OCCIDENTAL CHEMICAL CORPORATION

OLIN CORPORATION

ENGINEERING REPORT

FINAL

VOLUME I

102nd STREET LANDFILL SITE

NIAGARA FALLS, NEW YORK

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FLUOR DANIEL, INC.

MARLTON, NEW JERSEY

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1.0 INTRODUCTION

Purpose

This Engineering Report presents the Remedial Design of the 102nd Street Landfill Site (Site). The following Section provides a brief project background followed by a scope of work and a description of the design program.

1.1 PROJECT BACKGROUND

Site Description

The Site covers approximately 22.1 acres and is located in Niagara Falls, Niagara County, New York. It consists of two separate properties owned, respectively, by Occidental Chemical Corporation (OxyChem) and Olin Corporation (Olin) (the Companies) plus contiguous and related areas as defined in the September 1990 Record of Decision (ROD) as amended on June 9, 1995. The OxyChem/Olin property is bordered on the south by the Niagara River, on the north by Buffalo Avenue, on the west by Griffon Park, and on the east by privately owned land which is known as the Belden site. The Site as defined for the purpose of this remediation also includes the areas immediately adjacent to the east and to the west, the adjoining river sediments, as well as closely proximate areas necessary to carry out the remediation. The 100th Street storm sewer outfall owned by the City of Niagara Falls traverses the Site.

Background

The Site was divided into three operable units for investigative and remedial alternative feasibility studies. The design of the selected remedy for each operable unit is addressed in this document. The three operable units (OU) are:

OU-1: Landfill residuals, perimeter soils, shallow groundwater, and non-aqueous phase liquids (NAPL);

OU-2: Sediments in the Niagara River within 300 feet of the shore; and

OU-3: The portion of the 100th Street Storm Sewer that crosses the site.

The remedy selected by EPA is described in the ROD. The remedy was selected based on data provided in the Remedial Investigation (RI) Report, July 1990, Remedial Investigation, Final Report, Volumes 1 and 2) and in the Feasibility Study (FS) Report, July 1990, Feasibility Study Final Report, Volumes 1 and 2), as most appropriate for protection of human health and the environment.

The selected remedial alternatives as presented in the Amended ROD, June 9, 1995 includes ten major components:

OU-1:
- capping the site with a compound liner consisting of a compacted soil layer and a synthetic flexible membrane liner;
- consolidation of perimeter soils under the cap;
- construction of slurry wall encompassing the Site;
- recovery and treatment of aqueous phase liquids (APL);
- recovery and treatment of non-aqueous phase liquids; (NAPL)
- monitoring of post-remedial action;
- restriction of access;
- institutional controls;

OU-2:
- removal of embayment sediments with subsequent placement on the Site; and

OU-3:
- relocation of 100th Street storm sewer outfall around the perimeter of the Site.

1.2 SCOPE OF WORK

The scope of work was defined by the Remedial Design Work Plan (RDWP) and included six major tasks:

- Task 1 - RDWP;
- Task 2 - Predesign Field Activities (PFA);
- Task 3 - Preliminary Engineering;
- Task 4 - Intermediate Engineering;
- Task 5 - Final Engineering; and
- Task 6 - Regulatory Liaison.

Task 1, the RDWP was approved by EPA on May 6, 1992. The RDWP describes the overall approach to the design of remedial measures for the Site, and includes schedules for the implementation of all Remedial Design (RD) and predesign tasks.

Task 2, the PFA, was conducted at the Site between September 22 to October 27, 1992. The PFA obtained information on the soil conditions along the perimeter of the Site for the engineering design. The Predesign Field Activity Report (PFAR), which documented the PFA, was submitted to the EPA on November 20, 1992.

A Supplemental Offshore Boring Program and was completed in August, 1994 in order to determine the feasibility of aligning the Slurry Wall closer to the existing shoreline. An additional boring program was also completed in August, 1994 along the proposed alignment for relocation of the 100th Street Storm Sewer. The results of these programs were documented in Addenda to the PFAR issued in August 1994 and September 1994, respectively.

Tasks 3 and 4, consisted of the preparation of the Preliminary and Intermediate Remedial Design Documents (RDDs) was completed in January 1993. The Preliminary and Intermediate Engineering were combined and both are included in Intermediate Engineering Report submittal issued January 29, 1993.

Task 5 consisted of completion of the Final Engineering as documented in this report. This Final Engineering Report, including drawings and specifications, constitutes the RD Report as defined in the Site's Administrative Order (AO) for Remedial Design and Remedial Action, September 30, 1991. The RDDs include the following parts:

- this Engineering Report,
- drawings,
- calculations,
- technical specifications, and
- project plans.

The Remedial Design is consistent with the selected remedy described in the Amended ROD and has taken into account and accommodated applicable or relevant and appropriate requirements (ARARs).

Task 6, Regulatory Liaison, has been and will continue to be a continuous activity throughout the RD process.

1.3 DESIGN PROGRAM DESCRIPTION

Engineering Report

This Engineering Report is organized into the following sections and appendices:

- Section 1 - Introduction;
- Section 2 - Remedial Design Components;
- Section 3 - Permitting Status;
- Section 4 - Construction Sequencing/Schedule;
- Section 5 - Institutional Controls;
- Section 6 - Value Engineering;
- Section 7 - Support Facilities;
- Appendix A - Supporting Calculations and Analyses;
- Appendix B - Technical Specifications; and
- Appendix C - Drawings.

Design criteria, including PFA results and other criteria, which may not be covered in the PFAR, are incorporated in Section 2.0 and Appendix A. There were additional geotechnical laboratory strength tests and one permeability test performed on soil samples that were not previously identified in the Geotechnical Sampling and Testing Plan (GSTP) and that were not presented in the PFAR. These tests were performed based on field observations of soil conditions at the Site and the results are presented in Appendix A.7 of this Engineering Report. No adjustments to the proposed approach were necessitated by the results of the PFA.

Remedial Design Documents

The Remedial Design Documents include the Final Engineering Report plus the following written project plans:

- Construction Management Plan which includes the Operations and Maintenance Plan for RA activities;
- Construction Quality Assurance Project Plan (CQAPP) including sampling and inspection activities during construction of the RA;
- Contingency Plan for construction activities which is incorporated in the Health and Safety Plan (HASP) as an appendix; and
- Sampling and Monitoring Plan (SAMP) for post-closure monitoring of groundwater level and chemical constituents.

2.0 REMEDIAL DESIGN COMPONENTS

Section 2.0 presents the principal design components for Remedial Design and Remedial Action at the Site. It is divided into 12 subsections which are further subdivided into individual design components. The following information is presented for each remedial design component:

- General,
- Design Data,
- Design Basis/Criteria,
- Detailed Description/Operation, and
- Reference Drawings and Specifications.

2.1 CAPPING SYSTEM

General

A capping system consisting of a combination of geosynthetic and natural soil materials will be installed over the 102nd Street Landfill Site. The capping system will cover approximately 24 acres. The capping system will serve to minimize infiltration of precipitation into the landfill and to isolate the landfill contents. The top surface of the capping system will be approximately 10 feet to 20 feet above the grades existing prior to placement of imported fill materials.

2.1.1 Design Data

The capping system design is summarized below and is shown diagrammatically on Drawing 594000-10S-02. A detailed description of the capping system is presented in subsection 2.1.3.

Vegetative Zone

• Topsoil	6 inches (19,500 yd^3)
• Select cover fill	18 inches (53,300 yd^3)

Drainage Zone

• Geotextile	nominal 8 oz. non-woven, Trevira Spunbond 1125 or Polyfelt TS700, or equivalent (116,700 yd^2)
• Geonet	minimum transmissivity of 0.21 x 10^{-3} m^2/sec for each foot of width for all slopes (Gundnet XL-14 or National Seal Co. Poly-Net 2000, or equivalent) (116,700 yd^2)

Moisture Barrier Zone

• Geomembrane	40-mil VLDPE (Gundle Gundline VL or National Seal Co. VLDPE, or equivalent) (116,700 yd^2). On slopes greater than 10 percent, a textured 40-mil VLDPE geomembrane (Gundle Gundline VLT or National Seal Co. Friction Seal VL, or equivalent, having a friction angle greater than 27 degrees).
• Geosynthetic clay layer	Claymax 200R or CETCO Bentomat CS, or equivalent (123,700 yd^2, includes 6-inch overlap) for slopes greater than 10 percent, Claymax 500SP, or equivalent.

