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COMMISSIONER OF ENVIRONMENTAL CONSERVATION

[signature]

12/4/01

Designated Representative

Date

RETEC

Final Engineering Report

Scajaquada Creek Sediment Remediation
Buffalo, New York
NYSDEC Site # 91514B

915141B

Prepared by:

RETEC Engineering, P.C.

Under Contract To:

ThermoRetec Consulting Corporation
1001 West Seneca Street, Suite 204
Ithaca, New York 14850-3342

ThermoRetec Project No.: NFGD1-02111-600

Prepared for:

National Fuel Gas Distribution Corporation
10 Lafayette Square
Buffalo, New York 14203

August 30, 2000

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Buffalo, New York 14203

Prepared by:

Dan Shearer, Site Engineer

Technically Reviewed by:

John T. Finn, P.E., Project Manager

August 30, 2000

Engineer's Certification

The sediment remediation work and associated construction activities at the Scajaquada Creek site in Buffalo, New York were completed in accordance with the NYSDEC-approved design documents, including the approved design changes, as described in this report.

Work for this project was performed, and this Final Engineering Report was prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of National Fuel Gas Distribution Corporation for specific application to the riparian component of the Iroquois Gas/Westwood-Squibb Pharmaceutical site in Buffalo, New York. No other warranty, express or implied, is made.

RETEC Engineering, P.C. under contract to
ThermoRetec Consulting Corporation

John T. Finn, P.E.
Senior Engineer

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

Executive Summary

This Final Engineering Report describes the sediment remediation work completed at the Scajaquada Creek site in Buffalo, New York. The work was performed in compliance with the Consent Decree and the approved design documents.

ThermoRetec Consulting Corporation (ThermoRetec) provided engineering design and field support during the work. Philip Environmental Services Corporation (Philip) was the general contractor. Oversight was provided by representatives of the New York State Department of Environmental Conservation (NYSDEC) and National Fuel Gas Distribution Corporation. The project field work began in July, 1998, and was completed in June, 1999. The overall objectives of this integrated sediment remedy were achieved.

Significant results of the project were :

- All contaminated materials from within the site boundary were successfully removed in accordance with design documents, with the exception of an area obstructed by underground electrical cables. This undredged volume was approximately 3% of the total volume.

- The cap and sheet pile barriers were constructed in accordance with the design documents, as modified due to the obstructing underground electrical cables.

- Results of the air monitoring program demonstrated that there were no sustained concentrations of contaminants above OSHA, NIOSH or ACGIH exposure limits beyond the site perimeter during the work. Within the site perimeter, workers were protected from exposure by appropriate personal protective equipment.

- Results of the surface water monitoring program demonstrated that there were no sustained exceedances of surface water criteria beyond the site perimeter during the work.

- A DNAPL recovery well was installed at the sheet pile barrier near the West Avenue Bridge. A second DNAPL recovery well is planned to be installed south of the railroad bridge.

- Site restoration, including planting of grass, shrubs, trees, and aquatic plants was completed.

The excavation of the creek bottom resulted in the removal of 18,976 cubic yards of contaminated sediment and debris. The following estimated quantities were transported off site and disposed of in permitted landfills:

- 13,000 tons of non-hazardous, contaminated sediment and debris; and
- 15,000 tons of RCRA hazardous sediment and debris.

The capping of the creek bottom resulted in a horizontal barrier along the 1,600 foot reach of Scajaquada Creek. It consists of the following quantities of materials:

- 5,000 tons of armor stone, at a minimum of six inches thick at top of cap;
- 140,000 square feet of geotextile fabric;
- 20,000 tons of clean sand, at a minimum of 18 inches thick; and
- 95,000 square feet of geosynthetic clay liner, at the bottom of the cap, from the West Avenue Bridge to the Railroad Bridge.

Installation of the sheet pile wall resulted in a subsurface vertical barrier across the 70 foot width of the creek close to West Avenue. Approximately 2,500 square feet of steel sheet piling was installed.

Weak bank conditions were unexpectedly encountered at one location during dredging. To restore the bank in this area along the west bank of the creek, 80 linear feet of sheet pile was installed.

Long-term operation and maintenance for the remedy will include annual inspections of the cap from the banks and inspection of the submerged cap conditions every two years. Details of the operation and maintenance procedures for the cap and the DNAPL recovery systems are described in the Operation and Maintenance Plan, provided under separate cover.

Table of Contents

Table of Contents

List of Appendices

PROVIDED UNDER SEPARATE COVER

List of Tables

List of Figures

Abbreviations

DNAPL - Dense, Non-Aqueous Phase Liquid
GCL - Geosynthetic Clay Liner
MHF - Materials Handling Facility
NAPL - Non-Aqueous Phase Liquid
NFG - National Fuel Gas Distribution Corporation
NYSDEC - New York State Department of Environmental Conservation
NYSDOH - New York State Department of Health
PAH - Polycyclic Aromatic Hydrocarbons
Philip - Philip Environmental Services Corporation
TPH - Total Petroleum Hydrocarbons
ThermoRetec - ThermoRetec Consulting Corporation and its subcontracted engineering company, RETEC Engineering, P.C.

1 Introduction

This Final Engineering Report describes the sediment remediation of Scajaquada Creek near the former Iroquois Gas manufactured gas plant facility at 100 Forest Avenue, Buffalo, New York, NYSDEC Site No. 19-15-141B. The site location is shown in Figure 1-1. The project consisted of dredging, stabilizing, and disposing of approximately 19,000 cubic yards of contaminated sediment; capping of a 1,600 foot section of Scajaquada Creek; installation of a DNAPL recovery system; and site restoration. This report presents pertinent analytical results, a summary of the total quantities manifested and removed from the site, a summary of the total quantities used in the capping of the remaining sediments in the creek, the results of the environmental controls employed for the health and safety of the workers and the community, key observations made during the project, and the status of the site upon completion of the work.

ThermoRetec was the project engineer and provided design engineering, documentation, and construction oversight during the project activities. Philip Environmental Services Corporation (Philip) was the general contractor. Additional oversight was provided by representatives from the NYSDEC and NFG.

1.1 Site History and Description

The Iroquois Gas/Westwood Pharmaceutical (IG/WP) site lies in a mixed industrial and residential area of Buffalo, New York on the east bank of the Scajaquada Creek. The creek itself flows through a zone of active and inactive industrial facilities upstream and downstream from the IG/WP site. Untreated sewage has been observed flowing into Scajaquada Creek from combined sewers in upstream locations and through the outfall on the east bank of the Site. Scajaquada Creek is approximately 40 to 110 feet wide in the section adjacent to the IG/WP site, with a creek level approximately 20 feet below the top of the east bank. The creek drains southwest into the Black Rock Canal of the Niagara River approximately one-half mile down stream. Creek elevations can vary by several feet over a period of an hour or less. The action of wind on Lake Erie and the opening and closing of canal locks causes the level of the Black Rock Canal to rise and fall, often resulting in rapid reversals in the direction of flow in Scajaquada Creek at the site location.

The site was divided into terrestrial and riparian areas. The terrestrial portion consists of an area of approximately nine acres where a manufactured gas plant

Site Location Map

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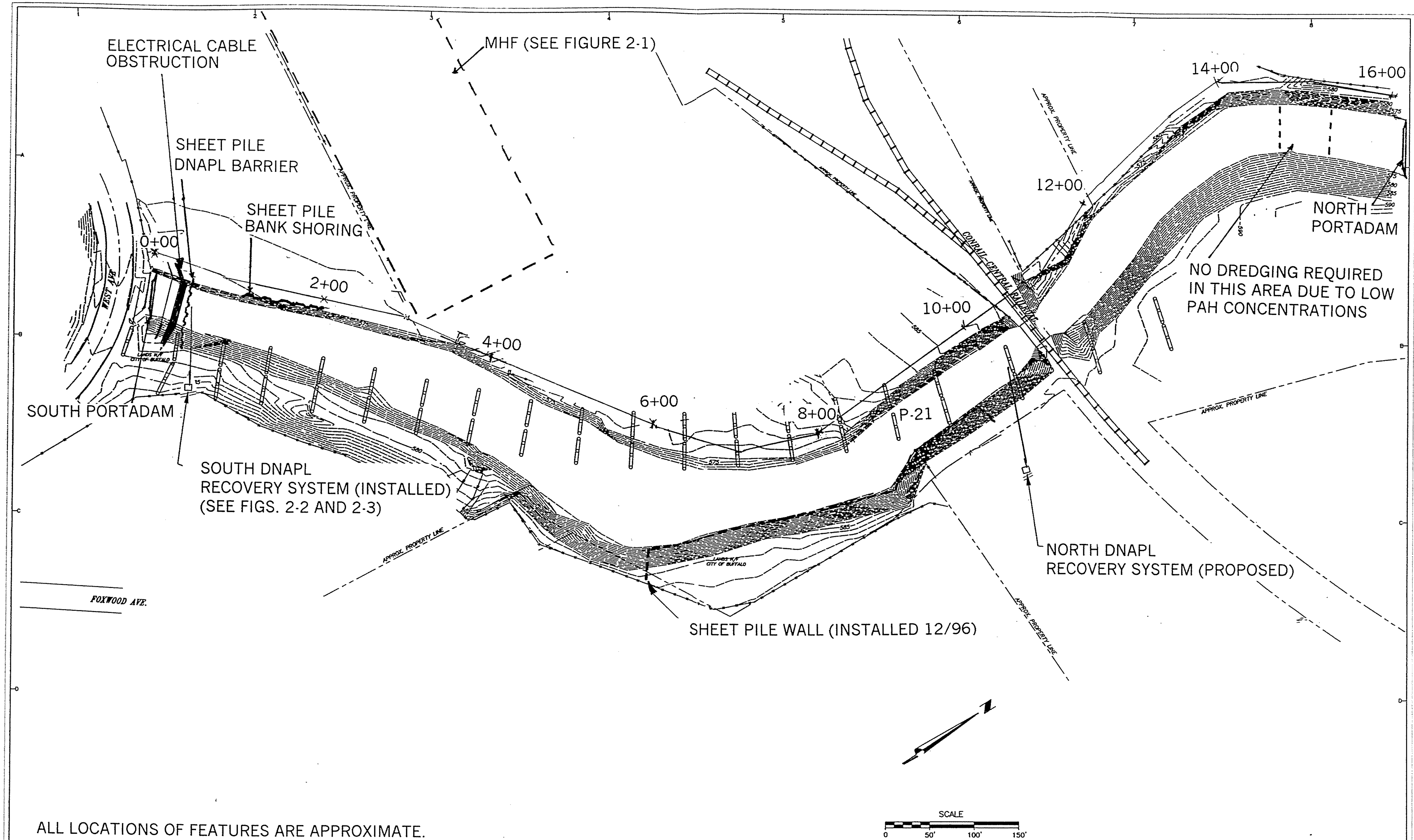
Figure 1-1



ALL LOCATIONS OF FEATURES ARE APPROXIMATE.
SEE AS-BUILT DRAWINGS FOR ACTUAL LOCATIONS AND DIMENSIONS

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		0	[illegible]	7/20/99	CLIENT REVIEW DRAFT				

NATIONAL FUEL GAS
SCAJAQUADA CREEK SITE
3-2111-600

CURRENT DATE:
CAD FILE:

SITE PLAN
SEDIMENT REMEDIATION

RETEC
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DRAWING NO. FIGURE 1-2 REV. 0

(MGP) facility was formerly located. This property is currently owned by the Westwood Squibb Pharmaceutical Company (WSP) and contains two buildings which cover about 50% of the area. The riparian portion of the site consists of the sediments of Scajaquada Creek impacted by MGP residues. The riparian site is located in a 1,600-foot-long stretch of the creek running from the West Avenue Bridge to a location 400 feet north of the New York Central Railroad Bridge.

In November and December, 1996, NFG constructed a sheet pile wall along the eastern bank of the creek, adjacent to the Westwood Squibb, Inc. property. The sheet pile wall was an initial component of the remedial actions for the terrestrial and riparian portions of the site. The successful completion of the sheet pile wall was documented [Remediation Technologies, Inc., 1997].

Additional historical information and a description of the site environmental conditions is provided in the Phase II Pre-Design Investigation Report [Remediation Technologies, Inc., 1996].

1.2 Objectives of the Remedial Program

The overall goal of this work was to provide a remedy which was protective of human health and the environment, did not damage structures or properties, and was financially practicable. Therefore, the remedy integrated removal and isolation technologies to achieve this goal.

The integrated sediment remedy consisted of five major components, which are shown in Figure 1-2:

- **Excavation** of approximately 19,000 cubic yards of contaminated sediments to a maximum depth of six feet as required and whenever possible to meet the cleanup goal set in the ROD.

