4.

2.6.2.1 Installation of DNAPL Collection Well Using a Drill Rig

As described in Section 2.6.1, an additional DNAPL collection well was installed using a drill rig at approximate Station 201+20 to facilitate the collection of DNAPL. Because this well could not be installed during the initial trench excavation activities, this well was installed on January 18, 2007 using a conventional drill rig. Consistent with the other DNAPL collection wells that were installed during the trench excavation activities, the bottom of the well was keyed a minimum of one foot into the top of the till layer and a 10-foot-long well screen and solid riser sections were installed. Documentation related to the location and elevation of this DNAPL collection well is included in Appendix A (Record Drawing) and Tables 1 and 4.

2.6.3 Installation of LNAPL Collection System

The LNAPL collection system consists of 60-mil HDPE geomembrane and vertical collection wells. The LNAPL collection wells consist of 8-inch diameter, 304 stainless steel well screen (90-slot) and solid riser pipe, and were installed adjacent to each of the DNAPL collection wells. The concept of the LNAPL collection system is to use the HDPE geomembrane as a barrier for the potential offsite migration of mobile NAPL, and to use the LNAPL collection wells to facilitate monitoring and recovery of LNAPL.

The installation of the LNAPL collection system was constructed once the trench was excavated (under biopolymer slurry) and a portion of the trench was backfilled with pea gravel. Both the bottom of the HDPE geomembrane and LNAPL recovery wells extended approximately 2 feet below the annual low groundwater table elevation or at approximate elevation 872 above mean sea level (AMSL) (NGVD 29). The HDPE geomembrane was installed vertically on the downgradient side of the trench. The HDPE geomembrane was temporarily staked at the ground surface on the downgradient side of the trench and was lowered into the biopolymer slurry using weights attached to the bottom of the geomembrane to prevent the geomembrane from floating in the biopolymer slurry. The HDPE geomembrane panels were overlapped a minimum of 4 feet to create a continuous LNAPL barrier on the downgradient side of the NAPL barrier wall. Once the HDPE geomembrane was installed, backfilling resumed within the trench using pea gravel up to approximately 3 feet bgs. At this point, the temporary stakes were removed and the HDPE geomembrane was placed over the width of the trench (covering the pea gravel) for the subsequent placement of the remaining backfill and surface restoration.

The LNAPL collection wells were assembled (thread connections) on the ground surface and were lowered into the trench and positioned on top of the pea gravel at the appropriate elevation (approximate elevation 872 AMSL). The LNAPL collection wells contained a 10-foot-long well screen at the bottom of the well, and the remainder of the well consisted of a solid riser section.

Documentation related to the location and elevation of the HDPE geomembrane and LNAPL collection wells is included in Appendix A (Record Drawing) and Tables 1 and 4.

2.6.3.1 Installation of Steel Sheeting and Adeka Sealant

As discussed in Section 2.6.1, the HDPE geomembrane could not be installed in an open excavation between approximate Stations 200+28 and 201+20; therefore, flat steel sheeting with an Adeka sealant for the interlocking joints was installed in this backfilled area. The sheeting installation activities were performed between November 4 and 6, 2006, and were installed using a vibratory hammer. Prior to installing the steel sheeting, Adeka sealant was applied along the interlocking joints to create a water-tight seal following steel sheeting installation. Consistent with the HDPE geomembrane, the bottom of the steel sheeting extended approximately 2 feet below the annual low groundwater table elevation, at approximate elevation 872 AMSL, and the top of the steel sheeting was approximately 3 feet bgs.

Specification information related to the steel sheeting and Adeka sealant is included in Appendix I. Documentation related to the location and elevation of the steel sheeting is included in Appendix A (Record Drawing) and Table 1.

2.6.3.2 Installation of LNAPL Collection Wells Using a Drill Rig

As a result of installing a grout plug between approximate Stations 201+20 and 201+30 (as discussed in Section 2.6.1) and the difficultly encountered during prior attempts to install an LNAPL well in the open excavation in this area, two additional LNAPL collection wells were installed at approximate Stations 200+32 and 201+18. Because these wells could not be installed during the initial trench excavation activities, these wells were installed on January 16 and 17, 2007 using a conventional drill rig. Consistent with the other LNAPL collection wells that were installed during the trench excavation activities, the bottom of the well was installed at an approximate elevation of 872 AMSL, and a 10-foot-long well screen and solid riser section were installed. Documentation related to the location and elevation of these LNAPL collection wells are included in Appendix A (Record Drawing) and Tables 1 and 4.

2.6.4 Backfill Excavated Trench

Upon the installation of the DNAPL collection system, the excavated trench was backfilled with pea gravel up to approximate elevation 872 AMSL. Once the pea gravel was placed to approximate elevation 872 AMSL, the LNAPL collection system was installed, followed by the placement of additional pea gravel up to approximately 3 feet bgs. At this point, the HDPE geomembrane was placed over the top of the pea gravel, and additional backfill was placed up to approximately 12 inches bgs in areas receiving asphalt or stone surface restoration and approximately 6 inches bgs in areas receiving topsoil and grass seed (additional information related to surface restoration is included in Section 2.8).

As summarized in Table 2, approximately 4,500 tons of pea gravel were used to backfill the trench for the NAPL barrier wall construction.

2.6.5 Degradation of Biopolymer Slurry

During and following the placement of pea gravel within the trench, the biopolymer slurry was degraded to promote the free flow of groundwater through the trench. The degradation process consisted of installing a series of temporary well points at various locations within the trench and pumping the biopolymer slurry from the temporary well points on the surface of the trench. This process of recirculating the biopolymer slurry was continued until a maximum Marsh Funnel viscosity of 30 seconds was attained and the pH of the biopolymer was approximate 7 S.U. Upon completion of the biopolymer slurry degradation process, the temporary well points were removed from the trench.

2.7 Air Monitoring

During the performance of pretrenching excavation, jet grout wall installation, trench excavation, and loading of impacted materials for offsite transportation and disposal, air monitoring was performed in accordance with the CAMP and HASP (Appendices A and C, respectively, in the NAPL Barrier Wall IRM Work Plan). The air monitoring activities were performed to evaluate airborne constituent levels for the purpose of confirming that work procedures and personnel protective equipment (PPE) were adequate, and that the work activities were not resulting in exceedances of the site perimeter action levels. The site perimeter action levels were established to protect downwind communities.

The air monitoring activities consisted of the following:

- Air monitoring within active work areas for airborne particulates and organic vapor to determine appropriate PPE requirements and/or appropriate control measures.

- Air monitoring at the site perimeter for airborne particulates and organic vapor to determine appropriate corrective actions to reduce or abate the emissions, if actions levels, as presented in the CAMP were exceeded.

Based on the results of the air monitoring, airborne constituent concentrations did not exceed the action levels presented in the CAMP and HASP. A summary of the air monitoring results are included in Appendix J.

2.8 Site Restoration

Upon the completion of jet grouting and backfilling the gravel-filled trench, the site surface was restored, and various underground/overhead utility lines were reactivated. The site surface restoration activities consisted of the following:

- The horizontal alignment of the NAPL barrier wall, as well as the horizontal location of the DNAPL and LNAPL collection wells, were surveyed by NYSEG's surveying group and were recorded on the Record Drawing (Appendix A).