Subgrade Preparation

• Fill/grade adjustment/ subbase material	12 inch (min. thickness), grade adjustment and to prepare subgrade for liner support (39,000 yd^3). CL, CH, ML or SC with 3/4-inch maximum particle size.
• Compaction	90% Standard Proctor at moisture content within four (4) percentage points of optimum.

2.1.2 Design Basis/Criteria

General

The proposed capping system has been designed based on the requirements of EPA/530-SW-89-047, "Technical Guidance Document: Final Covers of Hazardous Waste Landfills and Surface Impoundments", July 89. In addition to minimizing infiltration of liquids into the Landfill, the following performance standards are listed in this document:

- The capping system shall function with minimum maintenance,
- The capping system shall promote surface drainage and minimize erosion of the cover, and
- The capping system shall accommodate settling and subsidence so that the performance of the system and its integrity are maintained.

Specific Criteria

Parameter	Value
Surface gradient	3 percent to 5 percent
Side slopes (landfill)	6H : 1V (desired)

	4H : 1V (minimum)
Ground cover	shallow rooted grasses
Cover over barrier zone	2 feet (minimum)

General Criteria

The following factors were considered in preparation of the capping system design:

- The geosynthetic clay liner is not adversely affected by freeze/thaw action; therefore, it does not need to be buried below maximum frost depth.
- Buried utilities between the Site and the southern edge of Buffalo Avenue will be relocated so that future utility maintenance will not impact the capping system.

2.1.3 Detailed Description

Vegetative Zone

Vegetation

A vegetative growth will be established to protect against erosional soil loss and to maintain an aesthetic appearance. The seed mixture will consist of native grasses appropriate for the local climate (per New York Urban Erosion Control Society guidelines).

The vegetation will be selected to provide habitat for migrant bird species of birds. This selection of vegetation will in effect enhance the quality of site habitat and thus can be considered for mitigation of the impacts of restoration.

Topsoil

Six inches of topsoil shall be placed over the select fill to promote and maintain a vigorous vegetative growth.

The topsoil shall be natural, friable, fertile, loamy soil containing between 2.5 and six percent organic material. The material shall not contain more than five percent by volume of stones, clods or other objects larger than one inch in any dimension. Topsoil shall be placed and lightly compacted. Approximately 19,100 cubic yards of topsoil will be required.

Select Cover Fill

Soil will be placed over the geotextile to support the following performance requirements:

- Accommodate the root system of the vegetative cover,
- Provide adequate water-holding capacity to sustain the cover vegetation,
- Protect the barrier zone from forces which could damage/penetrate the liner, and
- Provide sufficient buffer material to the underlying capping system components in the event of long-term erosional soil loss.

Approximately 57,400 cubic yards of material will be required to provide a minimum 18-inch protective cover layer. This material shall consist of CL, CH, ML or SC soils with a 3/4-inch maximum particle size. The select cover shall also be free of any significant organic and other deleterious materials. The select soil shall be compacted to 80 percent Standard Proctor density to provide a stable cover material and to prevent over compaction that may inhibit growth of the vegetative cover.

Drainage Zone

Geocomposite Drainage System

The drainage system will consist of a geotextile fabric in combination with a geonet. The geonet will be placed directly over the geomembrane. The purpose of the geocomposite drainage system is to collect and convey infiltrating water to the subsurface drainage collection system and away from the barrier layer thus preventing ponding and minimizing infiltration.

Geonet

The geonet will act as a drainage layer to convey precipitation, which has percolated through the upper soil layers, quickly away from the barrier layer and into the subsurface drainage collection system. The geonet will possess sufficient transmissivity to rapidly convey any water away from the barrier layer thus

maintaining a low hydraulic head that will minimize the potential for infiltration through the barrier layer.

The geonet will consist of a polyethylene grid that has sufficient strength to support the compressive stresses of the overlying cap materials and live loads (truck traffic).

Subsurface Drainage Collection System

The subsurface drainage collection system consists of four-inch diameter perforated HDPE pipe. The HDPE pipe will be embedded in shallow trenches and backfilled with crushed stone. The collection system will be installed beneath the perimeter drainage swales and beneath the internal swale that runs north to south. The collection pipes beneath the drainage swales will be located above the geomembrane in a recessed trench. The water collected by the geonet and conveyed by the subsurface drainage collection system is considered non-hazardous. The system will discharge the collected water via the drainage blanket consisting of a distribution pipe and gravel bedding which runs east-to-west within the bulkhead along the southern boundary of the Site behind the riprap. The water will exit the drainage blanket, along its entire length, into and through the riprap embankment of the bulkhead and ultimately into the Niagara River.

Geotextile

An eight-ounce non-woven geotextile fabric will be placed immediately above the geonet and beneath the select soil cover. The geotextile will prevent soil particles from being washed out of the overlying soil into the geonet while allowing percolating water to pass into the geonet for conveyance to the subsurface drainage collection system.

Moisture Barrier Zone

Compound Liner/Barrier System

The moisture barrier will be a compound liner/barrier system consisting of a geomembrane (flexible membrane liner) and a geosynthetic clay layer (GCL). Together these layers comprise a superior barrier to the passage of water into the landfill.

Geomembrane

A geomembrane will be installed directly on top of the Geosynthetic Clay Liner and will act as the primary barrier against infiltration of water into the landfill.

The selected geomembrane will consist of very low density polyethylene (VLDPE). This material has been selected due to its ability to deform elastically when subjected to differential settlement, and its relatively large interface angle of friction

angle with adjacent layers. The selected membrane thickness was based on ensuring the integrity of the geomembrane throughout construction, seaming, and over the life of the landfill.

VLDPE geomembrane seaming will be performed by fusion (wedge) or extrusion welding. Long seams will be fusion welded allowing the air pocket between the welds to be pressure tested for quality control (QC). Extrusion welding of VLDPE will be performed primarily for patching and seaming around appurtenances. All seaming will be in accordance with the material manufacturer's procedures.

A rigorous field QC program will be required during construction. The geomembrane QC will include observation of panel placement, making sure all panels are seamed, checking that all seams are tested, and observing that all patches are welded and tested.

Geosynthetic Clay Liner

A GCL will be installed directly over the prepared subbase to form a low-permeability moisture barrier directly below the geomembrane liner. The geosynthetic clay liners specified have a non-hydrated thickness of 0.125 to 0.20 inches and a permeability of less than 10^{-9} cm/sec.

Subgrade Preparation

Subbase Material

Prior to placement of the liner/barrier system, the subbase will be specifically prepared to provide a firm foundation free of all materials/objects which could damage the liner/barrier system. The subbase materials, the soil material to be placed within one-foot of the liner/barrier, shall consist of CL, CH, ML or SC soils. Soil materials from the existing Fill Placement Cell meeting the specification for subbase material will be used, as appropriate.

Subbase material shall be free of any significant quantity of organic and other deleterious materials. This material shall be compacted to 90 percent Standard Proctor density at a moisture content within four (4) percentage points of optimum. The subbase material will be free of any hard objects greater than one inch in any dimension and all sharp objects capable of penetrating the geosynthetic clay liner or geomembrane.

2.1.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the capping system design.

Drawing No.	Title
594000-10U-01	Master Site Grading Plan
594000-10U-02 through 05	Site Grading Plan Areas 1-4
594000-10S-01	Site Details
594000-10S-02	Capping System & Bulkhead - Sections and Details
594000-10S-03	Typical Site Grading Cross Sections

Specification No.	Title
02200	Earthwork

2.2 GRADING

General

Grading is required to shape the surface of the Site to the desired contours and gradient such that proper drainage characteristics are provided and erosion is minimized. Grading includes all necessary measures to control stormwater runon/runoff and for erosion and sediment control.