- **Placement of a protective cap.** After dredging and partial backfilling, a cap was placed over the remaining contaminated sediments. The protective cap consists of geosynthetic clay liner (GCL), angular sand, geotextile and anchoring stone. The GCL was placed at the bottom of the protective cap to prevent direct contact of ecological receptors to contaminated sediments. Sand was placed (with a minimum thickness of 18 inches) on the GCL. Geotextile was placed on the sand and anchoring stone was placed on top of the protective cap to provide a beneficial ecological habitat and protect the cap from being damaged. GCL was not used as part of the protective cap, north of the Railroad

Bridge because there were no contaminated sediments remaining after dredging in this area.

- **Handling, transportation, and offsite disposal** of dredged contaminated sediments and water resulting from the dredging operations.

- **Installation of DNAPL recovery systems** near the West Avenue Bridge and the Railroad Bridge. A sheet pile wall barrier was installed across the width of the creek to provide for DNAPL collection near the West Avenue Bridge and prevent offsite migration of DNAPL. The two recovery systems will provide additional mass removal of contaminants remaining after dredging. The DNAPL recovery system near West Avenue was installed in the spring of 1999. The second system required access to offsite property and is planned to be installed at a later date after access is obtained. An addendum to this Report will be compiled once the second system is installed.

- **Site Restoration** including physical restoration of staging areas and haul roads and restoration of creek banks. Grass seed, shrubs and tree seedlings, and aquatic vegetation (submergent and emergent) was planted and maintained on bank areas which were cleared. To prevent bank erosion and to promote the growth of emergent species, 520 linear feet of 18 inch diameter, organic fiber rolls were placed parallel to the creek on the 571.5 foot elevation contour. Organic topsoil was placed to a minimum depth of four inches along the banks in areas where aquatic vegetation was planted.

This remedial work was coordinated with the City of Buffalo's construction of the Scajaquada Bicycle Pathway adjacent to the western bank of the Site.

1.3 Design Documents

The five components of the remedial action were described in the Preliminary Remedial Design / Remedial Action Work Plan [RETEC, 1998a], which was prepared in conformance to the Consent Decree [New York State, 1995] and approved by NYSDEC [NYSDEC, 1998].

The work was accomplished in accordance with detailed design documents. Detailed plans for the work were described in the following design documents, all of which were reviewed and approved by NYSDEC:

- Technical Specifications and Drawings, Sediment Remediation [RETEC, 1998b];
- Remedial Action Work Plans [RETEC, 1998c];
- Philip's Technical Execution Plan [Philip, 1998];
- Design Change Forms 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 (canceled), 12 and 13 (provided in Appendix F);
- Site Restoration Plan [RETEC, 1998d]; and
- DNAPL Design Document [RETEC, 1998e].

1.4 Citizen Participation Plan

The following public communication activities were completed in accordance with the Citizen Participation Plan (Section 2 of the Remedial Action Work Plans [RETEC, 1998c]):

- All pertinent documents relating to the investigation and remediation of the site were filed at the Document Repository located at the North District Branch Library, 271 Grant Street, Buffalo, NY.
- A sign was posted at the site and information was available at the site regarding the project.
- Project newsletters were sent to the distribution list of the Citizen Participation Plan. Newsletters were sent at the completion of the design, during the remediation, and after remedial construction (sediment cap and southern DNAPL recovery system) was complete. The newsletters were approved by Mr. Michael Podd of NYSDEC.
- National Fuel Gas established a contact person to be available to the public and to discuss plans, concerns, or questions about the site. Very few questions and no concerns or complaints were lodged with the contact person.

1.5 Project Coordination

All site activities were closely coordinated among National Fuel Gas and its contractors, the MHF property owner (Sherwin - Williams), and the City of Buffalo's bike path architect (Wendel).

National Fuel Gas contracted directly with Philip Environmental Services Corp., as the general contractor to conduct the work. Philip's scope of work was detailed in their contract and associated documents. ThermoRetec was retained under a separate contract with National Fuel Gas to act as their technical agent for the work. The ThermoRetec site engineer provided engineering support of specified field activities. ThermoRetec reviewed Philip's written submittals and monitored Philip's work to ensure general compliance with the project specifications. ThermoRetec reviewed Philip's applications for payment and provided recommendations to National Fuel Gas. Proposed changes to the specified work were reviewed by ThermoRetec and NFG, and approved by NYSDEC.

1.6 Final Engineering Report Organization

This report is organized into four additional sections: Section 2 describes the remedial methods used for each of the project components and the significant events which occurred during the project, Section 3 describes the site management and environmental controls in place during the work, Section 4 summarizes key observations made during the project, and Section 5 provides references to related documents. A total of 16 appendices provide additional project documentation.

2 Remedial Methods and Events

This section describes each remedial activity and provides summary information regarding the quantity of materials removed from the site. A project timeline is presented in Appendix A. The locations of site features are identified by the survey reference line established along the west bank of the site, marked in 100-foot stations from Station (Sta) 0+100 at the West Avenue Bridge, to Sta 16+100 at the north end of the site. This survey reference line is shown on the As-Built Drawings in Appendix D.

The following activities were conducted to remediate the 1,600 foot section of Scajaquada Creek in accordance with the project design documents:

- Mobilization and site preparation, including installation of temporary dams, diversion of Scajaquada Creek flow, and dewatering of the work zone;
- Excavation of the partially dewatered sediment and debris;
- Materials handling and offsite disposal of excavated materials;
- Placement of a cap, which was a minimum of two feet thick, over the areas which were excavated;
- Sheet pile wall construction;
- DNAPL recovery system construction; and
- Restoration of the site, including re-vegetation.

2.1 Summary of Material Removed From Site

The site remediation included the offsite disposal of liquids and solids. Table 2-1 provides a summary of the quantity of these materials removed from the site. The site is located in an industrial, urban area beneath an expressway, and unauthorized dumping of refuse is commonplace in this reach of Scajaquada Creek. Much of this refuse was removed during the dredging process. Safes, paint drums, several empty weathered 55 gallon drums, an automobile, shopping carts, concrete, bottles, automobile parts, leather, pieces of metal, and several logs were removed along with the contaminated sediments from the creek.

Table 2-1
Offsite Material Shipment Quantities

Material	Approximate Quantity	Units	Destination
Paint Drums	100	gallons	Research Oil, Ohio (Permitted treatment facility)
Water	150,000	gallons	Sanitary Sewer
Carbon	8	tons	BFI Landfill, NY (Non- hazardous waste landfill)
Dredged Sediments (non-hazardous)	7,000 5,000	tons tons	BFI Landfill, NY (Non- hazardous waste landfill) Modern Landfill, NY (Non-hazardous waste landfill)
Dredged Sediments (Hazardous)	4,000 11,000	tons tons	Sarnia, Ontario, Canada (Hazardous Waste Landfill) Quebec, Canada (Hazardous Waste Landfill)
Stone	1,000	tons	Modern Landfill, NY
Construction Debris	50	tons	Modern Landfill, NY

A surveyed in-place volume of 18,976 cubic yards of contaminated sediments and debris were removed from Scajaquada Creek. The sediments were classified as either "hazardous" or "non-hazardous". Based on initial complete waste profiling, sediments found to have a TCLP-Benzene value equal to or greater than 0.5mg/L were classified as hazardous, all others were classified as non-hazardous (see Appendix G). Non-Hazardous sediments, rip-rap and debris were sent off site to the BFI and Modern landfills in Western New York. Hazardous sediments were sent to landfills in Canada.

Water collected in the materials handling facility adjacent to the site was treated prior to permitted discharge to the sanitary sewer. Activated carbon used in this water treatment process was disposed of as non-hazardous waste in the BFI landfill.

A chronological summary of offsite shipments, with manifest numbers and designations, is provided in Appendix C.

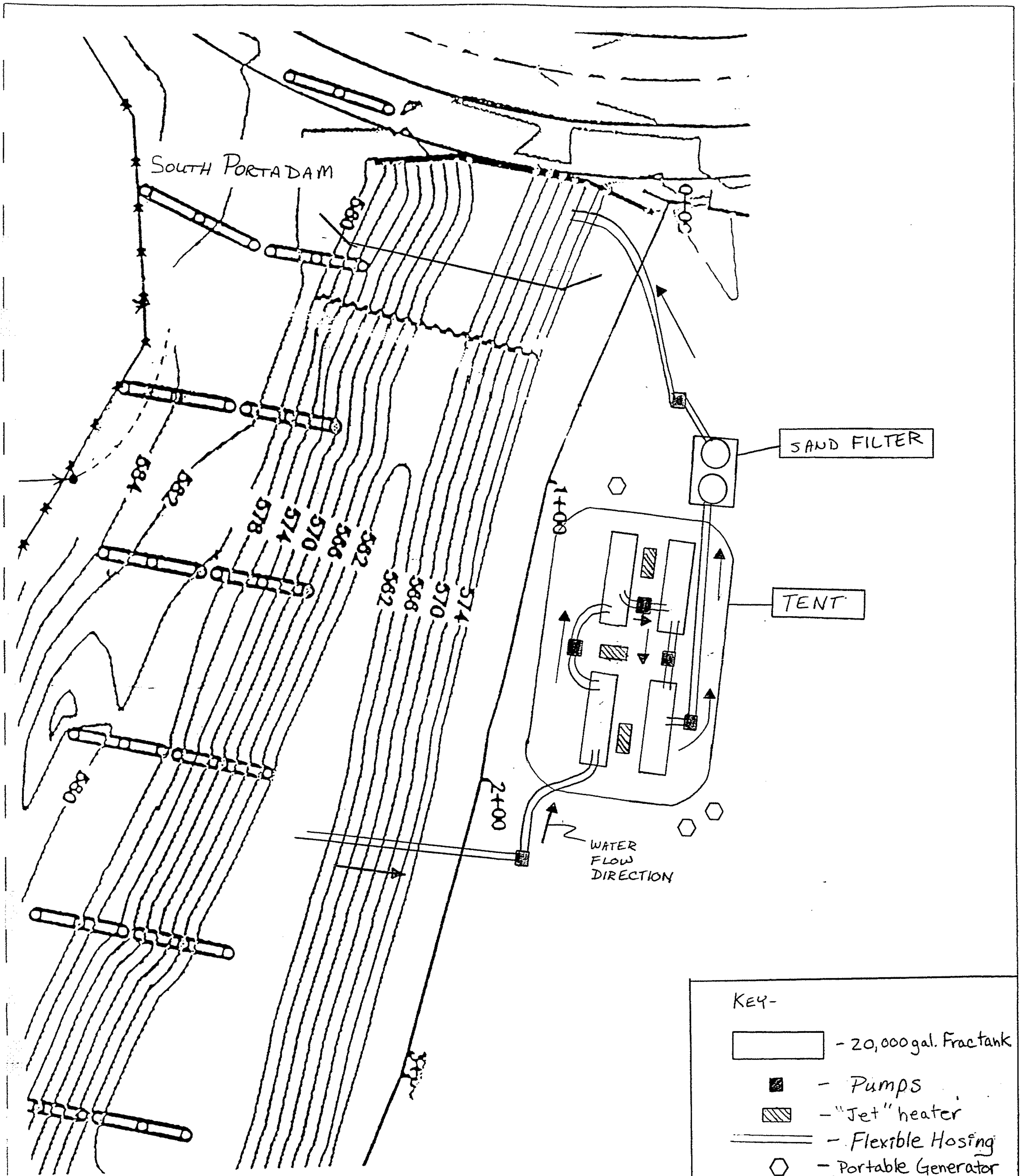
2.2 Site Preparation, Temporary Dams and Bypass

Mobilization by Philip and its subcontractors began on July 7, 1998. The mobilization and site preparation for dredging took three weeks to complete. During this time, Portadams were placed at each end of the work zone. Portadams are temporary dams which consist of an impermeable fabric liner secured to a metal frame. A crane was used to place the frame sections and divers then secured the fabric liner to the frames. Divers placed sandbags on the base of the liner to form a seal. Technical information regarding the Portadams is provided in Philip's Technical Execution Plan (Philip, 1998). Godwin Pumps of Batavia, NY installed three pumps at the northern Portadam and two HDPE pipes from the pumps to West Avenue, a distance of 1,600 feet. The HDPE pipe served as a bypass from the work zone. The intakes of each of the three pumps measured 12 inches in diameter and had a maximum pumping capacity of 5,500 gpm per pump. The diameters of the two bypass pipes were 12 inches and 18 inches, respectively. The alignment of the pipes is shown in the as-built drawings in Appendix D.

Flood Delays

Flooding of the work zone occurred eight times during the project. On six occasions, water runoff from a storm event or thaw overflowed the north Portadam. On November 11, 1998, high westerly winds caused the water from Lake Erie to rise and flood the work zone by overflowing the south Portadam. On August 22, 1998, vandalism to the fabric liners of each Portadam caused the site to be flooded from each direction.