- The 8-inch diameter stainless steel riser sections for the DNAPL and LNAPL collection wells installed during the trench excavation activities were cut to approximately 6 to 12 inches bgs, and a locking enclosure was installed over the wells. The top of the enclosures was flush to the ground surface, and an expandable 8-inch diameter rubber J-plug was installed over the top of each DNAPL and LNAPL collection well. The DNAPL and LNAPL collection wells installed using the drill rig were installed as flushmount wells, and each well was finished with a concrete seal and an expandable 8-inch diameter rubber J-plug was installed over the top of each well.

- Grass areas were backfilled with approximately 4 to 6 inches of imported topsoil, followed by the application of grass seed and covering the grass seed with a layer of straw. The grass areas that were restored included the area adjacent to Brandywine Avenue, the area between the two driveways for the site, and the area in front of the former Columbia Gas office building. Note that the concrete sidewalk was replaced with an asphalt sidewalk and the surface water drainage culvert was not replaced in kind, as discussed and agreed upon with the City of Binghamton.

- Excess soil that was not visibly impacted with MGP related materials and was not used for the site restoration activities was placed along the northern edge of the site for future reuse at the site, and was seeded and covered with straw. The reuse of soil was consistent with the Waste Management Plan presented as Appendix F to the NYSDEC-approved NAPL Barrier Wall IRM Work Plan.

- Asphalt areas were backfilled with approximately 6 to 12 inches of asphalt millings, followed by the placement of approximately 6 inches of asphalt to match the original ground elevations. The only asphalt area that was restored (with the exception of the section of asphalt pavement in Court Street, which is discussed in Section 2.8.2) was the parking lot area within the Binghamton Materials Handling property. Prior to subbase and asphalt placement, the asphalt restoration limits were reviewed and agreed upon with the property owner, and the limits of asphalt restoration were saw cut to remove the existing asphalt within this area. Upon the completion of the asphalt restoration, a bitumastic sealant was placed within cracked sections of the asphalt adjacent to the existing building.

- Stone areas were backfilled with approximately 6 to 12 inches of stone and asphalt millings. The stone and asphalt millings were graded and compacted to provide a smooth surface and to match the original ground elevations.

- Existing underground/overhead utility lines were reinstalled and reactivated by NYSEG. These utility lines included the underground 8-inch diameter natural gas main located east of the eastern driveway, overhead electric to the former Columbia Gas office building, and overhead electric to the existing natural gas control building.

- New chain-link fencing was installed along the south and west sides of the site to restore fencing that was removed from the NAPL barrier wall construction activities. In addition, gates were installed at the two driveway areas. Approximately 650 linear feet of new chain link fencing and one new chain link gate was installed during this restoration effort.

The following fill materials were imported to the site and used as part of the above-described site restoration activities:

- Pea Gravel – Approximately 4,400 tons of pea gravel were imported to the site from Barney and Dickinson, Inc. of Vestal, New York.

- Saw Clay – Approximately 625 tons of saw clay (also referred to as Saw Mud and Pond Clay) was imported to the site from B.S. Quarries of Montrose, PA. The saw clay was used to back fill the pre-trench excavation on the Binghamton Materials Handling (BMH) property. The saw clay also aided in filling voids within debris exposed during pre-trenching activities.

- Asphalt Millings – Asphalt millings were provided by Bothar Construction Company. The NYSDOT reviewed and approved of the use of these materials as a sub-base during the repair of Court Street on November 7, 2006. These NYSDOT-approved materials were also used as sub-base restoration of the BMH parking lot.

- Topsoil – Topsoil removed and stockpiled during the site preparation activities was reused during site restoration. In addition, a total of three truckloads of topsoil were imported to the site by Ricelli Enterprises on October 18, 2006. The topsoil was from a NYSDEC-permitted source (Permit #8-3240-00033) located in Phelps, New York and was used to supplement the topsoil reused on the site.

The pea gravel, saw clay, and topsoil were virgin quarried materials and analytical data for these materials was not obtained.

2.8.1 Repair Work to Existing 66-Inch Diameter Storm Sewer

As discussed in Section 2.5, the drill rig used to install the jet grout wall struck the top section of the 66-inch diameter storm sewer in three locations. ARCADIS BBLES subsequently performed an inspection inside the 66-inch diameter storm sewer and observed a total of three locations that were affected by the drilling operation. At one location, the drill completely protruded through the Danby PVC lining system, and at the two other locations, the drill struck and deflected the Danby lining system. In addition, based on inspections that were performed by ARCADIS BBL inside the 66-inch diameter storm sewer on July 25 and August 24, 2006 (these inspections were performed as a separate monitoring effort associated with the 66-inch diameter storm sewer and were not related to the NAPL barrier wall construction), a total of seven seams of the Danby PVC lining system were visually observed to contain potential oil staining. These observations were documented in a monitoring log, which is included in Appendix F. Based on these observations, NYSEG directed ARCADIS BBLES to investigate and repair the seams containing potential oil staining to determine the integrity of the Danby PVC lining system.

As a result, ARCADIS BBLES retained Lash to repair the three locations of the Danby PVC lining system that were affected by the jet grout drilling operation, as well as to repair the seven seams of the Danby PVC lining system that were observed to contain potential oil staining. Lash worked directly with a Danby representative to develop a procedure for repairing the various sections of the Danby PVC lining system (Appendix

G), which primarily consisted of removing sections of the Danby PVC lining system and covering with a 3M DP-605 Scotch-Weld.

The repair work for the Danby PVC lining system was performed by Lash between November 6 and November 10, 2006. The first three days were spent dewatering the existing Tompkins Street Stormwater Pump Station in order to access the inside of the 66-inch inch diameter storm sewer. In addition, an inflatable plug was placed inside the 66-inch diameter pipe at the existing manhole located at the northwest corner of the site, and a bypass pump was used to divert water from the pipe away from the repair work.

Repairs to the three areas of the Danby PVC lining system that were damaged due to the jet grout drill rig were completed on November 9, 2006, and repairs to the seams of the Danby PVC lining system that contained potential oil staining were completed on November 9 and November 10, 2006. During the repair work on November 9, 2006, eight additional seams were observed to require repair work; therefore, a total of 15 locations were repaired due to the presence of potential oil staining. A summary of the repair activities are included in Appendix H, and a more detailed report of the repair activities will be prepared by NYSEG separately from this Engineering Certification Report. Note that during the inspection and repair activities, the areas with potential oil staining did not exhibit noticeable odors or generate VOC readings on the air monitoring equipment. A follow-up evaluation of potential oil seeps, including removal of portions of the Danby PVC lining and visual review of the grout placed behind the liner did not confirm or otherwise indicate that oil or MGP residual materials had penetrated the lined 66-inch storm sewer. Based on this evaluation, the staining within the 66-inch storm sewer is not due to failure of the lining system and is likely related to storm flows within the lined sewer. The *Storm Sewer Repair Report* (to be prepared separately) will provide additional detail regarding the observed staining and likely causes.