As a result of providing the required cover and surface gradients for proper drainage (3 to 5 percent), space is provided under the capping system for placement of materials which will be imported from off-site or will be generated by the remedial construction activities (e.g., consolidation of off-site and perimeter soils). These fill materials are listed in subsection 2.2.1 below.

2.2.1 Design Data

Grading and erosion control design components are summarized below. A detailed description of these components is presented in subsection 2.2.3.

Fill Material

- Remediation Generated 41,800 yd^3
- Imported Fill 200,000 yd^3

Erosion Control Measures

- Silt Fencing — Initially along west, north and east limits of grading; later along bulkhead.
- Filter Traps — Hay Bale Traps at all Catch Basins Along Buffalo Avenue.
- Diversion Berms — Off-site borrow, clayey silts to silty clay; along top of existing river bank.
- Sedimentation Pond — 500,000 gallons
- Sediment Traps — In major drainage swales to replace sedimentation pond.

2.2.2 Design Basis/Criteria

General

The grading/erosion control design components are based on existing Site conditions and capping design requirements described in Section 2.1.

Specific Criteria

Parameter (Fill)	Value
Imported	200,000 cy (desired)
Remediation-generated	41,800 cy

Remedial Activity	Volume (cy)
Perimeter Slurry Wall	10,200
Off-site (triangular area) Soils	3,300
Perimeter Soils	7,200
Dredged Sediments	21,100

Height	< 20 feet above Buffalo Avenue (desired)
Gradient	3 to 5 percent

Parameter (Storm Drainage)	Value
Storm interval	10 year
Gradient - swales	0.5 percent (minimum) 1.0 percent (preferred)
Velocity - 10 year	< 2.0 fps
Open channel depth of flow - 10 year	< 1.0 feet

General Criteria

The following factors were considered in preparation of the grading design.

- Minimize disturbance of existing landfill materials including phosphorus buried on OxyChem property.
- Breaching (i.e., excavating) contents of RCRA cells on Olin property is prohibited. (Refer to Topographic Map of 102nd Street Landfill Site, McIntosh & McIntosh, P.C., 8-7-92).
- Spreading of OxyChem perimeter soil pile containing Dioxin is prohibited.
- Limit soil loading, resulting from additional fill and cap materials, over the RCRA cells.
- Encroachment onto the Buffalo Avenue Right-of-Way (R.O.W.) will be granted due to the required alignment of the slurry wall within the R.O.W.

2.2.3 Detailed Description

Grading/Fill Operation

The final grades indicated on the construction drawings provide "air space" for approximately 200,000 cubic yards of fill to be imported by the Companies and approximately 41,800 cubic yards of material generated by remedial construction activities. The approximate 200,000 cubic yards of fill consisted of materials as described in Specification 02200 - Earthwork. These materials will be placed initially in Area 2 (refer to Drawing No. 594000-10U-06 for delineation of placement areas) within approved placement cells. Filling activities will generally progress along the perimeter (east, west and north) then north to south toward the low area in the central southern part of the Site.

The soil analyses typically used to certify the suitability of backfill material will consist of TCLP.

On slopes steeper than 4:1 (horizontal:vertical), lifts will extend beyond the finish slope line, then be cut back to the desired grade.

During initial filling operations onshore, runoff from the Site will be directed to the sedimentation pond via the diversion berm/swale discussed previously.

Materials to form the bulkhead in the vicinity of the planned APL Collection Trench located along the bulkhead will be free of debris and be classified as a sandy silt or similar soil to promote groundwater flow toward the APL Collection Trench.

Refer to Section 4.0 for further discussion regarding the sequencing of filling operations.

Erosion Control

Measures will be provided to isolate the Site from runon from adjacent property, prevent off-site discharge of runoff from active areas and inhibit transport of sediment off the Site.

A diversion berm/swale will be constructed along the top of river bank to collect and divert runoff from the Site to a central sedimentation pond. This sedimentation pond will be located in an existing low lying area. A berm will be constructed along the edge of the shore extending vertically to match the existing elevation at the top of bank (elev. 575±). This berm will be constructed with off-site borrow consisting of clayey silts to silty clay compacted to 90 percent Standard Proctor density. The pond will be subdivided by installing a sediment filter trap to form two ponds, one (sediment pond) to trap the majority of sediment the other to serve as a "Clear" pond. The water in the "Clear" pond will be periodically sampled and discharged to the river pending satisfactory analytical results. A sediment filter traps is defined as a rock filter constructed to reduce the velocity of water and create small areas for sedimentation.

Silt fencing will be installed along the north, east and west sidelines of the Site at the limit of work to inhibit the loss of water borne soil particles from the Site.

Hay bale filter traps will be placed around the catch basins to be installed along Buffalo Avenue adjacent to the Site. These will be maintained until vegetation is established on the cap.

As soon as the fill is brought to subgrade in Area 2, sediment traps will be installed near the end of each of the swales. Silt fences will be installed along the bulkhead to replace the diversion berm to filter runoff from Area 2. A silt fence is defined as a fabric barrier hung to remove sediment from water passing through the material.

Prior to seeding operations, the drainage swales will be lined with erosion netting. The swale will be widened to induce sheet flow toward the bulkhead. A riprap drainage blanket will intercept and convey the runoff out through the bulkhead.

2.2.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for grading and erosion control.

Drawing No.	Title
594000-10U-01	Master Site Grading Plan
594000-10Q-01	Stage I - Construction Sequence - Soil Erosion and Sediment Control
594000-10Q-02	Stage II - Construction Sequence - Soil Erosion and Sediment Control
594000-10Q-04	Soil Erosion Control Details
594000-10S-03	Typical Site Grading Cross Sections

Specification No.	Title
02200	Earthwork

2.3 OFF-SITE AND PERIMETER SOILS

General

Perimeter soils that exhibit concentrations of the Site Specific Indicators (SSI) above the survey level will be excavated and consolidated under the 102nd Street Landfill Site cap. The areas immediately adjacent to the Site (perimeter soils) on the north, east and west sides will be excavated and consolidated under the cap. Perimeter

soils along Buffalo Avenue where also shown to contain Dioxin as reported in the RI. These soils will be consolidated in a separately designated fill placement area. The extent of soils above the survey level was reported in Milestone Report No. 4, Off-Site Soils Survey, Rev. 1, October 1988 and the Remedial Investigation (RI) report (July 1990).

The perimeter soils include the areas immediately adjacent to the Site to the north, between the Site and Buffalo Avenue, and to the east and to the west. The horizontal limits of SSI parameters above survey levels have been identified in Milestone Report No. 4, and the areal extent of SSI presence has been depicted in Figure 7.16 of the RI. Pre-excavation verification sampling will be completed prior to the start of the remedial action activities.

The scope of the remedial program for the perimeter soils includes the following construction activities: tree removal, clearing and grubbing, fencing/delineation of work zone, traffic controls, stormwater management, excavation of the surficial soils to a minimum depth of 18 inches (including the topsoil and ground vegetation) and placement under the 102nd Street Landfill Site cap, and backfill and restoration of the area excavated.

2.3.1 Design Data

The perimeter soil consolidation approach and design are summarized below. A detailed description of the perimeter soils is presented in subsection 2.3.4.

Quantities

- Area 86,400 ft^2

• Depth	18 inches minimum
• Volume	7,200 yd^3

Backfill

• Material	Borrow: CL, CH, ML, or SC
• Compaction	90 percent Standard Proctor

Vegetative Zone

• Topsoil	6 inches (1,600 yd^3)

2.3.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
Ground Cover	Shallow rooted grasses
Surface Gradient	Refer to grading plans

2.3.3 Detailed Description

Extent

The north area (between the Site and Buffalo Avenue) is a narrow parcel of land, located within the right-of-way of Buffalo Avenue, with a constant width of approximately 26 feet and is approximately 2010 feet long.

The east area is a narrow parcel varying in width from approximately 105 feet to 55 feet (north to south) approximately 610 feet long, bordered to the west by the eastern Site property line and to the east by the horizontal limit of SSI parameters above survey levels.