Flooding caused significant delays to the schedule of the project. This eventually meant having to perform dredging and capping operations in a creek covered in ice. The frigid conditions did not have a significant impact on the performance of capping and dredging; however, water pumped from the leading edge could not be treated and discharged. On January 21, 1999 a sand filter was brought on site. The contractor constructed a large tent over the intake pumps, four temporary separation tanks, and sand filter apparatus, and placed heaters under the tent for the purpose of thawing out the tanks and pumps. Capping resumed shortly thereafter. A sketch of the heated equipment area is provided in Figure 2-1.



Heated Equipment Area

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Figure 2-1

2.3 Excavation

Excavation (dredging) was scheduled to begin on July 20, 1998. A labor disagreement at the site between Philip and Local 17 of the Operating Engineers led to a delay of activities at the site for one and a half weeks.

Excavation began at the site on August 10, 1998 at the north end of the work zone.

A specialized backhoe was used in the excavation of the creek. It had a reach of approximately 40 feet and was supported by large pontoon tracks which allowed the vehicle to float. This amphibious excavator is called, and will be referred to in this document, as a marsh buggy.

The marsh buggy was stationed in the channel of the creek during the excavation. The marsh buggy placed dredged sediments along the west bank, where a conventional long-reach excavator positioned on the bank would lift and place the sediments into a dump truck. The dump truck would haul the material from the leading edge of the work zone to the MHF, where the semi-solid sediments were stockpiled as described in Section 2.5.

The excavation proceeded in accordance with the design drawings to achieve the final depth and width required in each section of the creekbed. Surveyed elevations and distances were obtained every 25 feet along the length of the creekbed to verify conformance with the design. Each set of survey data was required to be reviewed and accepted by the ThermoRetec field engineer prior to continuing with cap construction in that area, as described in Section 2.4. The field record of approved excavation surveys is provided in Appendix E. The record of the excavation work is shown in the as-built drawings provided in Appendix D. All surveying for the project was performed by Niagara Boundary licensed surveyors, under subcontract to Philip.

The Phase II Pre-Design Investigation found that one area had low PAH concentrations and did not require dredging. This area was located between Sta 14+75 and 15+60.

The following modifications to the dredging design of the Technical Specifications and Drawings were made during the course of the work:

- The existing sheet pile wall, constructed in 1996, required temporary bracing to allow for dewatered excavation adjacent to the wall on the east side of the creek. The bracing was designed, built, and installed by Philip and its subcontractors. The surveyor monitored the position of the top of the sheet piles during the work and observed no measurable deflection of the wall.

- The Technical Specifications established that dredging and capping be performed in a controlled sequence, such that dredging would proceed a maximum of 100 linear feet downstream ahead of capping. Design Change No. 2 was issued to allow dredging to continue to a distance past this 100 foot limit. The purpose of this design change, issued on August 13, 1998, was to allow the contractor to continue to dredge material until suitable capping materials arrived on site. After this design change, another marsh buggy was used to perform a "rough dredge" of the creek. (Design Change No. 2 and related Design Change No. 4 are provided in Appendix F.) The original marsh buggy was used to finish the dredging to the specified elevations.

- The excavation design required the excavated banks to have a 1:1 slope; however, Philip overdug the banks on several occasions causing steeper slopes.

- The presence of immovable obstructions was anticipated in the Technical Specifications; however, most obstructions including rip-rap stone, concrete debris and an automobile were movable and were removed during excavation. Two obstructions were not movable and remained in place: a 12 foot length of sheet piling remaining from the Expressway Bridge construction at Pier 21, and a set of underground electrical cables located near the West Avenue Bridge.

- The presence of the sheet piling at Pier P-21 did not result in any substantial reduction in the quantity of material removed from that area. The presence of the electrical cables made excavation in that area too dangerous (these electrical cables feed most of this portion of Buffalo and were not practical to relocate or even temporarily turn off). The quantity of sediment not removed due to the presence of the electrical cables was estimated at 600 cubic yards, or about three percent of the total quantity removed. In accordance with NYSDEC's request, four samples of sediment were collected in the area affected by the presence of buried electrical lines. The sample collection was performed on February 23 , 1999. Samples were collected from 1 to 2 ft. using a hand shovel. Surveyors determined the elevation of the sampled sediments as approximately 560 ft. GLD. The results indicated that TCLP benzene was not detected in any of the four samples. Total PAHs in the samples were 53.24, 53.79, 29.67, and 497 mg/kg. A sketch of the sampling locations and a copy of the laboratory reports is provided in Appendix H.

2.4 Cap Construction

The Technical Specifications provided for a cap with 18 inches (minimum) of sand, geotextile support and a top layer of six inches (minimum) of stone. In the southern portion of the site, this cap was underlain by a geosynthetic clay liner. The cap was constructed in accordance with the Technical Specifications except in one portion of the west bank and the area near the underground electrical cables.

The repairs on the portion of the west bank (from Sta 9+40 to Sta 7+40 were made in accordance with Design Change No. 10, provided in Appendix F. The change to the cap design in this area involved repair of the bank placing armor stone up the side of the bank instead of sand and armor stone.

The underground electrical cables located between Sta 0-100 and 0+50 prevented excavation to the design depth in this area. Consequently, the cap thickness was decreased to prevent long-term flood control problems in this area. The modified cap consisted of GCL overlain by a minimum of six inches of sand (instead of 18 inches), geotextile, and a minimum of six inches of armor stone. This work was done in accordance with Design Change No. 8. Clough Harbour, Inc. confirmed that this modified construction did not pose a flood control concern. The report by Clough Harbour is provided in Appendix G.

2.4.1 Sand

Construction of the cap began in the northern portion of the site on August 12, 1998. At first, a "sand slinger" was used to distribute sand along the channel; however, placement of the sand using the long reach backhoe and swamp buggy, which were also used in the dredging, proved to be more effective. The sand was placed with a minimum thickness of 18 inches. The final slope of the sand on the banks was 2:1. Initially, the sand was sloughing at the toe of each bank. Change Order No. 5, issued on August 18, 1998, provided for the contractor to use a more angular sand with more than five percent fines (limestone screenings from stone milling, supplied by Buffalo Crushed Stone, Inc.). This modification in the sand capping material allowed capping to continue as planned. Where overdigging of the banks occurred, more sand was needed. As the job progressed, a mini-bulldozer was used to spread and compact the sand on the bottom of the channel.

After the sand was placed, it was surveyed and the depth of the sand was spot checked by physical probing of the sand with a steel rod.

2.4.2 Geotextile

Once ThermoRetec accepted the survey numbers, geotextile was placed over the sand cap. The geotextile was a woven polypropylene fabric (Carthage Mills FX-77) which was placed to prevent erosion of the sand cap and to prevent the capping stone, yet to be placed, from sinking into the sand.

2.4.3 Stone

Stone was placed on top of the geotextile to provide fish habitat and an armoring layer for the cap. The stone was placed to a minimum depth of six inches. Six inch diameter rounded stone was used as the stone for a majority of the cap. Where the creek channel was wider and, therefore, the flow velocities slower, three inch diameter stone was used instead. Six inch angular stone was used for capping the banks along the last two hundred feet of creek. The angular stone was used because it held to the bank better than the rounded stone. The stone was supplied by Gernatt Asphalt Products, Inc. Once the survey of the stone was accepted at a particular location, the cap was considered completed at that location.

2.4.4 GCL

A geosynthetic clay liner (GCL) was placed beneath the sand from the railroad bridge to the Portadam at the West Avenue Bridge. The GCL was placed to serve as a barrier between the contaminated sediments remaining after dredging and the cap materials. The GCL used was Bentomat "CL" manufactured by Colloid Environmental Technologies Co. Bentomat "CL" is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles which are needlepunched together and laminated to a membrane liner of 4 mil polyethylene.

GCL was placed in overlapping strips across the width of the creek. The following installation procedure was used:

1. The excavated section of creek was prepared by removing sheen from the area in front of the leading edge of the previously installed GCL strip.

2. Granulated bentonite was placed on the leading edge of the previously installed GCL strip to prevent the seams of the GCL from being a pathway for contaminant migration from the remaining sediments.

3. A roll of GCL material was positioned on the creek bank and a new strip of GCL was unrolled and stretched across the width of the creek. This was accomplished by attaching a bar clamp (called a spreader bar) to the end of the strip which allowed it to be lifted and pulled by the mechanical arm of the swamp buggy excavator without damage to the GCL.

4. The GCL was placed down onto the dredged subgrade. Each 14.5 foot wide strip of GCL was placed to ensure that a minimum of two foot overlap occurred between it and the last strip of GCL which had been placed.

5. The end of the GCL was cut to the correct length.

6. The overlap area was covered with granulated bentonite.

During the application of the GCL, some areas of dredged subgrade were found to be softer than others. Areas of soft subgrade were found between Stations 9+40 and 10+00, Stations 8+50 and 8+80, Stations 7+00 and 7+10, Stations 6+50 and 7+00, and between Stations 6+10 and 6+30. Water samples which are representative of these soft subgrade areas will be collected during the Operations and Maintenance phase of this project.

The discovery of the electrical conduits near West Avenue modified the dredging and capping in the area from the south sheet pile wall to West Avenue. The creek bottom between Stations 0+60 and 0+15 was not dredged according to the technical specifications. In this area, no more than one foot of sediment was removed. The remaining subgrade was smoothed out to reduce potential damage to the cap. GCL was placed on approximately three inches of sand. No less than six inches of sand was then placed on top of the GCL. Geotextile was spread over the sand cap and no less than six inches of armor stone was placed on the geotextile.

As an additional protective measure, NFG approved Design Change #9, which specified GCL placement beneath the railroad bridge. This GCL was installed by hand and anchored with armor stone.

The quality of the leading edge of the cap was of paramount importance. The Technical Specifications allowed for capping to occur in a hydrated condition; however, sheen and turbid water were not allowed on the cap. In the DNAPL-contaminated areas where the GCL was placed, the water was often observed to have a sheen, and brown Non-Aqueous Phase Liquids (NAPL) were frequently observed as well. In order for the contractor to prevent contamination migrating onto the clean cap, the water level at the leading edge of the cap was lowered.

Water from the leading edge of the work zone in the creek was pumped to a series of temporary separation tanks located near West Avenue. The locations of the separation tanks are shown on the Site Plan, Figure 1-2. The capacity of each tank was 20,000 gallons. The water was treated in batches. The flow rate into the tanks varied from about 10 gpm to 100 gpm depending on the number of pumps and the effective head at each pumping location. This water was stored until the heavier particulates had settled out, with the assistance of alum and a polymer (which were added to the water). This settling usually took one day, after which the water was pumped at a flow rate of about 100 gpm to the controlled outfall beneath the West Avenue bridge. When work had progressed such that the leading edge was within a few hundred feet of the tanks, the water was very turbid and the settling times of the water in the tanks were no longer sufficient to lower the turbidity to acceptable discharge levels. A sand filtration unit was then brought on site to filter the stored water before it was discharged. This lowered turbidity discharge values to acceptable levels, and again allowed discharge after one day of settling.

2.4.5 Surveying and Completion

Surveying was performed progressively for each section as it was excavated and capped. In accordance with the Specifications, three sets of survey data were obtained: 1) after excavation, 2) after the sand capping material had been placed, and 3) after the stone had been placed. The surveys were performed at 25 foot intervals. Each survey consisted of locating the 574 foot msl (Great Lakes Datum) elevation along each bank, surveying the toe for each bank, and surveying the middle of the creek bed. The survey numbers were then brought to the Site Engineer for approval. Refer to Appendix E for a complete listing of the survey results.

Capping was completed on February 26, 1999. Refer to Appendix D for As-Built drawings which record the capping activities and conditions. Tabulated survey results for the as-built cap are provided in Appendix E. An inspection of the cap by NYSDEC was conducted on March 1, 1999. NYSDEC approved the work and the bypass pumps were subsequently turned off and the site was slowly re-flooded.