2.8.2 Repair Work for Court Street Asphalt Pavement

As discussed in Section 2.6.1, the cracks that developed in the Court Street asphalt pavement required repairs in accordance with NYSDOT guidelines and requirements. This effort was coordinated closely with the NYSDOT to maintain the safety of vehicular traffic and to satisfy NYSDOT requirements. Based on the NYSDOT’s direction, the following asphalt pavement repair requirements were established:

- Close off a section of Court Street in the area of the cracked pavement until the asphalt repair work was completed. ARCADIS BBLES submitted a lane closure permit to the NYSDOT to identify the appropriate lane closure components which was approved by the NYSDOT.

- Approximately 2,000 square feet (approximately 130 feet by 16 feet) of asphalt pavement required repair work.

- The asphalt pavement repair work required the removal of the underlying concrete (approximately 9 to 11 inches thick) and underlying asphalt (approximately 6 to 9 inches), compaction of the existing underlying granular subbase material, placement and compaction of additional NYSDOT-approved granular subbase material, and placement and compaction of asphalt base (5 inches thick) and asphalt binder (3 inches thick).

The asphalt pavement repair activities were performed between November 6 and 9, 2006, and consisted of the following:

- The existing asphalt was removed using a milling machine that conveyed the asphalt into a dump truck, and the milled material was hauled offsite.

- The existing concrete was removed using an excavator and was hauled offsite in a dump truck.

- Once the underlying granular subbase material was exposed, a NYSDOT representative was on site to observe the material and to inspect compaction of this material. The resulting compaction efforts were approved by the NYSDOT representative.

- Imported NYSDOT-approved granular subbase material was placed, graded, and compacted up to the appropriate grade/elevation. However, this granular subbase material was rejected by the NYSDOT representative due to excessive moisture. Therefore, in lieu of using granular subbase material, the NYSDOT approved the use of asphalt millings for the subbase layer. The imported asphalt millings were placed, graded, and compacted to the appropriate grade/elevation, and the resulting grading/compaction efforts were approved by the NYSDOT representative.

- Approximately 6 inches of NYSDOT-approved asphalt base was placed with a paving machine and compacted with a steel drum roller. Also, approximately 3 inches of asphalt binder was placed with a paving machine and compacted with a steel drum roller. The resulting asphalt thickness was approximately 9 inches, and the resulting asphalt placement and compaction efforts were approved by the NYSDOT representative.

Upon the completion of the asphalt pavement repair activities on Court Street, the lane closure components were removed from Court Street and the roadway was reopened to vehicular traffic. The asphalt pavement repair activities were monitored by the NYSDOT, and the NYSDOT verbally provided final approval of the completed work to Mr. Joseph Molina, P.E., of ARCADIS BBLES.

2.9 Demobilization

Concurrent with restoration activities, site demobilization activities commenced for the project. The demobilization activities included:

- Cleaning the onsite frac and polyethlyene tanks and subsequent demobilization. Prior to demobilizing the frac tanks, wipe samples were collected and analyzed by Life Sciences for polychlorinated biphenyls (PCBs). Once the frac tanks were cleaned and the PCB wipe sample results were non-detect, the tanks were demobilized from the site. The wipe sample analytical results are included in Appendix N. Polyethylene tanks remain on-site.

- Fine grading of the site.

- Removal of temporary fencing.

- Demobilization of equipment, labor, and materials.

3. Offsite Transportation and Disposal

During the construction of the NAPL barrier wall, various waste materials were generated and required offsite transportation and disposal. These waste materials included the following:

- Excavated soil

- Collected wastewater
- Metal structures
- Miscellaneous materials

A summary of the activities performed to manage and transport these materials for offsite disposal/recycling is provided below.

3.1 Waste Characterization Soil Sampling and Analysis

During the construction of the NAPL barrier wall, excavated materials were temporarily stockpiled in a waste material staging area for dewatering, waste characterization sampling, and subsequent offsite transportation and disposal. Once the excavated materials were placed in a waste material staging area, a composite soil sample was collected at an approximate frequency of one sample for every 500 tons of material, and the composite sample was submitted to Life Sciences for waste characterization analyses. The waste characterization analyses were performed to determine the Resource Conservation and Recovery Act (RCRA) hazardous characteristics and other parameters and consisted of the following:

- Toxicity by using the Toxicity Characteristic Leaching Procedure (TCLP) for VOCs, SVOCs, and metals (using USEPA Methods 8260 for VOCs; 8270 for SVOCs; 6010 for arsenic, barium, cadmium, chromium, lead, selenium, and silver; and 7471 for mercury).
- Ignitability using American Society for Testing and Materials (ASTM) Method E-502-84.
- PCBs using USEPA Method 8082.
- Reactive cyanide using USEPA Method 9012.
- Reactive sulfide using USEPA Method 9030A.
- Water extractable pH using USEPA Method 9045.
- Paint filter test using USEPA Method 9095.

A total of 12 waste characterization samples were collected and analyzed by Life Sciences, which satisfies the sampling frequency of one sample for every 500 tons of material (approximately 5,894 tons of material were excavated and transported offsite to Seneca Meadows for land disposal). Based on the waste characterization samples collected and analyzed, there were no analytical results that exceeded the RCRA hazardous characteristic limits; therefore, the excavated materials were managed and disposed as a nonhazardous waste. The analytical results for the waste characterization samples are included in Appendix L, and were submitted to Seneca Meadows throughout the NAPL barrier wall construction, which is discussed further in Section 3.3.

3.2 Wastewater Characterization Sampling and Analysis

During construction of the NAPL barrier wall, wastewater was generated during the removal, draining, and capping of inactive, underground natural gas lines, as well as from the dewatering of stockpiled materials within the waste material staging areas. One water sample was collected from an onsite frac tank and was submitted to Life Sciences for waste characterization analyses, which included PCBs (USEPA Method 608), ignitability (USEPA Method 1010), and benzene (USEPA Method 624). Although the analytical results did not exceed the RCRA hazardous characteristic limits, as a conservative measure, NYSEG elected to manage and dispose of the wastewater as a coal tar water hazardous waste (approximately 13,307 gallons). The analytical results for the waste characterization sample are included in Appendix M, and were submitted to Clean Harbors, which is discussed further in Section 3.4. The analytical results for confirmation wipe samples for frac tanks are included in Appendix K.

3.3 Offsite Transportation and Disposal of Soil Materials to Seneca Meadows

A waste profile was prepared and submitted to Seneca Meadows to obtain approval from this facility for the offsite landfill disposal of soil materials generated during the NAPL barrier wall construction. In addition, during the City of Binghamton's repairs to the water main along Court Street, in front of the site in October 2006, a discrete amount of soil (less than approximately 5 tons) was generated. The excavated soil appeared to have potential oil or MGP-related impacts and as a conservative measure, the excavated soil materials were placed in the soil stockpile that was subsequently characterized and disposed off-site.