The west area is a narrow parcel varying in width from approximately 75 feet to 175 feet (north to south) approximately 870 feet long, bordered to the east by the western Site property line and to the west by the horizontal limit of SSI parameters above survey levels.

The extent of excavation of perimeter off-site soils will extend from 6.5 feet inside the slurry wall to the SSI survey line. Previously identified off-site soils, which are located inside the slurry wall, will not require excavation as they will remain under the cap. The north area will be excavated up to the edge of pavement of Buffalo Avenue.

Site Preparation

All trees contained within the extent of surficial excavation are to be removed. The portion of the trees aboveground shall be cut and felled in a manner to avoid unnecessary disturbance of the surficial soils. Measures such as cribbing with branches cut from the trees will be employed to avoid disturbing the ground surface. Fallen trees will be cut into sections and hauled onto the Site and stockpiled. These tree sections will be chipped along with stumps and root systems removed from the excavation area.

Stumps and root systems will be removed in conjunction with the excavation of soil, hauled to the Site and stockpiled for chipping. The stockpile will be temporarily covered with tarps due to potential for fugitive dust from soil containing chemicals

of concern (COCs) adhered to the surface of the roots. Grasses and other ground vegetation are to be removed concurrent with the excavation operation of the soils.

Fencing

The boundary of the site will be totally enclosed with security fencing to demarcate the Work zone. Along Buffalo Avenue, fencing will be installed adjacent to the pavement. Appropriate traffic control measures will be implemented.

Backfilling and Restoration

The excavated area will be backfilled with clean fill. Prior to shipping of fill to the site, samples of the fill material will be collected and tested to verify its physical properties meet the specifications. The area will be backfilled to the grades shown on the grading plans. In areas to be vegetated, a minimum of six inches of unscreened topsoil will be placed to support vegetation.

Consolidation at Site

The excavated material will be spread in 12-inch lifts in the area designated areas on the Site. Excavated material containing Dioxin will be consolidated in the separately designated fill placement cell. Each lift will be compacted prior to placing any additional lifts.

2.3.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the perimeter soils.

Drawing No.	Title
594000-30K-01C	Master Site Remediation Plan Perimeter Soils
594000-30K-02C through -05C	Site Remediation Plan - Areas 1 through 4; Removal & Consolidation of Perimeter Soils

Specification No.	Title
02201	Earthwork - Perimeter Soils

2.4 BULKHEAD (SLURRY WALL WORK PLATFORM)

General

In order to install the offshore portion of the slurry wall, an earthen bulkhead will be constructed against and parallel (to the extent feasible) the existing shoreline of the Niagara River along the southern edge of the Site. The bulkhead will provide a work platform for construction of the perimeter slurry wall. The bulkhead will be designed to resist washout resulting from up to a 100-year flood event. The height of the bulkhead will be based on the 100-year flood elevation.

The bulkhead will be a permanent structure constructed of locally available suitable soil typically sandy, clayey silts. The outside slope will be faced with large (typically

ranging from 8 to 12-inch in maximum dimension) riprap to above the 100-year flood elevation in order to provide protection from wave and ice erosional forces.

The bulkhead will not impact navigation in the Niagara River. Also, the existing width of the Little Niagara River channel will be maintained. Refer to Drawings No. 594000-30K-03 and 594000-30K-05 for the planned alignment and Drawing No. 594000-10S-02 for typical details.

The bulkhead will be constructed in two phases. In the first phase, the bulkhead is constructed to elevation 571 to form the work platform for installation of the slurry wall. After completion of the slurry wall, the bulkhead will be filled to elevation 574.7 to provide freeze protection over the slurry wall cap.

2.4.1 Design Data

Design data for the bulkhead design are presented below. A detailed description of the bulkhead is presented in subsection 2.4.3.

Bulkhead Dimensions

- Crest elevation — approximately 574.7 feet
- Base elevation — 559.2 to 561.5 feet
- Base width — 56 to 76 feet
- Length — approximately 1750 feet
- Side Slopes — 2 horizontal : 1 vertical (2:1)

Bulkhead Materials

• Embankment fill	CL, CH, ML, or SC (must achieve required factors of safety)
• Woven geotextile	Mirafi 700x, Exxon GTF-400E, or equivalent
• Riprap bedding	6-inch thick, 3/4 inch uniform size, clean crushed gravel or crushed stone, NYDOT Spec. Section 703-02
• Riprap	Class 2; 50% between 8 and 12-inch size; 1.5 feet minimum layer thickness

2.4.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
Bulkhead stability {minimum factors of safety (F.S.)}	
• End of construction	F.S. = 1.4
• Rapid drawdown	F.S. = 1.2
• Long term	F.S. = 1.5
• Seismic loading	F.S. = 1.1

General Criteria

The following factors were considered in preparation of the bulkhead design.

- The construction of the bulkhead in the Niagara River will meet the requirements of the EPA and U.S. Army Corps of Engineers.
- The perimeter slurry wall will be constructed to minimum height of 100-year flood elevation, 569.0 feet.
- Minimize encroachment into Little Niagara River channel.
- Normally, shore structures are subject to wave forces, comparable in magnitude, to the maximum probable pressure that might be developed by an ice sheet. As the maximum wave forces and ice thrust cannot occur at the same time, the armor stone can be primarily designed for wave resistance.

2.4.3 Detailed Description

Compacted Embankment Fill

The soil embankment will be a compacted CL, CH, ML or SC soil with a maximum particle size of 3/4 of an inch. The soil will be compacted in a manner consistent with New York Department of Transportation embankment compaction specifications. Lifts will be a maximum of 12-inches thick. The soil will be compacted to a minimum of 95 percent of Standard Proctor density and to the requirements of Specification 02200 at a moisture content within four (4) percentage points of optimum. The fill will be certified as suitable for use through TCLP testing as described in the QAPP (September 1995).

Woven Geotextile

A woven geotextile will be placed between the final outside slope of the embankment and the bedding material of the riprap. The purpose of the geotextile is to prevent erosion of the embankment soils out through the riprap, while allowing water to pass through freely. The design of the geotextile is based on the particle size of the embankment fill.

Riprap Bedding Material

Riprap bedding material consists of a six-inch layer of 3/4-inch diameter stone. The bedding material allows the riprap armor stone to be placed without damaging the underlying geotextile.

The bedding material will be connected to the capping system drainage layer shown on Detail A, Drawing 594000-10S-02, to provide discharge of water collected by the drainage system.

Riprap Armor Stone

The riprap is designed to resist long-term erosional forces and washout and will be resistant to wave action and ice. The riprap will be Class 2 with at least 50 percent having a maximum dimension between 8 and 12 inches and comprising a layer at least 18 inches thick.

Walkway

A walkway will be located along the south side of the landfill adjacent to the Niagara River. The walkway will be 8 feet wide and will be placed on a compacted subgrade. The subgrade will be overlaid by a woven geotextile. The composite of the walkway is as follows:

- 4-inch dense aggregate road way mix;
- 2-inch bitum binder coarse, type 6F (NYDOT 403); and
- 2-inch bitum top wearing, type 6F (NYDOT 403);

A guiderail will be placed between the walkway and the Niagara River. This guiderail will meet NYDOT specifications. A detail of the walkway and guiderail are shown on drawing 594000-10S-02.

2.4.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the bulkhead design.

Drawing No.	Title
594000-10U-01	Master Site Grading Plan
594000-10S-02	Capping System & Bulkhead - Sections and Details

Specification No.	Title
02200	Earthwork

2.5 PERIMETER SLURRY WALL

General

The perimeter slurry wall will provide a physical barrier to APL and NAPL migration from the Site. It will be constructed around the 102nd Street Landfill Site and keyed three feet into the confining Clay and/or Glacial Till layers that underlay the Site. The slurry wall will be constructed of soil-bentonite backfill possessing a maximum permeability of 1×10^{-7} cm/sec. The effectiveness of the slurry wall will be enhanced by maintaining a one-foot minimum inward hydraulic gradient across the slurry wall to prevent APL migration from the Site. The slurry wall will be constructed using the slurry trench method to excavate the three-foot wide trench and backfill the excavation with a soil and bentonite mixture. The backfill material will be comprised of fill with a minimum of 20 percent fines pass the No. 200 sieve, bentonite slurry and dry bentonite.