2.5 Materials Handling and Offsite Transport and Disposal

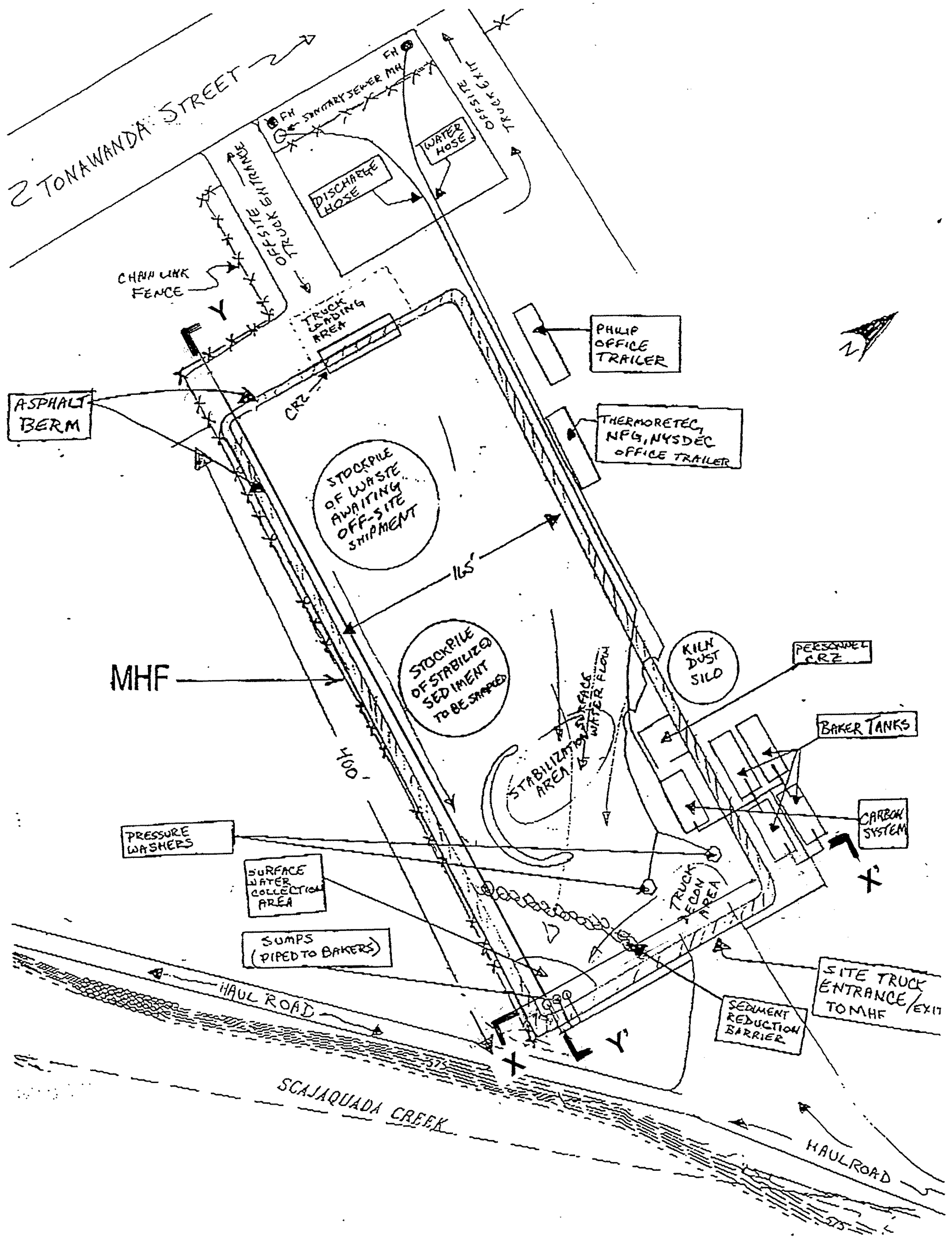
Materials handling and offsite transport and disposal was accomplished in accordance with the Technical Specifications. The materials handling facility (MHF) was constructed by placing hot asphalt and seal coat on a 160-foot x 400-foot surface of a former parking lot adjacent to the site. Asphalt berms were constructed on the perimeter to control water run-on and run-off. The location of the MHF is shown in Figure 2-2. Cross section and longitudinal views are provided in Figure 2-3.

The following sequential operations were conducted at the MHF adjacent to the site, to prepare the excavated materials for offsite transport and disposal:

- Handling and placement of wet material in the MHF;
- Sampling and analysis of material for disposal characterization;
- Stabilization;
- Stockpiling; and
- Loading into trucks for offsite transport.

2.5.1 Handling and Placement

Sediments were removed from the channel of the creek by the bucket of a marsh buggy. The marsh buggy then placed the dredged sediments along the western bank of the creek where the sediments were retrieved by a long reach backhoe. The backhoe loaded the contaminated sediments into a site dump truck, which was stationed nearby. Once filled, the dump truck traveled along the haul road, located at the west bank, until it reached the MHF. At the MHF, the truck dumped its contents onto the asphalt pad and was decontaminated by two



NOT TO SCALE

Y – Y' LONGITUDINAL VIEW

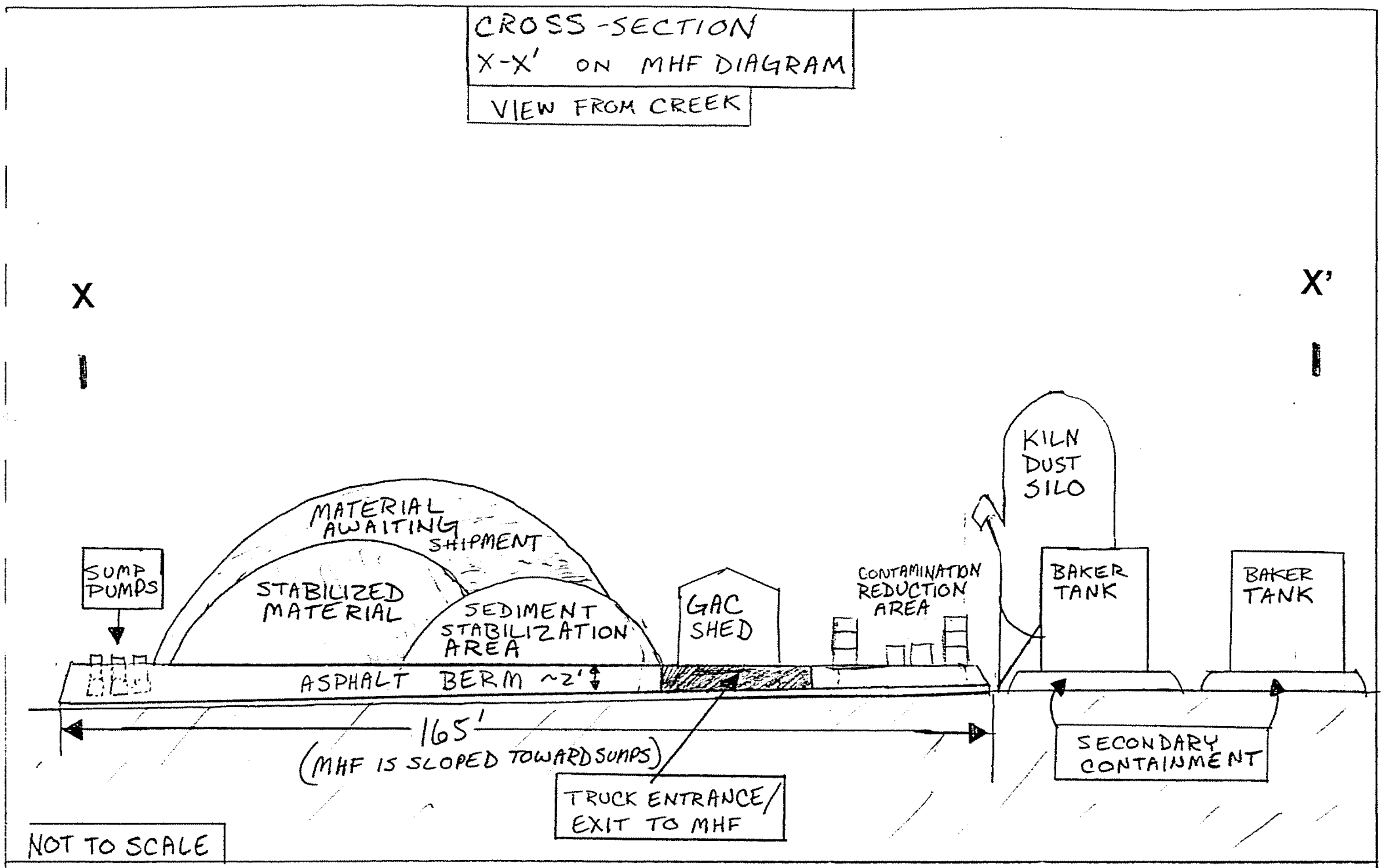
X – X' CROSS SECTION

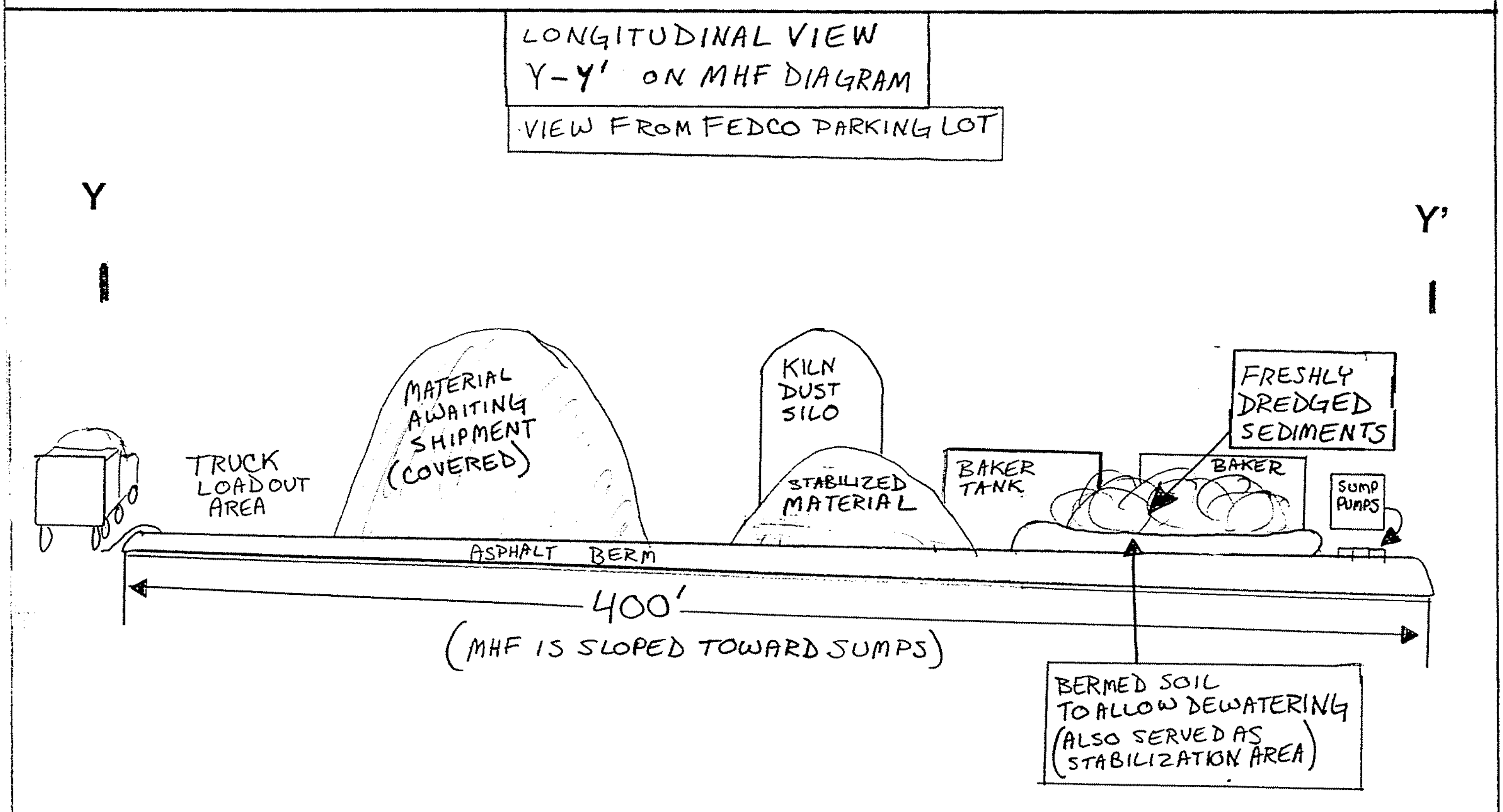
MHF General Arrangement Diagram

RETEC

RETEC ENGINEERING, P.C.

DRAWING NO.	REV.
Figure 2-2	





MHF Cross Section and Longitudinal Views	RETEC RETEC ENGINEERING, P.C. DRAWING NO. REV Figure 2-3

pressure washers. After the site truck was decontaminated, it returned to the creek to be reloaded.