As indicated in Section 3.1, waste characterization soil samples were collected from the stockpiled materials within the waste material staging areas and analyzed by Life

Sciences, and the analytical data were submitted to Seneca Meadows. Based on the waste profile and the waste characterization analytical results, Seneca Meadows approved this waste stream as a nonhazardous waste for landfill disposal. A copy of the waste profile and approval letter from Seneca Meadows are included in Appendix N.

Once the stockpiled materials within the waste material staging areas were dewatered (either by gravity dewatering or solidification using powdered cement), the materials were loaded into transport vehicles, a canvas tarp was placed over the top of each transport vehicle's bed, a nonhazardous solid waste manifest was prepared for each truck and was signed by the truck driver and a NYSEG representative, and each transport vehicle transported the material to Seneca Meadows for landfill disposal. Each truckload of material transported to Seneca Meadows was weighed prior to landfill disposal. A copy of the nonhazardous solid waste manifest and weigh ticket for each truckload of material transported to Seneca Meadows are included in Appendix O. As summarized in Table 3, approximately 5,894 tons on nonhazardous materials were disposed at Seneca Meadows during the NAPL barrier wall construction activities.

3.4 Offsite Transportation and Disposal of Wastewater to Clean Harbors

A waste profile was prepared and submitted to Clean Harbors to obtain approval from this facility for the offsite treatment of wastewater generated during the NAPL barrier wall construction. As indicated in Section 3.2, a wastewater characterization sample was collected and analyzed by Life Sciences, and the analytical data was submitted to Clean Harbors. Based on the waste profile and the waste characterization analytical results, Clean Harbors approved this waste stream for treatment at their facility.

Wastewater was temporarily stored in a combination of frac tanks (up to two) or polyethylene tanks (up to four) at the site, and a total of three tanker trucks were used to transport this wastewater from the site to Clean Harbor's facility for treatment. A hazardous waste manifest was prepared for each truck and was signed by the truck driver and a NYSEG representative prior to exiting the site. A copy of the hazardous waste manifest and volume ticket for each truckload of wastewater transported to Clean Harbors is included in Appendix P. Approximately 13,307 gallons of wastewater was transported to Clean Harbors for treatment.

3.5 Offsite Transportation and Recycling of Metal Materials

A waste profile was prepared and submitted to Casie Protank to obtain approval from this facility for the offsite recycling of the two large metal structures that were removed during the excavation of the gravel-filled trench. Based on the waste profile, Casie Protank approved this waste stream for recycling. A copy of the waste profile and approval letter from Casie Protank are included in Appendix Q.

The metal structures were temporarily stored in the waste material staging area, and one rolloff container was used to transport the metal structures material from the site to Casie Protank's facility for recycling. A nonhazardous manifest was prepared for this load and was signed by the truck driver and a NYSEG representative prior to exiting the site. A copy of the nonhazardous manifest and transportation ticket for the one truckload of metal material transported to Casie Protank are included in Appendix R.

3.6 Offsite Removal of Miscellaneous Materials

During the NAPL barrier wall construction, nonhazardous site waste (such as food waste and PPE) was generated and transported to an offsite municipal solid waste facility. In addition, concrete and asphalt materials that were removed during the repair of the asphalt pavement within Court Street (as discussed in Section 2.8.2) were transported offsite to a local fill area.

4. Post-Construction Monitoring

4.1 Introduction

This section presents initial (12-month) monitoring plan for the NAPL barrier trench to determine optimal monitoring and NAPL recovery methods and frequencies. Due to the uncertainties associated with NAPL movement, little to no NAPL may accumulate in the recovery wells during the initial monitoring period. In any event, this post-construction monitoring plan will be revised, as appropriate, after 12 months.

4.2 Post-Construction Monitoring

Post-construction monitoring will be conducted to assess the location and amount of NAPL that enters the trench and to monitor the area between the trench and the Susquehanna River for the presence of NAPL. Initially, the NAPL trench will be monitored monthly for LNAPL and DNAPL for a period of 12 months. The monitoring activities will include the measuring and recording as listed below.

DNAPL Recovery Wells

- Depth to bottom of the DNAPL monitoring wells
- Presence, thickness, and visual characteristics of DNAPL
- Depth of groundwater

LNAPL Recovery Wells

- Presence, thickness, and visual characteristics of LNAPL
- Depth to LNAPL
- Depth to groundwater

If recoverable amounts (i.e., more than 6 inches) of DNAPL is present in a well, the DNAPL will be collected and contained for disposal. If recoverable amounts of LNAPL (i.e., more than 2 inches) are present in a well or piezometer, the LNAPL will be collected and contained for disposal. The recovered volumes of NAPL will be recorded.

Recovery monitoring data will be used to determine optimal removal frequencies. If, based on volumes of NAPL recovered and/or rate of NAPL accumulation, automated NAPL recovery systems are warranted, NYSEG (or their engineer) will propose a plan to assess and develop NAPL recovery methods for the NYSDEC's approval. If after 12 months, NAPL has not entered any recovery wells, NYSEG may propose less frequent monitoring (e.g., quarterly) for the NYSDEC's approval.

<u>Monitoring Wells and Piezometers</u>

In addition to the LNAPL and DNAPL Recovery Well Monitoring Program, select monitoring wells and piezometers will be monitored. The following locations will be monitored semi-annually for depth to groundwater and the presence, thickness, and visual characteristics of LNAPL or DNAPL: MW97-7S, NMW-2, PZ-0301D, PZ03-02A, PZ03-02D, PZ03-03A, PZ03B, PZ03-03D, PZ03-04A, PZ03-04B, PZ03-04D, PZ03-05A, PZ03-05B, PZ03-05C, PZ03-05D, PZ003-06A, PZ03-06B, PZ03-06C, PZ03-06D, PZ03-07A, PZ03-07B, PZ03-07C, PZ03-07D, PZ03-08A, PZ03-08B, PZ03-08C, and PZ03-08D.

5. References

ARCADIS BBL, 2006. *NAPL Barrier Wall Interim Remedial Measure Work Plan* prepared for New York State Electric & Gas Corporation, Binghamton Court Street Former Manufacturer Gas Plant Site, New York (July 2006).

BBL, 2002. *Final Remedial Investigation Report*. Prepared for New York State Electric & Gas Corporation, Binghamton, New York (December 2002).

BBL, 2005. *NAPL Barrier Conceptual Design Letter.* Prepared for New York State Electric & Gas Corporation, Binghamton, New York (November 3, 2005).

USEPA, 2002. *Clinton Street Ballpark Aquifer System Support Document*. Obtained from the Internet: www.epa.gov/region02/water/aquifer/clinton/clinton.htm#12.