The installation of the perimeter slurry wall will serve to reduce the amount of APL that would require collection and treatment to prevent off-site migration. The slurry wall will enclose all areas of NAPL.

The compatibility of the bentonite slurry and soil-bentonite backfill with the chemical constituents of the NAPL and APL of the Site have been evaluated. Material

compatibility data is available from the OxyChem S-Area site. The chemical nature of the APL and NAPL from that site is similar to the 102nd Street Site. On this basis, the S-Area materials testing program was evaluated for its application to the 102nd Street slurry wall. Refer to Section 5.0, PFA Report (1992), for a description of the compatibility testing.

At present, groundwater in the fill/alluvium generally flows towards the Niagara River. Once the slurry wall is in place along Buffalo Avenue, groundwater will flow around the slurry wall. The bedding of the relocated eight-inch city water line along Buffalo Avenue, as well as the 6-inch perforated PVC underdrain, should facilitate groundwater movement around the slurry wall. Groundwater mounding along Buffalo Avenue is not anticipated. However, water levels in the piezometers will be monitored for mounding effects. Should significant groundwater mounding be observed, the existing subdrain system will be inspected and evaluated to determine measures to relieve groundwater mounding.

2.5.1 Design Data

The perimeter slurry wall design is summarized below. A detailed description of the slurry wall is presented in subsection 2.5.3.

Slurry wall dimensions

• Width	3 feet (nominal)
• Depth	varies (15 to 32 feet)
• Alignment length	approximately 5,000 feet

Slurry mix

• Slurry additive	Wyoming grade bentonite
• Hydration	potable water for 24 hours (min.)
• Apparent viscosity	40 seconds (Marsh Funnel) (min.)
• Bentonite content	6 percent (min.)

- Density — 65 (min.) to 85 pcf
- Water loss (min.) — 20 cm^3 in 30 minutes (filter press)

Backfill

- Material — well graded soil with minimum 20 percent passing the No. 200 sieve and maximum particle size of 0.5 of an inch
- Slump — 3 to 6 inches
- Bentonite content — 3 percent (min.)
- Permeability — 1 x 10^{-7} cm/sec (max.)
- Density — 15 pcf greater than slurry density

2.5.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
Permeability	1 x 10^{-7} cm/sec (max.)
Elevation - top	100-year flood (elev. 569 feet)
Elevation - bottom	Clay/Till (elev. varies)

General Criteria

The following factors were considered in preparation of the perimeter slurry wall design.

- An appropriate imported soil material meeting the specified parameters will be used for all slurry trench backfill soil. The material excavated from the trench will not be used for construction of the perimeter slurry wall and will be placed within the confined landfill.
- Compatibility of slurry backfill and the Site chemistry (e.g., APL and NAPL) was assessed using existing data from the S-Area site.
- A two-foot thick slurry wall clay cap will prevent desiccation of the slurry backfill during construction, prior to placement of the Site cap.

2.5.3 Detailed Description

Location/Dimensions

Alignment

The alignment of the perimeter slurry wall is based on the following factors:

- Areal extent of the 102nd Street Landfill, and
- Requirement to contain NAPL.

The establishment of the alignment was the subject of the Predesign Field Activities Report, submitted to the EPA/State on November 20, 1992.

The alignment along the southern boundary is located in the bulkhead.

Results from the Predesign Field Activities program outlined in the PFAR (1992) indicate that all onshore and offshore borings along the alignment of the slurry wall, and recovered soil samples, did not contain NAPL.

Depth/Key

Standard design practice requires that this type of slurry wall be keyed into an underlying impervious soil or bedrock unit to minimize leakage of groundwater around the base of the slurry wall. The slurry wall will be keyed three feet into the clay/till (elevation varies). The maximum depth of the key will be 3.5 feet, and the minimum will be 2.5 feet.

At the 102nd Street Landfill Site, two soil deposits are present that will provide optimal key units; the glaciolacustrine clay (Clay) and the glacial till (Till). One or both of these units is present beneath the entire Site, as interpreted from the available soil borings.

The Clay unit consists of a soft, low plasticity, inorganic silty clay. The Till unit consists of a highly overconsolidated, hard, low plasticity, inorganic sandy, clayey silt.

Elevation of Top of Slurry Wall

The top of the perimeter slurry wall must be above the 100-year flood elevation to prevent infiltration of water into the landfill during such an event. Based on flood insurance studies of the Niagara Falls area, the elevation of the 100-year flood is 569 feet. In areas where the existing ground surface elevation is above elevation 569 feet, the top of the slurry wall will be at or above the 100-year flood elevation. Ground surface elevation greater than elevation 569 feet currently occurs at the top of the existing bulkhead adjacent to the river and all of the existing landfill area.

In areas of the embayment, where the existing ground surface elevation is below elevation 569 feet, a permanent work platform will be constructed to raise the local elevation (refer to Section 2.4 for additional discussion of the work platform and

bulkhead). Drawing 594000-30K-09 indicates in profile, the areas where work platforms (bulkhead fill) will be required.

Work Platform

Slurry wall construction operations will be carried out from a work platform along the alignment of the perimeter slurry wall. The work platform provides a flat, clear area for equipment movement and mixing of the backfill. The top of the work platform must be a minimum of three feet above the local water table to provide adequate slurry height above the groundwater for trench stability. Additionally, the work platform must be relatively flat, with a maximum slope of 0.5 percent in the direction of the slurry wall alignment.

The width of the work platform is determined by the depth of the slurry wall and the construction procedures that are employed. The imported soils for the slurry wall backfill will be transported to the work platform by truck and mixed adjacent to the trench. The mixing area will require a width of approximately 20 to 30 feet. The transportation route for the trucks delivering imported soil and removing excavated materials will require approximately 12 feet of width. The digging of the trench by the hydraulic excavator will require approximately 8 feet. Total width of the work platform will be 50 feet to ensure safe construction practices.

Perimeter soils that will be consolidated under the landfill cap will be excavated prior to construction of the work platform. The work platform in the embayment area will be constructed as part of the bulkhead at elevation 570 feet. The design of the bulkhead is discussed in Section 2.4.

Slurry Wall Trench

The perimeter slurry wall trench will be constructed to be a minimum of three feet wide. This width is standard practice for soil-bentonite slurry walls installed at remedial project sites. The three-foot width facilitates the use of a standard excavator bucket for the backhoe.

The length of open trench will vary from 100 to 250 feet during construction. The amount of trench open at any one time will be dependent upon the depth to the confining layer and the slope of the backfill in the trench. The toe of the backfill slope will be maintained between 50 feet and 100 feet from the digging face of the trench.

The "corners" of the slurry wall will be constructed by extending the trench beyond the points of intersections to allow for complete overlapping of the slurry wall legs.

Slurry Materials

Slurry Mix

The trench stability will be maintained during construction by the use of a bentonite slurry in the trench. The slurry will consist of Wyoming-grade bentonite that has been hydrated for a minimum of 24-hours with water meeting the specification.

At the time of introducing bentonite slurry into the trench excavation, the slurry will have a minimum apparent viscosity of 40 seconds, as measured by the Marsh Funnel, and a minimum bentonite content of six percent. The slurry density shall be a minimum of 65 pcf. The water loss shall not be greater than 20 cubic centimeters in 30 minutes as measured by a filter press.

The minimum apparent viscosity of the bentonite slurry in the trench at any time shall not be less than 40 seconds as measured by the Marsh Funnel. The density of the slurry in the trench should not exceed 85 pcf. The water loss will not be greater than 20 cubic centimeters in 30 minutes.

The method of mixing of the slurry (continuous mixer, tank or pit) will be determined by the selected contractor. However, no mixing will occur in the trench, as described in Specification 02901. Construction QA/QC testing to be performed in conjunction with the slurry wall is presented in the CQAPP (September 1995).