During dredging operations, a laborer was dedicated to removing drips and spots of contamination between the point where the site trucks were being loaded and the MHF. When larger spills from the trucks occurred, a bucket loader scraped down the area. During periods of extreme cold, when the decontamination of site trucks and equipment was not possible, the action portion of the haul road was covered with geofabric to capture dredged material. Two types of dump truck were used during the dredging of the creek, a regular tandem wheel dump truck and off-road site trucks. The standard tandem dump trucks needed to be frequently resealed to reduce leakage along the haul route. The off-road site trucks did not have a problem with leakage; however, their rental costs were not attractive to the contractor. To remedy the problem of leakage, a drip catcher was constructed out of four inch plastic pipe.

All equipment which was used to dredge and transport contaminated sediments along Scajaquada Creek was taken to the MHF, thoroughly pressure washed, certified as clean by Philips' Health and Safety Officer, and then visually inspected by ThermoRetec's Site Engineer.

Water run-off from the MHF was pumped to holding tanks. Initially, the stored water was processed through a granular activated carbon (GAC) system before it was discharged into the City of Buffalo's sanitary sewer system, beginning on August 25, 1998. However, analytical results of the influent to the carbon unit were found to be below levels for discharge criteria for the City of Buffalo, the contractor was then allowed to discontinue the use of the carbon unit.

2.5.2 Sampling and Analysis

Composite confirmation sampling was performed on each thousand cubic yards of sediment removed to determine if the stockpiled sediment was hazardous or non-hazardous.

Grab samples were taken of the sediment before it was stabilized. The grab samples were then composited and sent for laboratory analysis for the concentration of TCLP-Benzene.

2.5.3 Stabilization

The dredged materials were taken from the creek to a materials handling facility (MHF) adjacent to the site where the material was tested, stabilized, and then loaded onto trucks for offsite shipment. The bermed MHF had two sump pumps at its lowest point. These sumps pumped excess water into five 20,000 gallon storage tanks. The water was allowed to settle out particulates before it was pumped through a granular activated carbon unit, and then disposed of into the City of Buffalo's municipal sewer system.

Once dredged sediments were on the MHF, the material was stabilized with kiln dust and/or Portland cement and staged in stockpiles of approximately one thousand cubic yards. The stabilizing agents were stored in a silo next to the MHF. A bucket loader, dedicated to use on the MHF, delivered the stabilizing agent from the silo to the material and worked it into the sediment by successive lifting and dropping with the bucket. The mixing of the dredged sediments and the stabilizing agents often created temporary visible dust and water vapor. When this occurred, the delivery stabilizing agent from the silo to the bucket loader and from the bucket loader to the sediment was slowed to decrease the dust and vapors.

2.5.4 Stockpiling

Odors emanating from the dredged material were a frequent concern. Continuous coverage of the stockpiles on the MHF was not required, however, it was requested by the property owner. Though the contractor had the option of using a foam application on the soil to control odor, the contractor covered the stockpiles with 5 mil polyethylene when it was necessary.

2.5.5 Loading

Dredging materials found to have a TCLP-Benzene value equal to or greater than 0.5mg/L were classified as hazardous, all others were classified as non-hazardous. Non-Hazardous sediments were sent off site to the BFI and Modern landfills, in Western New York. Hazardous sediments were sent to landfills in Canada. The bucket loader dedicated to the MHF was also used in the loading of trucks for offsite disposal of the contaminated waste. Offsite shipment of non-hazardous waste began on August 28, 1998 and concluded on May 5, 1999. Offsite shipment of hazardous waste to a landfill in Sarnia, Ontario, Canada began on February 1, 1999. That source for disposal discontinued allowing shipments to its facility on February 25, 1999. Hazardous waste shipment resumed on March

22, 1999 when the Horizon Landfill in Quebec, Canada allowed Philip to dispose of its hazardous material at their facility. Laidlaw, Harold Marcus, and Frank's Vacuum Service transported hazardous waste under subcontract to Philip. Hazardous waste was transported to two Philip Transfer Facilities, in accordance with US RCRA requirements. The sediments were then designated, according to the Canadian system, as non-hazardous waste and delivered to either Canadian Waste System or Horizon Landfill. Hazardous waste shipment of contaminated sediments concluded on April 27, 1999.

2.6 Sheet Pile Wall Construction

2.6.1 Sheet Pile Construction for DNAPL Recovery System

A sheet pile wall was installed at the south end of the site, across the creek. The purpose of the sheet pile wall is to prevent offsite migration of DNAPL and to serve as a collection point for DNAPL in the groundwater. ThermoRetec later installed a DNAPL Recovery System immediately north of the sheet pile wall, with its well screen in direct contact with the DNAPL as described in Section 2.7. The sheet pile was type Z-22. Each pile was visually inspected by the Site Engineer. Herbert F. Darling, Inc. was the sheet pile subcontractor to Philip. The OZA Group of Buffalo, NY performed vibratory monitoring under the Scajaquada Expressway during the installation of the sheet pile wall. Vibrations were within acceptable limits.

The sheet pile wall layer was designed to be installed to a depth of approximately 550 ft. msl. Darling was allowed to stop pile driving at 552 ft. msl if the sheet pile had driven through resistance for over two feet, indicating that the bottom of the wall is well within a layer of stiff clay. Appendix D provides As-Built Drawings of the DNAPL sheet pile wall.

Table 2-2 presents a chronology of events which were involved with the sheet pile installation.

Table 2-2
Sheet Pile Wall Installation Chronology

Date	Event
August 7, 1998	Due to equipment limitations, the sheet pile contractor requested that the location of the sheet pile be moved closer to West Avenue to allow their crane to operate from the West Avenue bridge. The original location of the wall was to be perpendicular to the creek at Station 0+30. Design Change No. 1 allowed the wall to be placed ten feet closer to the bridge.
August 18 & 19	Locates performed by all underground utility companies who may have underground lines or pipes in the area.
August 20	Darling Co. mobilized to site and began sheet pile wall installation at west bank.
August 21	Darling reached refusal (inability to drive steel sheeting) near east bank, under the expressway. Rip rap along the eastern bank did not allow pile driving to occur in this location.
November 4 & 5	UFPO locates redone by underground utility companies.
November 6	Rip rap removed from east bank.
Early November	While reviewing a NYSDOT drawing (circa 1952) of West Avenue, ThermoRetec's Project Manager observed that an electrical conduit was shown in the area where the sheet pile wall is to be installed.
November 9	Niagara Mohawk Power Corporation confirmed that a bank of live underground electrical conduit is located underneath the creek at the location where it was shown on the NYSDOT drawing. There are 11 4-inch cables, each carrying a voltage of 23KiloVolts.
December, 1998 - January, 1999	NYSDEC, ThermoRetec and Philip agreed to remove the sheet pile partially installed in August and reinstall it at Station 0+60, as provided for in Design Change No. 8.
January 28 & 29	UFPO locates performed for sheet pile wall installation at Station 0+60.
February 1 - February 8	Darling removed sheet pile wall from previous location and reinstalled it across Scajaquada Creek at Station 0+60.

2.6.2 Sheet Pile Installation between Stations 2+00 and 1+20

On December 29, 1998 bank failure occurred along the west bank between Stations 2+00 and 1+20. There were a number of contributing factors in the failure of the bank. Among the factors were: unexpected presence of loose fill causing weak soil conditions, wet weather, vertical forces in the area caused by heavy equipment, seeps in the bank, and overdigging of the bank. The soil in the area where the sloughing occurred consists of loose, unconsolidated fill. Approximately forty cubic yards of bank sloughed into the creek from the bank. The soil was then excavated and later shipped off site as hazardous waste.

It should be noted that during the remedial design phase, ThermoRetec and Clough, Harbour [Clough, Harbour, 1998a] engineers recommended to NYSDEC that a 2:1 slope be adopted for the excavation design. NYSDEC insisted on requiring a 1:1 slope [RETEC, 1998a].

To repair the bank at that location, a sheet pile wall was installed along the creek where the top of the original bank existed. The sheet pile was 30 feet in length and had weep holes placed throughout it to allow the previously mentioned seeps a pathway under the cap. Darling was the sheet pile contractor. The sheet pile was installed in three days, from April 13 to April 15, 1999. Refer to Appendix D for the location of the sheet pile wall in the As-Built Drawings and for construction details of the sheet pile wall installation between Stations 2+00 and 1+20.

2.7 DNAPL Recovery System Construction

The remedial design called for DNAPL recovery systems to be installed in two areas where complete excavation of impacted sediments was impractical due to the proximity of NYSDOT expressway piers and due to the depth of the sediments. The locations of the two systems (Northern and Southern) are shown in Figure 1-2.

At the time of this report, access negotiation is underway for construction of the Northern system.

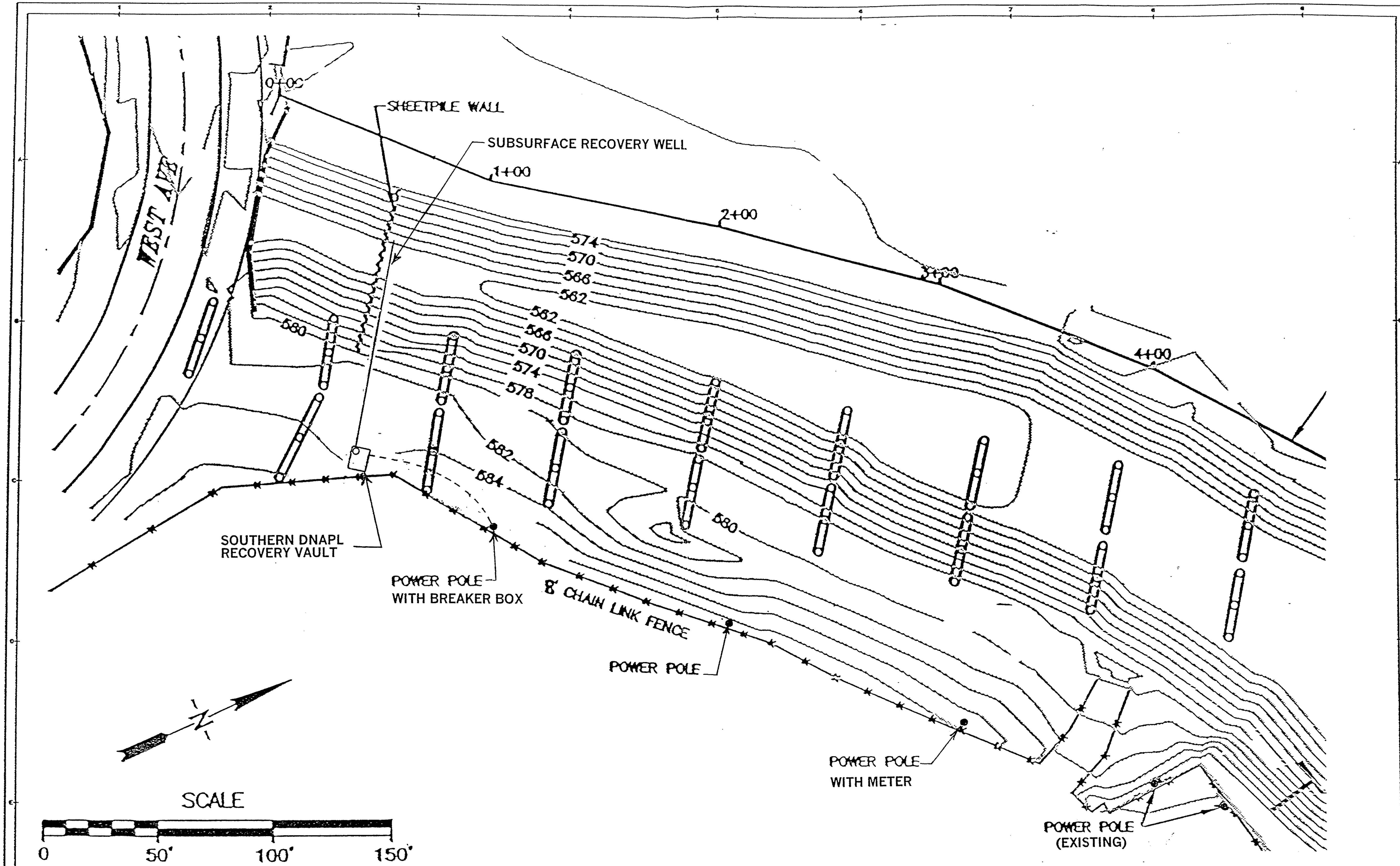
Seeps containing DNAPL were encountered at the toe of the western bank during the excavation of sediments in the southern portion of the site. In response to this finding, a DNAPL recovery trench was excavated at the toe of the western bank and filled with coarse stone. At the location of the sheet pile wall barrier across the creek, this trench was extended in an "L" to the center of the creek to allow for DNAPL to flow to the subsurface recovery well. This work was completed in accordance with Design Change 8. The location of the recovery trench is shown on the as-built drawings in Appendix D.