USGS, 2001. *Provisional Stage and Discharge Data for the Susquehanna River at Conklin, New York (Station #1503000)*. Obtained from the Internet: waterdata.usgs.gov

Tables

TABLE 1

SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING, BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Station	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
200+25	53.0	789.0	56.0	786.0	56.0	786.0	825
200+27	53.0	789.0	57.0	785.0	56.0	786.0	825
200+30	53.0	789.1	57.0	785.1	55.8	786.3	825
200+35	53.0	789.1	55.0	787.1	54.8	787.3	825
200+40	53.0	789.2	55.0	787.2	54.6	787.6	825
200+45	52.0	790.2	54.6	787.6	54.4	787.8	825
200+50	52.0	790.3	54.6	787.7	54.2	788.1	825
200+55	52.0	790.3	54.2	788.1	54.0	788.3	825
200+60	51.0	791.4	54.0	788.4	53.8	788.6	825
200+65	50.0	792.4	53.0	789.4	52.8	789.6	825
200+70	50.0	792.5	52.3	790.2	52.0	790.5	825
200+75	48.0	794.5	52.0	790.5	51.8	790.7	825
200+80	48.0	794.5	50.0	792.5	49.8	792.7	825
200+85	48.0	794.6	49.9	792.7	49.6	793.0	825
200+90	48.0	794.6	49.8	792.8	--	--	825
200+95	48.0	794.7	49.0	793.7	--	--	825
201+00	48.0	794.7	49.8	792.9	--	--	825
201+05	49.0	793.7	51.0	791.7	--	--	825
201+10	49.0	793.8	52.0	790.8	--	--	825
201+15	49.0	793.8	49.8	793.0	--	--	825
201+20	49.0	793.9	51.0	791.9	*Grout Plug*	--	--
201+25	49.0	794.0	50.0	793.0	*Grout Plug*	--	--
201+30	50.0	793.0	51.5	791.5	*Grout Plug*	--	--
201+35	50.0	793.1	53.0	790.1	53.0	790.1	827

TABLE 1

SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING,
BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Station	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
201+40	50.0	793.1	53.5	789.6	53.0	790.1	827
201+45	50.0	793.2	52.4	790.8	52.2	791.0	827
201+50	51.0	792.2	52.0	791.2	52.0	791.2	827
201+51	51.0	792.2	52.0	791.2	51.8	791.4	827
201+55	51.0	792.2	52.1	791.1	51.7	791.5	827
201+60	51.0	792.3	51.7	791.6	51.6	791.7	827
201+65	49.5	793.8	50.5	792.8	50.4	792.9	827
201+70	49.5	793.9	50.5	792.9	50.2	793.2	827
201+75	49.5	793.9	50.4	793.0	50.0	793.4	827
201+80	49.0	794.5	50.3	793.2	49.8	793.7	827
201+85	49.0	794.5	50.2	793.3	49.6	793.9	827
201+90	48.0	795.5	50.0	793.5	49.4	794.1	827
201+95	48.0	795.6	49.0	794.6	48.6	795.0	827
202+00	48.0	795.5	48.5	795.0	48.0	795.5	827
202+40	44.0	800.0	48.9	795.1	NA	NA	827
202+45	44.0	800.0	49.3	794.7	48.5	795.5	827
202+50	44.0	800.0	48.3	795.7	47.5	796.5	827
202+55	44.0	800.0	48.0	796.0	47.0	797.0	827
202+60	44.0	800.0	46.6	797.4	46.2	797.8	827
202+65	44.0	800.0	46.3	797.7	46.0	798.0	827
202+70	44.0	800.0	46.0	798.0	45.9	798.1	827
202+75	43.0	801.0	45.9	798.1	45.8	798.2	827
202+80	43.0	801.0	45.8	798.2	45.7	798.3	827
202+85	43.0	801.0	45.6	798.4	45.5	798.5	827

TABLE 1

SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING, BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Station	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
202+90	43.0	801.0	45.5	798.5	45.4	798.6	827
202+95	43.0	801.0	45.5	798.5	45.2	798.8	827
203+00	43.0	801.0	45.3	798.7	45.0	799.0	827
203+05	43.0	801.0	44.7	799.3	44.7	799.3	827
203+10	41.0	803.0	44.7	799.3	44.6	799.4	827
203+15	41.0	803.0	44.5	799.5	44.4	799.6	827
203+20	41.0	803.0	44.5	799.5	44.3	799.7	827
203+25	41.0	803.0	43.5	800.5	43.2	800.8	827
203+30	41.0	803.0	43.0	801.0	43.0	801.0	827
203+35	41.0	803.0	43.4	800.6	43.1	800.9	827
203+40	42.0	802.0	43.5	800.5	43.2	800.8	827
203+45	42.0	802.0	43.6	800.4	43.4	800.6	827
203+50	42.0	802.0	44.2	799.8	44.0	800.0	827
203+55	42.0	802.0	44.5	799.5	44.2	799.8	827
203+60	42.0	802.0	44.5	799.5	44.3	799.7	827
203+65	42.0	802.0	44.8	799.2	44.6	799.4	827
203+70	44.0	800.0	45.0	799.0	45.0	799.0	827
203+75	44.0	800.0	45.5	798.5	45.2	798.8	827
203+80	44.0	800.0	45.6	798.4	45.4	798.6	827
203+85	44.0	800.0	45.9	798.1	45.8	798.2	827
203+90	44.0	800.0	46.4	797.6	46.4	797.6	827
203+95	44.0	800.0	47.0	797.0	46.9	797.1	827
204+00	44.0	800.0	47.0	797.0	47.0	797.0	827
204+05	45.0	799.0	47.5	796.5	47.5	796.5	827

TABLE 1

**SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING,
BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS**

**NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK**

Station	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
204+10	45.0	799.0	48.2	795.8	47.8	796.2	827
204+15	45.0	799.0	48.3	795.7	48.0	796.0	827
204+20	45.0	799.0	49.0	795.0	49.0	795.0	827
204+25	45.0	799.0	49.6	794.4	49.5	794.5	827
204+30	46.0	798.0	51.4	792.6	50.0	794.0	827
204+35	46.0	798.0	52.7	791.3	50.5	793.5	827
204+40	46.0	798.0	53.1	790.9	51.0	793.0	827
204+45	46.0	798.0	52.5	791.5	49.8	794.2	827
204+50	46.0	798.0	52.4	791.6	49.6	794.4	827
204+55	47.0	797.0	52.0	792.0	49.4	794.6	827
204+60	47.0	797.0	50.6	793.4	49.2	794.8	827
204+65	47.0	797.0	50.0	794.0	49.0	795.0	827
204+70	47.0	797.0	50.0	794.0	48.6	795.4	827
204+75	47.0	797.0	49.7	794.3	48.4	795.6	827
204+80	47.0	797.0	49.2	794.8	48.2	795.8	827
204+82	47.0	797.0	49.0	795.0	48.0	796.0	827
205+39	47.5	797.5	51.0	794.5	50.0	795.5	827
205+40	47.5	797.5	51.0	794.5	49.5	796.0	827
205+45	47.5	797.5	50.5	795	49.5	796.0	827
205+50	47.5	797.5	50.0	795.5	49.0	796.5	827
205+55	47.5	797.5	50.0	795.5	49.0	796.5	827
205+60	47.5	797.5	49.5	796	48.5	797.0	827
205+65	47.5	797.5	49.5	796	48.5	797.0	827
205+70	47.5	797.5	49.0	796.5	48.0	797.5	827