Backfill Materials

Backfill

The backfill shall consist of off-site borrow material meeting the specifications mixed together with bentonite slurry and dry bentonite. The backfill may be mixed with grading equipment or by means of a mill to achieve a uniform composition and consistency. The mixture will have a slump of three to six inches, a bentonite content of not less than three percent and a maximum permeability of 1×10^{-7} cm/sec. The density of the backfill in the trench will be maintained at least 15 pcf greater than the unit weight of the slurry in the trench to ensure that the backfill flows to the bottom of the trench without trapping slurry.

Slurry Wall Protection

Slurry Wall Cap

Upon completion of the perimeter slurry wall, or sections of the wall, a compacted clay cap will be placed over the exposed top of the wall. The intent of the clay cap

is to prevent the exposed top of the slurry wall from drying and cracking. Additionally, the cap will protect the wall from ongoing construction activities.

The slurry wall cap will be five feet wide at its base and will be constructed on one to one slopes for a thickness of two feet. The cap will be compacted to 90 percent Standard Proctor density. The landfill cap will be constructed on top of the slurry wall cap. The final grade of the slurry wall cap must meet the elevation requirements for placement of the landfill cap. This requires that the slurry wall cap be constructed one to two feet below the top of the working platform in some locations. This will be accomplished by excavating the top one to two feet of the slurry wall, placing the clay in lifts and compacting it. The bulkhead area of the working platform, in the southwest corner, is one such area.

2.5.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the perimeter slurry wall.

Drawing No.	Title
594000-30K-01	Master Site Remediation Plan
594000-10S-02	Cap Section and Details
594000-30K-09	Slurry Wall Profile

Specification No.	Title
02200	Earthwork
02901	Slurry Wall

2.6 APL COLLECTION SYSTEM

General

This section includes discussions of the APL collection system and the loadout facility.

The APL collection system will be installed to create and maintain an inward gradient across the perimeter slurry wall. The APL collection system consists of a collection trench approximately 2275-foot long, four wet wells, and associated piping, pumps and controls.

The inward gradient across the perimeter slurry wall will be achieved by reducing the static groundwater level within the encapsulated landfill area adjacent to the perimeter slurry wall to approximately one-foot below the natural groundwater levels outside the perimeter slurry wall to the west, north and east of the Site and to approximately one foot below the Niagara River to the south of the Site. Once the desired levels are achieved, any remaining sources of infiltration will consist of the following:

- precipitation infiltration through the cap,
- groundwater infiltration through the perimeter slurry wall,
- groundwater infiltration beneath the perimeter slurry wall, and
- groundwater migration from the bedrock formation upward through the confining Clay/Till deposits.

Infiltration through the cap was estimated using the HELP model (Schroeder et. al., 1988) for the landfill capping system design shown on Drawing 594000-10S-02.

The APL will be treated at the OxyChem Buffalo Avenue facility. This facility consists of an activated carbon treatment system that discharges to the City of Niagara Falls sanitary sewer system for subsequent additional treatment at the City's Waste Water Treatment Facility. OxyChem has obtained approval from the Waste Water Treatment Facility for addition of the APL from the 102nd Street Landfill Site. OxyChem will continue to monitor the effluent of the Buffalo Avenue facility.

A loadout facility will be located between the two landfill cap mounds on the OxyChem side of the Site for temporary storage of APL pending transportation off-site for treatment and disposal. The loadout facility will consist of the following elements:

- Two (2) 10,000 gallon APL storage tanks,
- A transfer pump,
- A secondary containment dike,
- A sump and sump pump,
- Associated piping and controls, and
- Remote monitoring of loadout facility status at the OxyChem Niagara Falls Plant.

2.6.1 Design Data

2.6.1.1 Design Data - APL Collection System

Design data for the APL collection system design are presented below. A detailed description of the collection system is presented in subsection 2.6.3.1.

Collection Trench - Dimensions

• Length (west)	500 feet
• Length (south)	1575 feet
• Length (east)	200 feet
• Depth	17 to 22 feet
• Width	2 feet (approximate)
• Cleanouts	7 manhole cleanouts

Collection trench - Materials

• Bedding	24 inches of graded gravel
• Piping	6-inch perforated or slotted HDPE pipe

Wet wells

• Type	concrete sumps
• Pump Model	Grundfos Redi-Flow 5E8, or equivalent
• Number	4

• Pump type	submersible
• Pump capacity	5.6 gpm
• Pump TDH	105 feet
• Pump HP	1/3
• Pump power	230 volts, single phase
• Material	304 Stainless Steel
• Electrical area classification	Class 1 Division 1 Group D

Forcemain

• Type	1.5-inch HDPE carrier pipe in a 3.5-inch HDPE container pipe
• Location	5 feet below grade (beneath cap geomembrane)
• Heat tracing	none required
• Cleanouts	7 in-line cleanouts
• Check valves	one at each wet well and one at the loadout facility

2.6.1.2 Design Data - Loadout Facility

Design data for the loadout facility design are presented below. A detailed description of the loadout facility is presented in subsection 2.6.2.2.

General

General

• Location	per Drawing 594000-30K-01
• Dimensions (plan)	30 feet x 36 feet
• Foundation	shallow, reinforced concrete slab
• Secondary containment	approximately 2.5-foot high containment dike
• Sump	2 feet x 2 feet x 2 feet
• Tank foundations	concrete saddle

APL Storage Tank

• Number	2
• Volume	10,000 gallons
• Size	9-foot dia. x 24.5 feet
• Type	horizontal
• Frost protection	removable electric panel coil heater with insulation
• Material	fiberglass reinforced plastic (FRP)
• Vent	4-inch carbon filter to atmosphere
• Leak detection	visual
• Secondary containment	containment dike

NAPL Storage Tank (FUTURE)

• Number	1

• Volume	500 gallons
• Size	4-foot dia. x 6.5 feet
• Type	horizontal, sloping 2% toward discharge port
• Frost protection	removable electric panel coil heater with insulation
• Material	FRP
• Vent	4-inch carbon filter to atmosphere
• Leak detection	visual
• Secondary containment	containment dike

APL Transfer Pump

• Number	1
• Type	centrifugal
• Model	Durco 2K or equivalent
• Capacity	75 gpm
• TDH	25 feet
• HP	2
• Power	230V/1 Phase/60 Hz
• Material	304 stainless steel

NAPL Transfer Pump (Future)

• Number	1

- Type — gear lobe
- Model — Waukeska 25 I or equivalent
- Capacity — 25 gpm
- TDH — 30 feet
- HP — 2
- Power — 230V/1 Phase/60 Hz
- Material — 316 stainless steel

Sump Pump

- Number — 1
- Type — self-priming centrifugal
- Model — Durco IK or equivalent
- Capacity — 50 gpm
- TDH — 30 feet
- HP — 1.5
- Power — 230V/1 Phase/60 Hz
- Material — 316 stainless steel

NAPL Trailer Storage Building (Future)

- Number — 1
- Dimensions — 15 feet x 15 feet x 10 feet high
- Entrance — 2

- Power none

2.6.2 Design Basis/Criteria

2.6.2.1 Design Basis/Criteria - Collection System

Specific Criteria

Parameter	Value
APL - pH	6 to 8

General Criteria

The following factors were considered in preparation of the collection system design:

- The inward gradient across the perimeter slurry wall may be achieved by reducing the static groundwater level within the encapsulated landfill area adjacent to the perimeter slurry wall to approximately one-foot below the natural groundwater levels outside the perimeter slurry wall to the west, north and east of the Site and to approximately one foot below the Niagara River to the south of the Site and as needed to maintain the head difference.

- It is envisioned that APL pumping will operate on an as needed basis, 24 hours a day for five days a week until the one-foot head difference across the perimeter slurry wall is achieved. It is estimated that the desired water levels will be achieved in six months.

- The hydrogeologic data needed to design the APL system and to perform the necessary supporting analyses were obtained from the RI Report (1990), supporting Milestone Reports No. 2, 8 and 14, Phosphorus Disposal Information (April 1990), and the PFAR (1994). Specific data used from these reports include:
  - Section 5.0 of the RI presents the results of the chemical analysis of the APL and Physical data.
  - The average hydraulic conductivity of the underlying Clay is 1.6×10^{-8} cm/sec (Table 4.3, RI, 1990). A table has been presented in Appendix A which lists the hydraulic conductivity test results utilized for computing the average hydraulic conductivity of the till.
  - The average hydraulic conductivity of the underlying Till is 6.5×10^{-8} cm/sec (Refer to Appendix A.1; calculated from Table 4.3, RI, 1990).