Construction of the southern DNAPL recovery well and pump system was begun April 29, 1999 and substantially completed May 26, 1999. The as-built plan and cross section for the southern system are presented in Figures 2-4 and 2-5, respectively.

2.7.1 Construction Sequence

ThermoRetec acted as the general contractor for this portion of the site remediation. The construction sequence of the southern system was as follows:

- Placement of survey stakes by Niagara Boundary for alignment of a directional drilling rig;
- Directional drilling by Case Boring to the target area in the confining clay layer beneath the DNAPL impacted gravel layer;
- Excavation of pit and temporary placement of trenchbox, and "thumper" rails;
- Driving 12 inch diameter outer casing over directional drill string;
- Construction of lined decontamination pit;
- Pulling and decontaminating directional drill string;
- Augering soil from interior of 12 inch casing with horizontal boring machine;
- Placing augered soil in 55 gallon drums and decontaminating augers;
- Placing four inch diameter well screen, riser, sand pack and grout inside 12 inch casing;
- Pulling back and decontaminating 12 inch casing;
- Developing well;
- Constructing concrete vault by Ideal Concrete Co.;



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE

APPVD DATE

NATIONAL FUEL GAS
SCAJAQUADA CREEK SITE
3-2111

CURRENT DATE: 1/25/99 CAD FILE 21115020

SOUTHERN DNAPL
RECOVERY SYSTEM
SITE PLAN

RETEC
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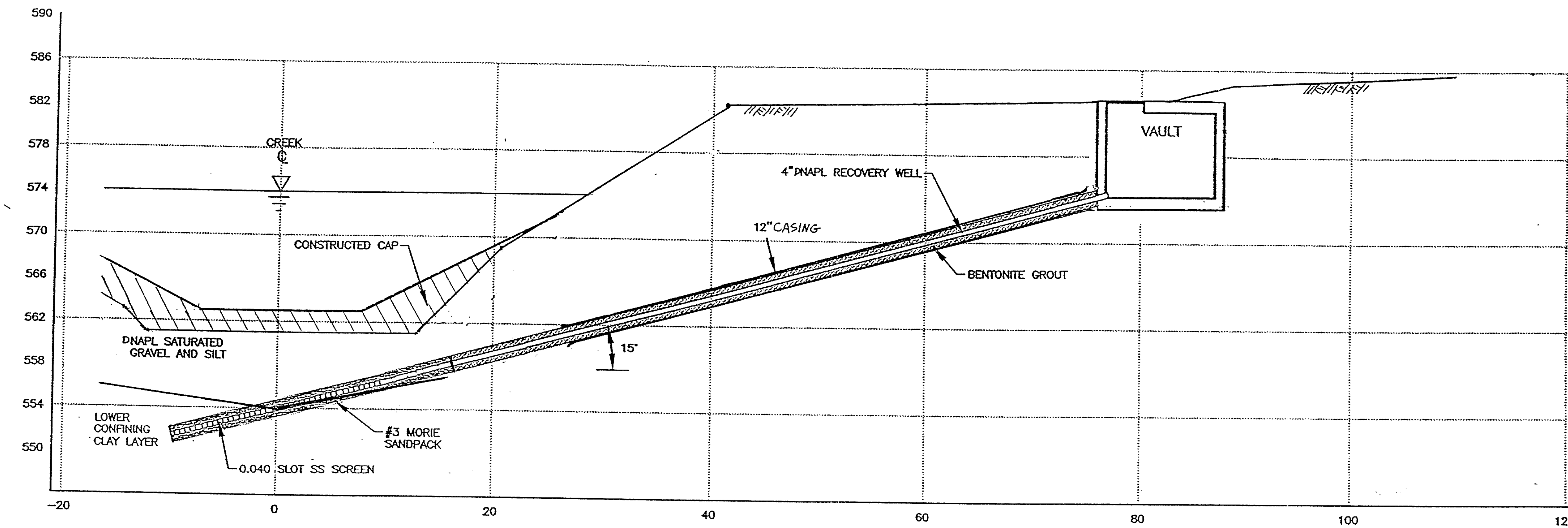
DRAWING NO. FIGURE 2-4 REV.



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
			MH	7/20/99	AS BUILT				
				4/16/99	FINAL DESIGN				

NATIONAL FUEL GAS
SCAJAQUADA CREEK SITE
3-2111

CURRENT DATE: 1/25/99 CAD FILE 10-05WRK

SOUTHERN DNAPL RECOVERY SYSTEM

AS BUILT

RETEC
RETEC ENGINEERING, P.C.
DRAWING NO. FIGURE 2-5 REV.

- Installing pump, pump controller, electrical system and power supply by Ferguson Electric Co.; and

- System shakedown.

2.7.2 Construction Methods and Materials

The directional drill string consisted of 130 feet of 2 1/2-inch diameter drilling rods with a directional drill head fitted with a sonde. The sonde delivered a continuous electronic signal, readable at the surface, which indicated the drill string's depth, slope, and rotational angle. Based on the signal, the drill string was steered and advanced at a 15 degree (26% to 28%) slope to the target location and depth. The driller reported encountering a gravelly layer followed by stiff clay. To assure sufficient sump volume within the clay layer (at the foot of the well), the drill string was advanced an additional 10 feet beyond the theoretical target. The directional drilling rig was then demobilized but the drill string was left in place.

The pit was excavated to sufficient size to allow placement of a trenchbox (per OSHA regulations) which was itself large enough to accommodate eventual construction of the concrete vault. The excavation exposed 40 linear feet of drill string which was then removed, leaving 90 feet of drill string to act as a guide during placement of the 12 inch diameter steel outer casing. The bottom of the excavation was temporarily left sloping at a parallel angle to the drill string.

The "thumper" consisted of a carriage mounted vibrating hydraulic ram. The "thumper" rode on 40 foot long steel rails and was strapped to the upper end of the 12 inch casing section. The rails, "thumper" and casing were aligned with the drill string on the excavation bottom at a 15 degree slope. The casing was driven over the drill string in 20 foot sections by the "thumper", with additional sections being welded as driving progressed. The drill string was anchored against movement by a cable fed up through the 12 inch casing, out an opening in the side of the drive head, and secured to the excavator's frame. The 12 inch casing was driven 90 feet to the same depth as the sonde.

After placement of the 12 inch casing, the "thumper" was demobilized and the directional drill string was removed (in sections) and decontaminated. DNAPL was observed on the directional drill head. A horizontal boring machine was then placed on the guide rails, polyethylene sheeting was placed below the mouth of the 12 inch casing, and the entire casing was augered out with 12 inch augers. Drill cuttings emerged as blended homogenous material so stratigraphic data was unobtainable. PID readings did, however, indicate extensive hydrocarbon impacts in the last third of the cuttings. All cuttings which indicated hydrocarbon impacts were containerized (by hand shovel) into 55 gallon drums placed within the excavation.

The four inch diameter DNAPL recovery well casing was pre-assembled in 20 foot sections, the first 20 feet consisting of 0.040-slot stainless well screen with welded endcap, the remainder being standard black iron riser. Centralizing feet were welded at 10 foot intervals to hold the well casing centrally within the 12 inch casing. The well casing was then installed by hand.

Because the well was installed at a shallow angle, it was not possible to simply pour the sandpack into position from the surface. Instead, a 120 foot long, two inch diameter steel "stinger" pipe was temporarily installed inside the four inch casing, starting approximately one foot from the bottom. The "stinger" was attached to the suction side of a diesel pump (supplied by Godwin Pumps) and (after removing and containerizing approximately 385 gallons of tarry water) the pump's discharge hose was placed back into the interstitial space between the four inch and 12 inch casings. As the pump recirculated water, #3 (equivalent) Morie sand was poured by hand into the interstitial space where it was washed down to the foot of the 12 inch casing and was trapped by the well screen. The water passed through the well screen and continued to be recirculated. A one inch diameter steel rod was placed in the interstitial space and was used to probe the top of the sand pack to continuously check the sandpack's height. A total of 27 linear feet of sand pack was installed.

While pulling out the 12 inch casing, the well casing was anchored against movement by tabs welded to the side of the "stinger". The "stinger" was, in turn, also anchored. The sandpack was held in place by continuing recirculation of well water. The 12 inch casing proved difficult to remove and ultimately a large hydraulic jack was mobilized to the site. The casing was then backed out an initial 26 feet.

Bentonite grout was installed as a thick pumpable slurry into the interstitial space between the casings. As the grout was being installed, jacking of the 12 inch casing continued. Ultimately, 40 feet of the casing was removed (50 feet was left in place as its removal was deemed uneconomical) and the interstitial space was grouted to the surface.

The "stinger" and diesel pump were used to develop the well. Sustainable yield during development was between 10 and 15 gpm. Two hundred and seventy five gallons of tarry water were ultimately removed. The first 100 gallons had a grey coloration, possibly attributable to bentonite slurry which may have seeped through the upper sand pack into the well during initial installation. The following gallonage was darker. The "stinger", diesel pump, associated hoses, and 12 inch casing sections were decontaminated and demobilized from the site.

The well casing was cut to length (final installed length of 89 feet) and the excavation bottom within the trenchbox was graded level. Approximately 12 inches of #2 crusher run gravel was placed and compacted in the bottom. The concrete vault was then constructed in three separate "pours": floor, walls, and roof. The DNAPL holding tank was placed in the vault prior to construction of the vault roof.

Electric power was supplied by installation of three utility poles and an overhead 230V line from a NMPC transformer located on Westwood-Squibb property. NMPC provided the meter which is located on the first pole along with a main On/Off switch. The third pole was equipped with a circuit breaker panel from which a 115V line was installed to the vault via a one inch diameter buried PVC conduit. A two inch PVC vent was placed in the trench parallel to the electrical conduit from the holding tank to a weatherhead approximately 15 feet up the utility pole.

Permanent electrical installations within the vault complied with Class I Division 2 specifications. Wiring for the pump and float switch were contained in Seal-Tite conduit; the pump controller and an additional receptacle were installed within a gasketed PVC box.

DNAPL extraction tubing consisted of 100 feet of 3/8 inch ID HDPE extending from a perforated strainer (placed at the foot of the well) to the pump inlet. The discharge tubing of similar material was connected directly to the holding tank.

Shakedown and operation of the Southern DNAPL recovery system is underway at the time of this report.

2.8 Site Restoration and Demobilization

Site restoration began on February 24, 1999. Demobilization began on March 1, 1999 immediately following the NYSDEC's final inspection of the dewatered cap. Site restoration and demobilization was generally done in accordance with the Technical Specifications [RETEC, June 1998] and Site Restoration Plan [RETEC, January 1999]. Additional work performed and deviations from the previously mentioned documents will be described in this section.

2.8.1 Demobilization

On March 1, 1999 the bypass pumps were turned off and demobilization had begun. The equipment involved in the dredging and capping processes was the first to be demobilized. Any equipment which had come into contact with contaminated sediments was decontaminated using a pressure washer. The decontaminated equipment was then inspected by Philip's site Health and Safety Officer (HSO). If the HSO deemed the equipment to be clean, he issued a certificate of decontamination to ThermoRetec's Site Engineer, who then visually inspected it before it was allowed to leave the site.

Equipment used in the handling of waste or water on the MHF was the last to leave the site. Philip completed demobilization on May 14, 1999.

2.8.2 General Site Restoration

Site fences and asphalt which had been damaged during the remediation work by the contractor were repaired. A bucket loader was used to restore the original grade of the site. A trench which was used for the bypass pipes was backfilled with clean fill from an offsite source and compacted.

Restoration of MHF

The restoration of the MHF at the Scajaquada Creek site was completed on May 5, 1999. The final step of restoration was the removal and offsite shipment of the asphalt berm, which was located around the perimeter of the 150' x 400' portion of asphalt.

After the dredged sediments were completely removed from the MHF on April 27, 1999, the paved area was thoroughly scraped with a bucket loader. The MHF was then washed off with a fire hose. To further clean the MHF, a pressure washing unit was brought on site. Pressure washing of the MHF took three days.

Concerns about the environmental condition of the MHF area were addressed when ThermoRetec sampled the asphalt on May 6. Copies of the analytical results are provided in Appendix I. Analytical results of the asphalt and the contaminated material below the asphalt indicated that the area can be considered non-contaminated.

2.8.3 Bike Path Restoration

In an effort to ease the transition between the remediation of the creek and completion of the City of Buffalo's Bicycle Pathway, Philip subcontracted a portion of the restoration work of the bike path to the City's bike path contractor, Gallo Construction.

The following items were addressed to restore the bike path to pre-existing conditions:

- Haul road material above previously placed crusher run and fabric from Station 16+00 to approximately Station 3+00, was removed. Material removed from Sta 10+00 to Sta 16+00 was used as a fill material elsewhere. Material removed from Sta 10+00 to Sta 0+00 was placed on plastic sheeting and later shipped off site at the request of the NYSDEC and the NYSDOH. Haul road material between Stations 0+00 and 3+00, and between the eastern entrance to the MHF and the haul road was removed until the native material was exposed.