TABLE 1

**SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING,
BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS**

**NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK**

	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
Station	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
205+75	47.5	797.5	49.0	796.5	48.0	797.5	827
205+80	47.5	797.5	49.0	796.5	48.0	797.5	827
205+85	47.5	797.5	49.0	796.5	48.0	797.5	827
205+86	47.5	797.5	50.0	795.5	48.0	797.5	827
206+13	49.0	800.9	51.0	798.9	50.5	799.4	827
206+15	49.0	800.9	51.0	798.9	50.1	799.8	827
206+20	48.5	801.2	50.0	799.7	49.9	799.8	827
206+25	48.0	801.3	49.5	799.8	49.6	799.7	827
206+30	48.0	801.3	84.5	764.8	49.5	799.8	827
206+35	48.0	801.0	49.0	800	49.0	800.0	827
206+40	48.0	801.0	49.0	800	48.8	800.2	827
206+45	48.0	801.0	49.0	800	48.7	800.3	827
206+50	48.0	800.7	48.5	800.2	48.4	800.3	827
206+55	48.0	800.7	48.5	800.2	48.4	800.3	827
206+60	48.0	800.7	48.5	800.2	48.2	800.5	827
206+65	48.0	800.7	48.5	800.2	48.0	800.7	827
206+70	48.0	800.7	48.5	800.2	48.0	800.7	827
206+75	48.0	800.7	48.5	800.2	48.0	800.7	827
206+80	48.0	800.7	48.5	800.2	48.0	800.7	827
206+85	48.0	800.7	48.5	800.2	47.8	800.9	827
206+90	45.0	803.4	46.0	802.4	45.0	803.4	827
206+95	45.0	803.4	46.0	802.4	45.0	803.4	827
207+00	43.0	805.1	44.0	804.1	43.5	804.6	827
207+05	43.0	805.1	44.0	804.1	43.5	804.6	827

TABLE 1

SUMMARY OF TRENCH, INVERT OF LATERAL COLLECTION PIPING, BOTTOM OF HDPE GEOMEMBRANE, AND STREEL SHEETING MEASUREMENTS/ELEVATIONS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Station	Till		Trench Excavation		DNAPL Collection Pipe		HDPE Liner/Sheet Pile Panel Bottom Elevation
	Depth (ft)	Elevation	Depth (ft)	Elevation	Depth (ft)	Invert Elevation	
207+10	42.0	805.8	43.0	804.8	42.5	805.3	827
207+15	41.0	806.8	42.0	805.8	41.0	806.8	827
207+20	41.0	806.5	42.0	805.5	41.0	806.5	827
207+25	41.0	806.5	42.5	805	41.5	806.0	827
207+30	41.0	806.2	42.5	804.7	42.0	805.2	827
207+35	41.0	806.2	43.0	804.2	42.0	805.2	827
207+40	41.0	805.9	43.0	803.9	42.5	804.4	827
207+45	41.0	805.9	43.0	803.9	42.2	804.7	827

Notes:

1. Measurements collected by Geo-Solutions, Inc. and provided to ARCADIS BBL.
2. Component elevations referenced to the NGVD 29 Datum.
3. -- = Indicates NAPL barrier wall component not installed at this location.
4. NA = Indicates measurement was not taken at this location.

TABLE 2

SUMMARY OF PEA GRAVEL QUANTITIES

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Date	Invoice No.	Quantity (tons)	Date	Invoice No.	Quantity (tons)	Date	Invoice No.	Quantity (tons)
07/25/06	28458	28.27	07/25/06	--	35.24	09/13/06	29710	32.71
07/25/06	28455	32.34	07/25/06	--	27.99	09/13/06	29704	32.91
07/25/06	28454	35.87	07/25/06	--	22.94	09/13/06	29702	28.50
07/25/06	28452	23.75	07/25/06	--	36.64	09/19/06	--	32.73
07/25/06	28416	23.52	07/25/06	--	34.44	09/19/06	--	30.61
07/25/06	28403	23.69	08/30/06	29440	33.30	09/19/06	--	30.10
07/25/06	28450	23.80	08/30/06	29438	26.72	09/19/06	--	31.02
07/25/06	28449	35.28	08/31/06	29420	25.54	09/19/06	--	30.95
07/25/06	28448	28.50	08/31/06	29425	27.97	09/19/06	--	30.21
07/25/06	28447	35.82	08/31/06	29400	28.10	09/19/06	--	30.21
07/25/06	28434	36.77	08/31/06	29415	28.52	09/19/06	--	30.50
07/25/06	28446	36.06	08/31/06	29416	30.12	09/19/06	--	30.72
07/25/06	28443	23.87	08/31/06	29419	30.08	09/28/06	30080	23.25
07/25/06	28433	23.77	08/31/06	29402	32.75	09/28/06	30077	23.39
07/25/06	28442	39.11	08/31/06	29411	32.72	09/28/06	30071	23.37
07/25/06	28441	28.86	08/31/06	29417	31.05	09/28/06	30065	23.56
07/25/06	28428	28.59	08/31/06	29421	31.06	09/28/06	30060	26.96
07/25/06	28440	37.80	08/31/06	29422	30.47	09/28/06	30054	23.36
07/25/06	28437	36.09	08/31/06	29426	32.60	09/28/06	30053	23.34
07/25/06	28430	33.27	08/31/06	29427	32.83	09/28/06	30052	23.20
07/25/06	28418	35.53	08/31/06	29429	32.16	09/28/06	30083	23.41
07/25/06	28420	28.68	09/12/06	29692	27.23	10/02/06	30168	23.39
07/25/06	28411	28.32	09/12/06	29683	27.72	10/02/06	30160	23.71
07/25/06	28422	33.06	09/12/06	29688	27.92	10/02/06	30166	23.42
07/25/06	28412	36.37	09/12/06	29668	27.43	10/02/06	30162	23.76
07/25/06	28414	23.35	09/12/06	29666	27.84	10/02/06	30157	27.07
07/25/06	28423	23.60	09/12/06	29679	27.79	10/02/06	30161	25.32
07/25/06	28402	39.47	09/12/06	29662	27.78	10/02/06	30124	23.17
07/25/06	28415	35.62	09/12/06	29658	28.70	10/02/06	30133	23.60
07/25/06	28425	36.51	09/12/06	29653	25.23	10/02/06	30138	23.37
07/25/06	28427	33.50	09/13/06	29707	32.63	10/02/06	30146	25.74