- Bottom two feet of the Till has gravel or high permeability base which is not representative of the Till at the site and therefore will not be considered as part of the confining layer.

- The historical groundwater elevations measured at the 102nd Street Landfill Site, presented in Appendix A of Milestone Report No. 8.

- Approximate depth to the top of buried phosphorus is six to seven feet, Phosphorus Disposal Information (April 1990).

• Conservative assumptions were made to estimate the maximum reasonable infiltration into the landfill (post-closure). The key assumptions are listed below:

- The width of the perimeter slurry wall is three feet. The maximum (and assumed average) hydraulic conductivity of this slurry wall is $1x10^{-7}$ cm/sec.

- A minimum of one-foot hydraulic head differential will be maintained across the perimeter slurry wall resulting in a water level elevation within the encapsulated landfill of approximately 562.6 feet MSL at steady state conditions.

- The area enclosed within the perimeter slurry wall is approximately 1.0 million square feet (Drawings 594000-10U-01 and 594000-30K-01).

- The average river elevation is 563.6 feet above mean sea level (MSL) and fluctuations are temporary and are not significant (Table 6, Milestone Report No. 8).

2.6.2.2 Design Basis/Criteria - Loadout Facility

Specific Criteria

Parameter	Value
APL volume recovered (initial)	20,000 gallons/day
APL volume recovered (steady state)	400 gallons/day
NAPL volume recovered (first 3 months)	1 to 10 gallons per well per month
NAPL volume recovered (steady state)	0 to 5 gallons per well per 3 to 6 months
APL - pH	6 to 8
NAPL - viscosity	1.5 to 16.1 centistokes
NAPL -Specific gravity	1.1 to 1.6

General Criteria

The following factors were considered during preparation of the loadout facility design.

- All weather operation.
- Any storage at the loadout facility will be for less than 90 days.
- Chemical concentrations are as reported in Section 5 of the RI.
- Characteristics of NAPL are as described in Section 9 of the RI.
- Locate loadout facility within the fenced boundary of the landfill to discourage vandalism.
- Provide for possible, future secure parking and storage for the NAPL collection equipment.
- Design secondary containment system for largest tank size in addition to containing a 24-hour rainfall for a 100 year storm. OK
- The twenty-four hour rainfall for a 100 year rainstorm is 4.8 inches (Tech. paper 40, Rainfall Frequency Atlas of the U.S., May 1961).
- Collected rainfall will be pumped into APL storage tank for subsequent treatment.
- The APL and NAPL will be transported off-site for treatment.
- Material compatibility studies related to APL and NAPL have been conducted for the Durez and Hyde Park Sites of OxyChem in Niagara Falls. While the APL and NAPL are specific to their respective sites, they possess the same general chemical makeup as the 102nd Street Landfill Site. These studies were used in the selection of the material of construction. The studies included:
  - Durez Material Compatibility Study, May 1989.
  - Materials Compatibility Study, Durez Site, Phase I Report, May 1988.
  - Materials of Construction for Handling Hyde Park Leachate, 1983 to 1986.

2.6.3 Detailed Description

2.6.3.1 Detailed Description - APL Collection System

Collection Trench

An APL collection trench will be installed to extract APL from the encapsulated landfill. A trench is being used, rather than extraction wells, to provide for the larger surface area required to effectively extract the APL from the relatively low permeability Landfill soils. The trench will be installed adjacent to the slurry wall along the west, south, and east sides of the Site, as shown on Drawing 594000-30K-01. The lengths of the trench will be approximately 500, 1575, 200 feet on the west, south and east sides of the Site, respectively. Depth to the bottom of the trench from final grade will range from 17 to 22 feet. Maximum depth to the bottom of the trench from existing grade is 17 feet. Details of the trench are shown on Drawing 594000-30K-08. The trench includes a six-inch diameter perforated or slotted HDPE pipe within a 24-inch gravel bedding.

The trench will be installed using standard excavation techniques. Specifications for the trenching operation are provided in Specification 02200. Allowing for one to one layback, the trench will be located approximately 15 to 25 feet away from the perimeter slurry wall. Seven cleanout manholes are also provided at changes in direction and at terminal points. The locations of these manholes are shown on Drawing 594000-30K-01 and details are shown on Drawing 594000-30K-08.

Wet Wells

Four wet wells will be used to collect APL from the trench. Locations of the wet wells are shown on Drawing 594000-30K-01. Depth of wet wells, from the final grade, is approximately 23 feet. Wet well details are presented on Drawing 594000-

30K-06. Specifications for materials of construction are presented in Specification Section 02011.

Pumps and level probes will be installed inside the wet well. Level controls, flow meter, control module, and valves will be installed in a subgrade precast six-foot square concrete structure. The electrical connection boxes and control modules will be electrical classification Class I, Division 2, Group D. The compound liner/barrier will be attached to the concrete well-head housing (see Drawing 594000-30K-06) to prevent leakage of surface water into the landfill.

APL Pumps

Grundfos model 5E8 submersible turbines or equivalent pump will be used in the APL wells. This pump was selected based on initial flow of a maximum of 5.6 gpm or 8000 gallons per day (per pump) and total dynamic head requirements of 105 feet. Supporting calculations are included in the Appendix A.1, Section 5.0. Steady state flow requirements for the APL Collection System are about 400 gallons per day or about 5600 gallons every two weeks. The system, based on initial pumping rate requirements, is sized such that up to 20,000 gallons per day can be handled.

APL pumps are 1/3 horse power (hp), 230 V, single phase, 304 stainless steel pumps. Operation of APL pumps will be controlled by a level probe and a controller to maintain water levels at a predetermined level. Data sheets and vendor information is included in Appendix B.

Forcemain

The APL system forcemain will consists of a 1.5-inch diameter HDPE carrier pipe in a 3.5-inch diameter HDPE container pipe. A container pipe is used to facilitate replacement of the carrier pipe, and to provide secondary containment should the carrier pipe develop leaks. The forcemain will be located beneath the capping system and about five feet below the finished grade, for freeze protection. If a leak should develop in the forcemain and leak beyond the secondary container pipe, it will drain back into the landfill and thus be contained by the perimeter slurry wall. Seven in-line cleanouts will provide inspection capability for leaks and will be located as shown on Drawing 594000-30K-01. Cleanout details are presented on Drawing 594000-30K-08.

The layout of the forcemain is shown on Drawing 594000-30K-01. It will run parallel to the south alignment of the perimeter slurry wall from the wet wells to the loadout facility. It will stay below grade until it reaches the loadout facility. At the loadout facility, the forcemain will be an above-grade 2-inch diameter heat traced and insulated FRP pipe.

The forcemain will have check valves at each wet well and at the loadout facility to prevent backflow (see Drawing 594000-25J-02).

Initial Operation for APL Collection System

Initially to achieve the desired reduction of water level within the encapsulated landfill within a six month period, the APL Collection System will be operated at a pumping rate up to 20,000 gallons per day, 5 days a week. Thereafter, the pumping rate will be adjusted to maintain the water levels along the slurry wall at the desired elevations (i.e. one foot below the water level outside the slurry wall).

Long Term Operation for APL Collection System

After the desired inward gradient is achieved, the total APL recovery rate can be reduced to the estimated rate of infiltration, 400 gallons per day (refer to Appendix A.1, Section 5.0). The recovered APL will be pumped, via the forcemain, to the two 10,000 gallon APL storage tanks located at the loadout facility (refer to Section 3.9). A 5000-gallon tanker will load APL on a frequency sufficient to maintain the APL storage tanks at less than 80 percent capacity. The operator will transfer APL from the storage tanks to the 5000-gallon tanker truck by connecting a flexible hose to the discharge line of the APL transfer pump. When the level in the APL storage tanks is at only one percent, APL transfer pump P-206, will be automatically shut off. APL is then taken to the OxyChem Buffalo Avenue wastewater treatment facility. The volume of APL transferred is manually read from the flow totalizer, FQI-5. Upon completion of the transfer, the power to the APL pumps will be restored and APL recovery will continue.