- To confirm that the road used to haul the dredged material has been returned to its pre-construction condition, ThermoRetec collected and analyzed surface soil samples of the haul road materials.

The following sampling was performed. (Refer to Appendix J for station locations and analytical results):

- A composite surface soil sample, obtained from five subsample locations, from Station 0+60 to Station 2+00. The sample was analyzed for Total PAH's.

- A composite surface soil sample, obtained from five subsample locations, from Station 2+00 to Station 4+50. The sample was analyzed for Total PAH's.

- A composite surface soil sample, obtained from five subsample locations, from Station 4+50 to Station 10+00. The sample was analyzed for Total PAH's.

- A composite surface soil sample, obtained from five subsample locations, near the east entrance of the MHF. The sample was analyzed for Total PAH's and TCLP-Benzene.

- A composite surface soil sample from Station 0+60 to Station 10+00, was analyzed for TCLP- Benzene.

- A grab sample of surface soil was obtained in the haul road, near Pier-11. It was analyzed for TCLP- Benzene and Total PAH's.

- A composite soil sample of the stockpile of material which was removed from the haul road, was analyzed for TCLP-Benzene and Total PAH's.

If analytical results for the samples were greater than 50 mg/kg total PAH's or TCLP-benzene levels was above 0.5 mg/L, then additional material was to be removed and the area was re-tested.

Samples were collected on March 31 in accordance with the NYSDEC-approved sampling plan finalized on March 30. In accordance with the sampling plan, four samples were analyzed for TCLP benzene and six were analyzed for PAHs. All TCLP benzene results were below detection limits. Results of PAH analyses are summarized below:

Analysis	East of MHF	Pier - 11	Haul Road Soil Stockpile	Haul Road 0+60 to 2+00	Haul Road 2+00 to 4+50	Haul Road 4+50 to 10+00
Total PAH (mg/Kg), including estimated "J" values	53.16	50.74	18.06	53.25	26.86	137.10

The stockpile soil and the haul road from 2+00 to 4+50 were below the 50 mg/Kg background concentration and require no further action. Three results just above the 50 mg/Kg background concentration include estimated "J" values and are, therefore, close to the background concentration. To be cautious, additional soil was removed from these areas as well as the one area with total PAHs definitely exceeding the background concentration. Re-sampling was started on April 13 and was completed on April 16.

Analytical results on the locations resampled indicated that the haul road was now within regulatory acceptance. Refer to Appendix J for copies of the laboratory analytical results.

Upon removal of the haul road material, a survey was conducted to determine elevations along several locations of the Bicycle Pathway. Results of the survey were forwarded to the City of Buffalo's bike path architect.

Approximately seventy cubic yards of clean haul road material was stockpiled on the western creek bank near Station 2+00 for use by the City of Buffalo in construction of the Pathway ramp to West Avenue. A silt fence was placed and keyed in along the west bank of the creek in areas where dredging and capping occurred. HDPE culverts and galvanized flared end sections were replaced at Stations 7+20, 7+80, 11+80 and 14+10. A Catch Basin Grate was replaced at Station 11+80.

2.8.4 Restoration of Grass and Trees

Restoration of grass and trees was generally described in Section 02935 of the Technical Specifications and detailed in the approved Site Restoration Plan (RETEC, 1999). Several approved clarifications and modifications were made to the plan during implementation.

Topsoil Specifications

The topsoil used as the plant bedding was a fertile, friable, natural loam, capable of sustaining plant growth. It's analysis was within the following range:

Clay	10% - 30%
Sand	10% - 60%
Silt	30% - 70%
Organic Matter	>5%
2-inch Sieve	100% passing
pH	5.5 - 7.0

It was acceptable to mix the topsoil w/ a silty sand manufactured from crushed limestone to a 1:1 ratio. The topsoil mixture was placed to minimum thickness of four inches along areas of the banks which had been impacted during construction. After placement, the topsoil mixture was covered with an organic fiber mesh, to control erosion.

Fiber Roll Specifications

The organic fiber roll used to create beds for emergent aquatic species was made of coconut fibers, and was a minimum of 18 inches in diameter. 520 linear feet of organic fiber roll was placed on the banks of the creek topographically along the 571.5 ft. contour.

Grass Specifications
Upon consulting with Larry Wolfe of Wolfe's Landscaping, the landscaping subcontractor for the City of Buffalo's bike path contractor, it was determined that the following mixture of grass seed would be appropriate for the seeding of areas disturbed by the remediation of Scajaquada Creek:

Type of Grass	Percentage
K-31 Tall Fescue	45%
Perennial Ryegrass	25%
Creeping Red Fescue	20%
Kentucky Bluegrass	10%

This mix of seed was used and the seed was mulched and watered.

Tree Specifications
Upon consulting with Wendel Associates, the City of Buffalo's bike path architect, modifications were made to the species of trees to be planted. The trees were healthy, root balled, with a minimum diameter of one inch. Maintenance of the trees will continue until a healthy stand of trees is established.

The number of trees to be planted was reduced. This reduction was due to the bike path requirement that the trees be spaced 30 feet on center. Approximately 2000 linear feet of creek bank were replanted, therefore, the number of trees planted was reduced from 83 to 67:

Species	Number of Individuals
Green Ash (Franxinus pennsylvanica)	8
Elder (Acer negundo)	24
Willow (Salix sp.)	8
Hackberry (Celtis occidentalis)	8
Black Alder (Alnus)	10
Big Tooth or Quaking Aspen (populus)	9
Total Number of Trees Planted	67

2.8.5 Restoration of Shrubs and Aquatic Plants

Beak Consultants performed the restoration of shrubs and aquatic plants in the Spring of 1999.

The following shrubs were planted:

Species	Number of Individuals
Red osher dogwood	8
Silky Dogwood	9
Staghorn Sumac	9
Blackberry	9
Arrowroot	10
Button Bush	9
Salix Willow	9
Elder	3
Total Number of Shrubs Planted	67

The following aquatic species were planted:

Species	Number of Individuals
Coontail	618
Wild Celery	412
Water Weed	412
Pond Weed	618
Yellow Iris	412
Soft-Stem Bullrush	412
Soft Rush	412
Blue Flag	412
River Rush	412
Arrowhead	412
Total Number of Aquatics Planted	4,532

3 Health & Safety and Environmental Controls

This section describes the following actions taken to protect health and safety and implement environmental controls during the work:

- Community Health & Safety Program
- Work Area Health & Safety
- Environmental Controls and Permits

3.1 Community Health and Safety Program

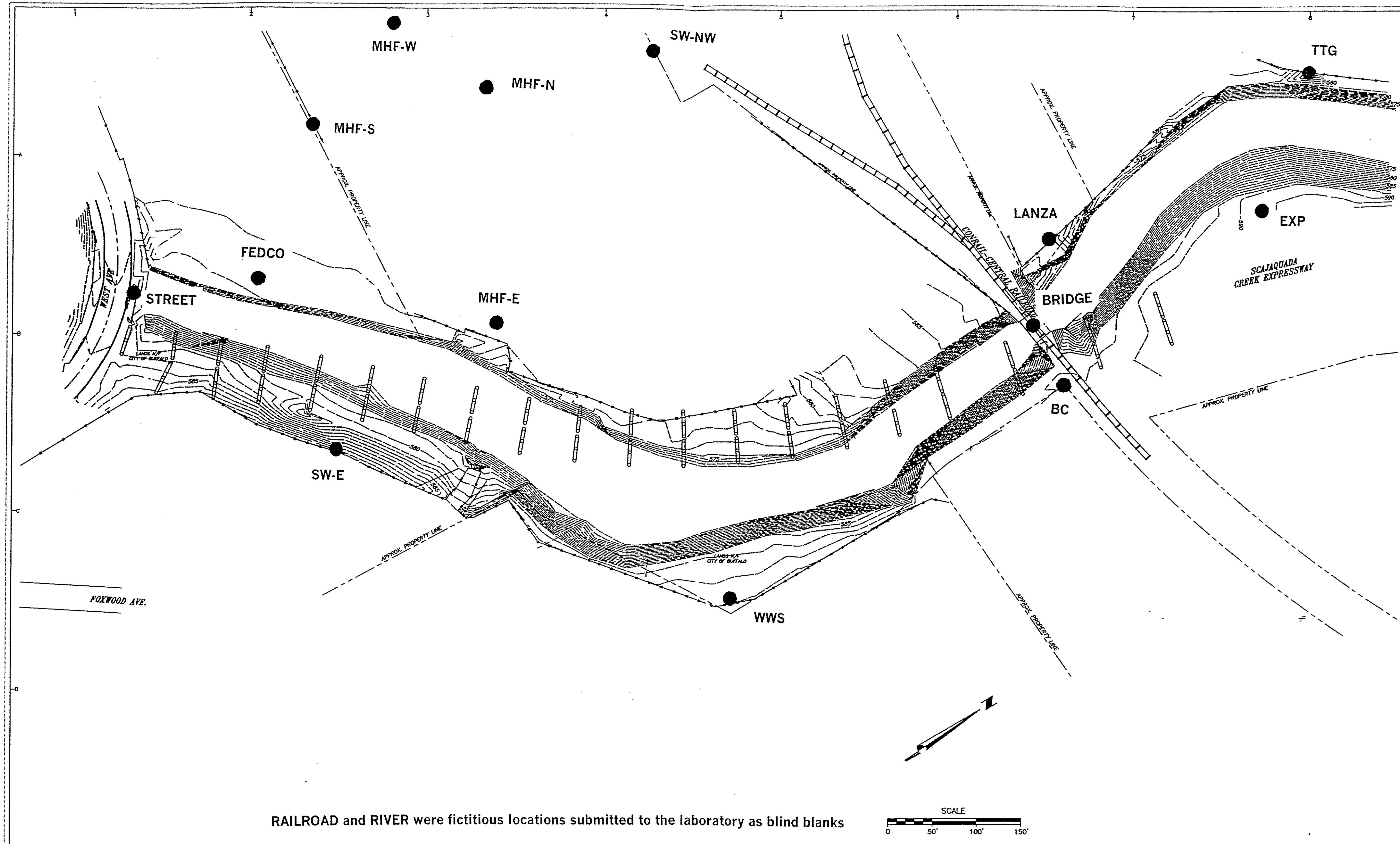
The Community Health and Safety program was included in the Environmental Monitoring and Control Plan [RETEC, 1998c]. It addressed elements of remedial activities which could potentially affect the nearby community. No community health and safety incidents related to the remediation of Scajaquada Creek were reported and no community complaints were registered. Community awareness of the project was provided by a newsletter distributed prior to the start of work and a second newsletter midway through the project, in accordance with the Citizen Participation Plan [RETEC, 1998c].

The protection of air quality was an essential part of the project. Coordination of events at the site considered wind and weather patterns in order to minimize offsite migration of dust and odor. The covering of stockpiles was not always maintained by Philip, and the need for stockpile covering was brought to Philips' attention by NYSDEC and ThermoRetec on an ongoing basis.

An air monitoring program was established to collect air quality data. The air monitoring results document that air quality at the site perimeter was maintained within maximum allowable contaminant levels. Cumulative time-weighted air monitoring was conducted, as well as real-time air monitoring.

3.1.1 Cumulative Time-Weighted Air Monitoring

Cumulative time-weighted air monitoring was done at several air monitoring stations placed at fixed locations on the perimeter of the site as shown on Figure 3-1. The time-weighted air monitoring results indicate that the maximum



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE

NATIONAL FUEL GAS
SCAJAQUADA CREEK SITE
3-2111-600

CURRENT DATE:
CAD FILE

AIR MONITORING LOCATIONS
PERIMETER AIR MONITORING PROGRAM

RETEC
RETEC ENGINEERING, P.C.

DRAWING NO. FIGURE 3-1
REV.

allowable contaminant levels established by USEPA, OSHA, NIOSH, and ACGIH were not exceeded beyond the site perimeter at any time during the project. A tabulated summary of the data is presented in Appendix K.

Depending on the type and location of site work in progress and the predominant wind direction, relevant sampling locations were located and a set of air samples was taken at each of the stations for some or all of the following:

- Volatile organic hydrocarbons (NIOSH method 1501);
- Polycyclic aromatic hydrocarbons (NIOSH method 5506); and
- Dust (NIOSH method 0500).