TABLE 2

SUMMARY OF PEA GRAVEL QUANTITIES

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Date	Invoice No.	Quantity (tons)	Date	Invoice No.	Quantity (tons)	Date	Invoice No.	Quantity (tons)
10/02/06	30144	23.77	10/09/06	30404	23.03	10/18/06	30585	23.55
10/02/06	30151	25.00	10/09/06	30400	22.97	10/18/06	30591	23.47
10/02/06	30136	23.28	10/09/06	30398	23.03	10/18/06	30582	23.81
10/02/06	30145	23.48	10/09/06	30392	24.12	10/19/06	30623	19.12
10/02/06	30150	26.98	10/09/06	30389	23.38	10/19/06	30629	18.52
10/02/06	30139	23.50	10/09/06	30386	23.13	10/19/06	30620	19.45
10/02/06	30129	23.20	10/09/06	30385	37.71	10/19/06	30621	19.14
10/02/06	30152	27.81	10/09/06	30383	23.19	10/19/06	30619	18.34
10/02/06	--	23.29	10/09/06	30377	37.72	10/19/06	30617	18.46
10/03/06	30252	23.34	10/09/06	30382	37.70	10/20/06	30630	18.92
10/03/06	30245	22.94	10/09/06	30380	22.97	**Total Pea Gravel Delivered**		**4419.76**
10/03/06	30248	26.45	10/09/06	30376	23.00			
10/03/06	30237	23.21	10/09/06	30375	38.40			
10/03/06	30218	25.69	10/10/06	30422	22.27			
10/03/06	30226	24.71	10/10/06	30413	22.21			
10/03/06	30224	22.84	10/10/06	30416	22.29			
10/03/06	30215	23.34	10/10/06	30419	22.48			
10/03/06	30240	24.70	10/10/06	30407	22.34			
10/03/06	30202	23.61	10/10/06	--	22.66			
10/03/06	30207	28.16	10/17/06	30566	18.02			
10/03/06	30208	26.33	10/17/06	30565	18.35			
10/03/06	30204	26.06	10/17/06	30564	18.51			
10/03/06	30197	26.02	10/17/06	30563	17.25			
10/03/06	30195	23.17	10/17/06	30560	18.27			
10/03/06	30183	23.36	10/17/06	30559	18.21			
10/03/06	30188	26.76	10/17/06	30558	17.88			
10/03/06	30191	26.76	10/17/06	30555	18.15			
10/03/06	30185	26.36	10/17/06	30552	18.14			
10/03/06	30174	26.58	10/17/06	30546	17.88			
10/03/06	30181	26.59	10/18/06	30601	27.36			
10/03/06	30175	23.58	10/18/06	30599	23.38			

Notes:

1. Pea gravel was delivered to the NYSEG Binghamton Court Street Former MGP Site by Barney & Dickenson, Inc. on the dates indicated.
2. -- = Indicates invoice did not have an identification number.

TABLE 3

SUMMARY OF NON-HAZARDOUS MATERIALS DISPOSED AT SENECA MEADOWS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Date	Manifest No.	Weigh Ticket No.	Weight (tons)	Date	Manifest No.	Weigh Ticket No.	Weight (tons)
09/26/06	BING-06-01	450104	32.84	10/09/06	BING-06-42	1448250	31.56
09/26/06	BING-06-02	450104	22.39	10/09/06	BING-06-43	1447961	39.86
09/26/06	BING-06-03	450104	29.67	10/09/06	BING-06-44	1447974	33.43
09/26/06	BING-06-04	450104	32.86	10/09/06	BING-06-45	1447979	35.08
09/26/06	BING-06-05	1441960	31.10	10/09/06	BING-06-46	1447997	37.81
09/26/06	BING-06-06	1441965	31.57	10/09/06	BING-06-47	1448000	32.73
09/27/06	BING-06-07	1442175	33.23	10/09/06	BING-06-48	1448122	32.87
09/27/06	BING-06-08	1442227	33.73	10/09/06	BING-06-49	1447947	41.61
09/27/06	BING-06-09	1442254	30.02	10/09/06	BING-06-50	--	--
09/27/06	BING-06-10	1442189	35.32	10/10/06	BING-06-51	1448395	32.23
09/27/06	BING-06-11	1442142	34.37	10/10/06	BING-06-52	1448388	34.37
09/27/06	BING-06-12	1442388	39.39	10/10/06	BING-06-53	1448666	32.00
09/27/06	BING-06-13	1442402	31.85	10/10/06	BING-06-54	1448827	33.06
09/27/06	BING-06-14	1442435	35.62	10/10/06	BING-06-55	--	--
09/27/06	BING-06-15	1442458	32.51	10/10/06	BING-06-56	1448543	30.75
09/27/06	BING-06-16	1442449	30.14	10/10/06	BING-06-57	1448613	29.01
09/27/06	BING-06-17	1442494	27.58	10/10/06	BING-06-58	1448665	34.41
09/27/06	BING-06-18	1442521	30.94	10/10/06	BING-06-59	1448385	31.30
09/27/06	BING-06-19	1442545	31.65	10/11/06	BING-06-60	1449054	36.21
09/27/06	BING-06-20	1442565	34.45	10/11/06	BING-06-61	1448732	31.53
09/27/06	BING-06-21	1442619	32.89	10/11/06	BING-06-62	1448810	35.74
09/27/06	BING-06-22	1442615	34.26	10/11/06	BING-06-63	1448521	29.91
09/27/06	BING-06-23	1442627	33.57	10/11/06	BING-06-64	1449041	29.70
09/28/06	BING-06-24	1442781	34.32	10/11/06	BING-06-65	1449042	28.52
09/28/06	BING-06-25	1443072	32.87	10/12/06	BING-06-66	1449920	32.27
09/28/06	BING-06-26	1442844	38.73	10/12/06	BING-06-67	1449929	34.86
09/28/06	BING-06-27	1442888	31.82	10/12/06	BING-06-68	1449957	31.28
09/28/06	BING-06-28	1442899	31.58	10/12/06	BING-06-69	1449959	34.71
09/28/06	BING-06-29	1442928	35.35	10/13/06	BING-06-70	1450679	35.20
09/28/06	BING-06-30	1443031	38.89	10/13/06	BING-06-71	1450357	35.00
09/28/06	BING-06-31	1443084	37.97	10/13/06	BING-06-72	1450427	33.99
09/28/06	BING-06-32	1443103	33.61	10/13/06	BING-06-73	1450429	34.05
09/28/06	BING-06-33	1443135	42.71	10/13/06	BING-06-74	1450461	33.03
09/28/06	BING-06-34	1443128	33.09	10/13/06	BING-06-75	1450484	33.64
09/28/06	BING-06-35	1443132	32.33	10/13/06	BING-06-76	1450467	34.77
09/28/06	BING-06-36	1443142	29.36	10/13/06	BING-06-77	1450532	32.03
09/28/06	BING-06-37	1443175	27.23	10/13/06	BING-06-78	1450557	30.23
09/28/06	BING-06-38	1443185	15.44	10/13/06	BING-06-79	1450569	32.44
09/28/06	BING-06-39	1443203	25.38	10/13/06	BING-06-80	1450647	33.40
09/28/06	BING-06-40	1443218	20.64	10/13/06	BING-06-81	1450334	31.82