Air sampling flow rates were checked several times per day using NIST traceable rotometers. Air temperature and barometric pressures were averaged over each day's sampling period. Final air volumes were calculated on a time-weighted basis and corrected to standard temperature and pressure. The samples were collected over the course of an entire working day, typically eight hours. All samples were collected approximately six feet above ground. The average wind direction over the day was determined, and the dominant upwind sample set and the sample sets downwind of the active areas (typically the excavation zone and the MHF) were submitted for analysis. The other sample sets were held for possible future analysis. QA/QC samples consisted of periodic blanks and blind duplicates.

3.1.2 Real-Time Air Monitoring

Real-time air monitoring was done at the site perimeter and at other locations in the vicinity of the site. The results of real-time monitoring indicate that except for occasional exceedances for dust, all real-time air quality parameters remained within acceptable limits. Dust exceedances occurred during episodes of high wind and dry conditions and were followed up with actions by the contractor including covering of stockpiles and wetting of onsite haul routes. A summary of real-time monitoring results is presented in Appendix L.

Depending on the type of site work in progress, the monitoring measured and recorded levels of the following:

- Volatile organic hydrocarbons;
- Noise;
- Dust; and
- Odor.

Total volatile organic hydrocarbon compounds (VOCs) including benzene, toluene, ethylbenzene, and xylenes were measured using a calibrated photo-ionization detector (PID). When PID measurements of greater than 1.0 ppm were sustained for five minutes (the OSHA permissible exposure limit for benzene), then further measurement of benzene was conducted using Draeger tubes. An action level of 1.0 ppm benzene was used to adjust engineering controls to further reduce emissions. No sustained perimeter PID measurements of VOCs above 1.0 ppm were recorded. PID measurements of VOCs above 1.0 ppm, but for less than five minutes (unsustained) were occasionally detected at the site perimeter and were typically associated with diesel exhaust from trucks and equipment.

Noise was monitored in accordance with the program and no incidents of excessive noise (above 85 dB) were recorded.

Real-time monitoring of airborne particulates was conducted using a measuring device called a Miniram air pump. The difference between upwind and downwind site perimeter concentrations never exceeded the action level of 15 mg/m^3 dust (the OSHA permissible exposure limit).

Odors were encountered during the project, but no odors above the threshold levels were measured at the site perimeter. Odor levels at the site perimeter were measured using the 8-point Odor Intensity Scale defined by American Society for Testing and Materials (ASTM) method E544. By this standardized method, trained personnel compared the intensity of outdoor odors with reference dilutions of n-butanol. Numerical results were reported as odor intensities.

3.1.3 Restrictive Site Access

Site access was restricted by the existing chain-link fence, temporary plastic fence, and posted signs forbidding access. No unauthorized personnel were permitted on site. Contractor access to the site was limited to the main gate on Tonawanda Street at the west side of the site. A vandalism event occurred on August 29, 1998. After this event, Philip increased the presence of security guards on site during all non-working hours.

3.1.4 Decontamination and Housekeeping

Satisfactory housekeeping procedures and proper decontamination protocols were followed during the work. The site was maintained in orderly condition and refuse was contained. Personnel removed soiled protective clothing and washed boots and protective gear prior to leaving the site.

Equipment which had come in contact with contaminated material was decontaminated prior to leaving the site and the wash water was contained and disposed of as described in Section 2.5. Approved offsite haul routes were used throughout the project, and only very temporary blockage of Tonawanda Street occurred during mobilization and demobilization of equipment.

3.2 Work Area Health and Safety Program

The work area health and safety program was conducted in accordance with the Site Worker Health and Safety Plans (HASPs). Site Worker Health and Safety Plans (HASPs) were developed by ThermoRetec and Philip for the project. The Health and Safety Plans applied to all employees and visitors at the site. Common elements of the Health and Safety Plans are briefly described below.

3.2.1 Incident Reporting

There was one OSHA reportable incident during the work. A ThermoRetec site engineer was overcome by heat stress on August 7, 1999, was briefly hospitalized, and then released. The engineer had a pre-existing condition making him vulnerable to heat stress.

Several non-reportable incidents occurred including the accidental overturning of a Philip pickup truck on site.

3.2.2 Training Requirements

Proof of appropriate and current OSHA 40 Hour Hazardous Waste Operations training was required of all personnel prior to working on site. Proof of an annual medical surveillance program and documentation of a successful respirator fit test within the past 12 months for the appropriate type of respirator needed for onsite work were also required.

3.2.3 Hazard Communications

All personnel assigned to the site were advised of the hazards associated with working on site and the means planned to mitigate those hazards. The information made available included material safety data sheets, chemical/physical hazards, personal protective equipment, and hazardous materials labeling. Each person working at the site signed a form acknowledging that they had been informed, understood, and would abide by the procedures and protocols established by the HASP. Mandatory health and safety meetings were held to routinely review and present safety protocols as well as to inform all personnel of changing site conditions and to address worker concerns.

3.2.4 Air Monitoring and Personal Protective Equipment (PPE)

Real-time air monitoring, similar to that conducted for the community, was conducted within the work area. The air monitoring was performed as an on-going check for contaminants in the worker's breathing zone, especially when work was initiated on a different phase of the project or associated with a confined space entry. Air monitoring results were used by the contractor to determine the type and level of PPE required for protection of personnel working in the affected area. No readings of VOCs above respirator use action levels were recorded during the project, therefore, respirator use was never mandatory. Work area real-time monitoring results are included in Appendix L.

PPE including hard hats and appropriate gloves was sometimes not worn by Philip personnel in the work zone. These violations of Philips' Health and Safety Plan were brought to Philips' attention by NYSDEC and ThermoRetec on an on-going basis.

3.2.5 General Site Hazards

All onsite personnel were familiar and experienced with the standard operating procedures associated with general site hazards such as electrical power, lockout/tagout requirements, fall protection, drum handling, cold and heat stress, eye protection, hearing protection, avoidance of underground and overhead utilities, and excavation and trenching.

3.2.6 Site Specific Hazards

Hazards associated specifically with the project were adequately addressed during the work. Information on chemical and physical hazards and material safety data sheets was posted in the office trailer. Of particular concern were the following:

- Confined space entry;

- Control of spills & surface water runoff through use of berms and sump pumps on MHF;
- Overhead hazards from cranes during sheet pile wall installation;
- Trench awareness;
- Heat exposure;
- Cold exposure;
- Ice (slipping hazards); and
- Backup alarms for heavy equipment and operator awareness and safety protocols.

3.2.7 Emergency Response/Contingency Plan

Emergency contacts and telephone numbers were posted in the project trailers. Also posted were a map with routes to the nearest hospital, evacuation routes, and a list of emergency equipment that were available on site.

3.2.8 Spills

No offsite spills of contaminated material occurred during the project. Onsite spills were confined to the site and the haul road. All spilled material and all native material impacted by the spill were removed and properly disposed of.

3.3 Environmental Controls and Permits

The procedures used in the dredging and handling of materials at Scajaquada Creek were designed to minimize contact between the contents of the holder and the surrounding environment.

Environmental controls focused water handling at the site. These controls were implemented in accordance with the Environmental Monitoring and Control Plan [RETEC, 1998c]. Downstream water quality conditions were required to meet the criteria of no visible sheen and an upstream/downstream turbidity difference of no greater than 17 NTU as measured by the onsite turbidity meter. The flow of Scajaquada Creek was diverted by pumping it through clean bypass pipes and discharging the flow downstream of the site. It did not require engineering controls to meet the downstream criteria. The water pumped from the excavation zone typically required settling and sheen removal in temporary tanks, and some water also required sand filtration to allow the downstream criteria to be met.

Water from the MHF was treated and discharged in accordance with Philip's permit from the Buffalo Sewer Authority.

The following permits and regulatory agency reviews were obtained for this project and are provided in Appendix O:

- NYSDEC approval of Preliminary Design, Remedial Action Work Plans, Technical Specifications and Final Remedial Design and Drawings. June 24, 1998;

- NYSDOT Highway Work Permit No. 598-0275. August 24, 1998;

- U.S. Army Corps of Engineers, Modification of Permit No. 98-976-0071(1), Nationwide Permit No. 38, June 3, 1998 modified August 31, 1998;

- New York State Office of Parks, Recreation and Historic Preservation, Finding of No Effect on Significant Historic or Cultural Resources 98 PRO931. April 7, 1998;

- U.S. Department of Interior. Fish and Wildlife Service Review and Finding of No Federally Listed or Proposed Endangered Species, August 20, 1996;

- NYS Department of State, New York State Coastal Management Program, Federal Consistency Assessment Concurance F-98-267. May 12, 1998;

- Buffalo Sewer Authority Temporary Discharge Permit No 98-06-TP053. July 30, 1998; and

- EPA Acknowledgment of Consent to export hazardous waste No. 399/98. August 25, 1998.

4 Key Observations

This section highlights key observations made during the course of the work which are of special importance to regulatory agencies and other interested parties. Observations of non-MGP contamination, bridge pier conditions, and flood control considerations.

4.1 Non-MGP Contamination

Most of the visible contamination encountered during the excavation appeared to have odors and colors consistent with coal-tar like residuals from manufactured gas production. However, the following observations of non-MGP contamination were made:

- Untreated sewage has been observed flowing into Scajaquada Creek from combined sewers in upstream locations and through the outfall on the east bank of the Site. The Buffalo Sewer Authority was contacted regarding this contamination.

- A white liquid was observed flowing from the outfall on the east bank near the Westwood Pharmaceutical Co. Westwood and NYSDEC were notified about this discharge. An MSDS for the material was obtained from Westwood and is provided in Appendix N.

- A shoe-leather waste material encountered along the west bank north of the Railroad Bridge (Sta 12+10 to 12+50) was encountered during dredging. The material caused a floating sheen on the creek water. The oil in the material was analyzed and found to be a mineral oil.

- A decayed drum containing solidified yellow paint was removed from the excavation zone, near Station 8+00, along the east bank. This material was profiled and properly disposed of at an off site landfill.

A summary of non-MGP sampling and analytical results is provided in Appendix N.

4.2 Long-term Flood Control

The design of dredging and capping was evaluated with regard to long-term flood impacts by Clough, Harbour & Associates, LLP [Clough, Harbour 1998b] and approved by NYSDEC Division of Water prior to the start of work. The actual elevations of the modified section near West Avenue were also reviewed for flood impacts as presented in Appendix G.

4.3 Bridge Conditions

Bridge piers of the Scajaquada Creek Expressway were not damaged during the work. An assessment of their condition was made prior to the work [Clough, Harbour, 1998c] and photographs were taken upon completion of the work. NYSDOT representatives were present on site several times during the excavation work.

The Conrail Railroad Bridge was not damaged during the work.

4.4 Contamination Observations during Dredging

Observations in the field were generally consistent with previous borings, which indicated more contaminated sediments south of the Railroad Bridge and less contaminated material north of the Railroad Bridge. Dredging from the north end of the site at Sta 16+00 to the Railroad Bridge involved removal of sediments that generally had no sheen or dark staining and slight odor. Dredging from the Railroad Bridge to West Avenue involved the removal of heavily contaminated sediments. Separate-phase DNAPL was often observed in the dredging area.

Dark stained soil, odors, and sheen were common throughout this area. Distinct vertical layers of more contaminated or less contaminated material were not observed during the dredging either because they were not present, or because the excavation methods resulted in mixing of materials.

Seeps of DNAPL migrating from the adjacent property to the creekbed were observed during the work. The analytical reports for these seeps are provided in Appendix H.

Seeps of DNAPL on the west bank near the West Avenue Bridge were observed as described in Section 2 of this Report. A representative sample from this seep area was sampled and analyzed. The sample was not analyzed for PAHs because it was obviously a tar-like material containing PAHs. However, the sample was analyzed by an infrared spectral technique for qualitative characterization (sample 100W Seep)to identify the material and provide information regarding its origin. The components observed and the ratios of each were consistent for identification as a carburetted water gas (CWG) tar. The analysis showed that the material, while similar to the DNAPL encountered in the MGP site, had no evidence of hydrocarbon oxidation. Therefore, its origin is possibly from a different source or of a different age. This information was provided to NYSDEC.

A second seep area, located on the east bank at approximately Station 500 was also observed. A representative sample of material from this area was analyzed by an infrared spectral technique for qualitative characterization. The components observed and the ratios of each were consistent for identification as a carburetted water gas (CWG) tar. It was much less oxidized than material from a similar sample taken from the creekbed being dredged.

5 References

Clough, Harbour, 1998a. Letter Report: Scajaquada Creek, Remedial Design, Buffalo, NY, Report on Slope Stability Analysis, April 16, 1998.

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RETEC, 1998d. Site Restoration Plan, Scajaquada Creek, Sediment Remediation, January 7, 1999.

RETEC, 1998e. DNAPL Design Memorandum: Basis for Design, February 2, 1999.

RETEC, 1999. Site Restoration Plan for Scajaquada Creek Sediment Remediation, January 7, 1999.