TABLE 3

SUMMARY OF NON-HAZARDOUS MATERIALS DISPOSED AT SENECA MEADOWS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Date	Manifest No.	Weigh Ticket No.	Weight (tons)	Date	Manifest No.	Weigh Ticket No.	Weight (tons)
09/28/06	BING-06-41	1443230	18.65	10/13/06	BING-06-82	1450694	35.48
10/14/06	BING-06-83	1450812	29.19	10/26/06	BING-06-124	1456340	34.06
10/14/06	BING-06-84	1450804	35.21	10/26/06	BING-06-125	1456343	34.10
10/14/06	BING-06-85	1450856	32.97	10/26/06	BING-06-126	1456416	35.95
10/14/06	BING-06-86	1450751	31.01	10/26/06	BING-06-127	1456395	36.72
10/16/06	BING-06-87	1451233	34.17	10/26/06	BING-06-128	1456436	37.40
10/16/06	BING-06-88	1451248	33.09	10/27/06	BING-06-129	1456825	34.73
10/16/06	BING-06-89	1451264	30.35	10/27/06	BING-06-130	1456826	36.17
10/16/06	BING-06-90	1451275	26.35	10/27/06	BING-06-131	1456892	35.66
10/16/06	BING-06-91	1451325	37.46	10/27/06	BING-06-132	1456874	34.95
10/16/06	BING-06-92	1451305	33.02	10/27/06	BING-06-133	1456886	33.42
10/16/06	BING-06-93	1451341	34.46	10/31/06	BING-06-134	1458045	39.42
10/16/06	BING-06-94	1451368	41.80	11/01/06	BING-06-135	1458734	39.64
10/16/06	BING-06-95	1451412	29.91	11/01/06	BING-06-136	1458531	33.81
10/18/06	BING-06-96	1452472	33.07	11/01/06	BING-06-137	1458553	37.61
10/18/06	BING-06-97	1452480	34.86	11/01/06	BING-06-138	1458570	33.87
10/18/06	BING-06-98	1452526	28.84	11/01/06	BING-06-139	1458558	35.47
10/18/06	BING-06-99	1452518	29.09	11/01/06	BING-06-140	1458564	33.16
10/18/06	BING-06-100	1452517	32.00	11/01/06	BING-06-141	1458615	32.78
10/18/06	BING-06-101	1452568	34.56	11/01/06	BING-06-142	1458590	33.32
10/19/06	BING-06-102	1452897	32.25	11/01/06	BING-06-143	1458621	36.64
10/19/06	BING-06-103	1452898	33.49	11/01/06	BING-06-144	1458622	32.48
10/19/06	BING-06-104	1452945	33.64	11/01/06	BING-06-145	1458517	40.89
10/19/06	BING-06-105	1452967	34.43	11/01/06	BING-06-146	1458745	35.43
10/19/06	BING-06-106	1452926	37.01	11/02/06	BING-06-147	1458834	35.96
10/19/06	BING-06-107	1453059	33.52	11/02/06	BING-06-148	1458823	34.58
10/19/06	BING-06-108	1453097	32.89	11/02/06	BING-06-149	1459086	35.24
10/19/06	BING-06-109	1453082	33.13	11/02/06	BING-06-150	1458798	33.67
10/19/06	BING-06-110	1453130	34.57	11/02/06	BING-06-151	1458864	34.00
10/19/06	BING-06-111	1453367	37.76	11/02/06	BING-06-152	1458888	35.73
10/20/06	BING-06-112	1453588	32.66	11/02/06	BING-06-153	1458882	34.13
10/20/06	BING-06-113	1453622	30.47	11/02/06	BING-06-154	1458979	37.87
10/20/06	BING-06-114	1453589	30.78	11/02/06	BING-06-155	1458990	28.60
10/20/06	BING-06-115	1453649	31.47	11/02/06	BING-06-156	1459016	31.11
10/20/06	BING-06-116	1453770	33.84	11/02/06	BING-06-157	1459007	32.42
10/20/06	BING-06-117	1453756	32.92	11/02/06	BING-06-158	1459032	31.18
10/20/06	BING-06-118	1453768	27.10	11/02/06	BING-06-159	1459077	33.51
10/20/06	BING-06-119	1453773	34.06	11/02/06	BING-06-160	1458824	32.02
10/20/06	BING-06-120	1453736	33.24	11/02/06	BING-06-161	1459094	35.62
10/20/06	BING-06-121	1453781	30.14	11/02/06	BING-06-162	1459143	35.90

TABLE 3

SUMMARY OF NON-HAZARDOUS MATERIALS DISPOSED AT SENECA MEADOWS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Date	Manifest No.	Weigh Ticket No.	Weight (tons)	Date	Manifest No.	Weigh Ticket No.	Weight (tons)
10/20/06	BING-06-122	1453749	26.52 [3]	11/02/06	BING-06-163	1459193	36.00
10/20/06	BING-06-123	1453791	26.85	11/02/06	BING-06-164	1459194	35.29
11/03/06	BING-06-165	1459359	30.37	11/08/06	BING-06-171	1460894	32.02
11/03/06	BING-06-166	1459361	28.75	11/08/06	BING-06-172	1460872	34.72
11/03/06	BING-06-167	1459360	28.35	11/08/06	BING-06-173	1460893	40.21
11/03/06	BING-06-168	1459483	34.40	11/08/06	BING-06-174	1460926	38.81
11/03/06	BING-06-169	1459481	33.70	11/08/06	BING-06-175	1460927	40.05
11/03/06	BING-06-170	1459488	18.12	11/08/06	BING-06-176	1460941	59.37
						TOTAL (tons)	**5,787**

Notes:
1. Summary of non-hazardous material disposal of at Seneca Meadows generated from non-hazardous waste disposal manifests and weigh tickets (see Appendix O).
2. -- = Indicates weigh ticket missing for truck load.
3. Original weigh ticket indicated 23.52 tons of material. Weigh ticket was hand-marked with edit quantity.

TABLE 4

SUMARY OF DNAPL RECOVERY AND LNAPL MONITORING TOP OF WELL CASING ELEVATIONS

NEW YORK STATE ELECTRIC & GAS CORPORATION
BINGHAMTON COURT STREET FORMER MGP SITE
BINGHAMTON, NEW YORK

Well ID	Purpose	Well Bottom Elevation (FAMSL)	Top of Casing (FAMSL)
RW-1	DNAPL Recovery	788.11	842.31
RW-2	DNAPL Recovery	789.82	842.12
RW-3	LNAPL Monitoring	825.08	841.83
RW-4	LNAPL Monitoring	825.41	842.51
RW-5	DNAPL Recovery	793.88	842.48
RW-6	DNAPL Recovery	794.47	843.57
RW-7	LNAPL Monitoring	825.38	843.58
RW-8	LNAPL Monitoring	824.95	843.05
RW-9	DNAPL Recovery	790.57	843.52
RW-10	LNAPL Monitoring	827.31	843.91
RW-11	DNAPL Recovery	794.14	843.84
RW-12	DNAPL Recovery	796.69	844.65
RW-13	LNAPL Monitoring	826.05	844.75
RW-14	LNAPL Monitoring	827.67	845.27
RW-15	DNAPL Recovery	796.03	845.23
RW-16	DNAPL Recovery	798.50	848.41
RW-17	LNAPL Monitoring	825.25	848.34
RW-18	DNAPL Recovery	803.84	845.82
RW-19	LNAPL Monitoring	826.70	845.81
RW-20	LNAPL Monitoring	826.51	841.96
RW-21	LNAPL Monitoring	826.02	842.02
RW-22	DNAPL Recovery	789.77	841.97

Notes:

1. Elevations referenced to the NAVD 88 Datum
2. FAMSL = feet above mean sea level.