In the event that the two 10,000 gallon APL storage tanks reach 80 percent capacity prior to the arrival of the transfer tanker, a remote message will also be sent to provide notification on the status of the APL storage tanks. The tanker will be sent immediately to the storage tanks to bring the quality below 80 percent capacity. Should the APL storage tanks become full, an automated cut off of the power supply to all the APL wet well pumps.

Water levels in the post-closure monitoring wells and the piezometers will be monitored to assure that the desired inward gradient is maintained. Should these measurements indicate that the one-foot differential water level is not being maintained, appropriate action, such as increasing the APL recovery rate, will be taken.

2.6.3.2 Detailed Description - Loadout Facility

APL Storage and Loadout System

Two nine-foot diameter by 24.5-foot long, 10,000 gallon horizontal APL storage tanks, T-201A and T-201B, will be used. A vendor supplied removable electric panel coil heater with removable insulation will be used to provide freeze protection to the tank contents. These horizontal tanks will be mounted on concrete saddles to provide for visual leak detection. The tanks will be vented through a four inch carbon filter to the atmosphere. Tank specifications are included in Specification 58023.

Inlet piping will be a two-inch heat traced and insulated FRP pipe. The discharge line will be a three-inch heat traced and insulated FRP pipe with a 0.5-inch sample port. The APL transfer pump, P-205, is a 75 gpm, 25 feet total dynamic head, 2.5 HP, 230V, single phase, 304 stainless steel centrifugal pump. The pump's discharge line has a local pressure gauge. Pump discharge will be to a tanker truck via a flexible hose.

Control logic is shown on the Drawing 594000-25J-02. When the level in the APL storage tanks are at 80 percent, a remote message will be sent via a remote phone dialer, XA-5. When the tank levels are at 95 percent, power to all three APL pumps (at the wet wells) will be cut-off. Similarly, when the level is at only one percent, the APL transfer pump P-205, will be automatically shut off. A local, override switch is provided for manual deactivation of the APL transfer pump.

A 5,000-gallon tanker truck trailor will load APL from the two 10,000-gallon APL Storage Tanks and transfer APL to the OxyChem Buffalo Avenue wastewater treatment facility. Four trips daily by the tanker trailors are planned during the initial

dewatering. The 20,000 gallon per day APL collection rate will occur during initial dewatering, which is expected to last about 6 months. Once inward gradients are established, APL collection rate will decline to approximately 400 gallons per day. The facility has been designed for long term operation. The Companies believe that additional storage capacity, which would only be used during the initial dewatering, is not necessary. Additional storage capacity would be provided by using tanker trailors for temporary and/or more daily trips, if necessary.

NAPL Storage and Loadout System (Future)

One four-foot diameter by 6.5-foot long, 500 gallon horizontal NAPL storage tank, T-301, will be installed. A vendor supplied removable electric panel coil heater with

removable insulation will be used to provide freeze protection to the tank contents. This horizontal tank will be mounted on concrete saddles to provide for visual leak detection. The tank will be vented through a four-inch carbon filter to the atmosphere. The carbon filter will be heat traced and insulated to prevent blockage. The NAPL tank will be installed with a two percent slope towards the discharge line. Tank specifications are included in Specification 58023.

The inlet and discharge pipe will be two-inch heat traced and insulated FRP pipes with 0.5-inch sample ports. NAPL transfer pump, P-311, is a 25 gpm, 30 feet total dynamic head, 2 HP, 230V, single phase, 316 stainless steel lobe pump. The pumps discharge line has a local pressure gauge. The pump discharge will be to a tanker truck via a flexible hose.

Control logic is shown on the Drawing 594000-25J-03. When the tank level is at one percent, NAPL transfer pump, P-311, will be automatically shut off. A local, override switch is provided for manual deactivation of the APL transfer pump.

Loadout Facility - Controls Panel

All controls, level recorders, remote phone dialer, and control panels will be located at the loadout facility as shown on Drawing 594000-25J-02 and as specified on Drawing 594000-65U-02.

Loadout Facility - Operation

The tanker truck operator will transfer APL from the storage tanks to the tanker truck by connecting a flexible hose to the discharge line of the APL transfer pump. APL will then be transported to the OxyChem Buffalo Avenue Wastewater Treatment facility. The volume of APL transferred will be indicated by the flow totalizer, FQI-5. Initially, APL will be transported off-site by tanker truck every working day. After

desired water levels are achieved (approximately six months), APL will be transferred approximately once a month, or on an as need basis.

Any rainfall collected in the loadout facility secondary containment area will be pumped to the APL storage tank. A self-priming centrifugal sump pump will be used to pump rainfall to the APL storage tank. If the APL storage tank is out of service, a locked valve will be opened and rainfall/spills from the APL storage tank will be pumped directly to a tanker truck for off-site treatment and disposal.

Access Road

The permanent access road to the 102nd Street Landfill Site loadout facility will be located on the south side of Buffalo Avenue approximately 500 feet west of the intersection of Buffalo Avenue and 102nd Street. 30-foot radii of curvature will be provided for the intersection of the access road sidelines with the Buffalo Avenue sideline. The 30-foot radii will provide the adequate turning space for large articulated tanker trucks entering and leaving the site without maneuvering into the lane of opposing traffic. The interior curves are also designed to accommodate the turning radius of the trucks. The tangent sections of the access road from Buffalo Avenue to the Loadout Facility will have a total improved width of 20 feet consisting of 16 feet of pavement with a 2-foot shoulder on each side.

The cross section of the access road will consist of an eight-inch compacted aggregate base topped with two inches of bituminous stabilized binder and a one inch bituminous top wearing course. The base will overly a woven geotextile (Mirafi 600X or equivalent) placed on top of a minimum of 18 inches of select cover fill.

Snow will be removed from the road, and the road will be sanded or salted, as needed to allow safe operations during winter. Flexible, high visibility markers will

be installed on both side of the road, approximately every 25 feet, to delineate the roads for snow removal.

2.6.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the APL collection system and the loadout facility.

Drawing No.	Title
594000-30K-01	Master Site Remediation Plan
594000-30K-02 through -05	Site Remediation Plan - Areas 1 through 4
594000-30K-06	APL, NAPL, and Monitoring Wells and Misc. Details
594000-30K-08	APL Collection System - Sections & Details
594000-25J-01	APL and NAPL System - Flow Diagram
594000-25J-02	Piping & Instrumentation Diagram - APL System
594000-25J-03	Piping and Instrumentation Diagram - NAPL System
594000-55N-01	Loadout Facility - Mechanical Plan & Details

Drawing No.	Title
594000-10S-02	Capping System & Bulkhead - Section and Details
594000-65U-01	Electrical Power Plan
594000-65U-02	Telephone and Instrumentation Plan
594000-65U-03	One Line Diagram - Power Distribution Panel Board

Specification No.	Title
02011	Post-closure monitor well, and piezometer installation
02200	Earthwork
02731	HDPE Pipe
50002	Process and Piping Design and Material

2.7 NAPL WELLS

General

NAPL at the Site will be recovered using ten (10) dedicated extraction wells, and the recovered NAPL will be temporarily stored at the loadout facility and then transported off-site for incinerated at OxyChem's Buffalo Avenue incinerator facility. After the extraction wells have been installed and are operational, and a

representative amount of NAPL (approximately 50 gallons) has been recovered from the wells, it will be characterized to provide the required analytical data to meet the requirements of the RCRA permit (EPA I.D. No. NYD000824482) and New York State Part 373 (I.D. No. 90-86-0707), of the incinerator facility. After the characterization has been approved, full operation of the NAPL recovery system will commence. The frequency of pumping will be determined during initial operation of the system. Based on results of the NAPL recovery test conducted on NAPL Well NR-05 (NAPL Recovery Well Testing Program, 1995), pumping frequencies of once a month for the first three months and thereafter once every three to six months are anticipated.

The NAPL recovery system consists of the following elements:

- Ten NAPL extraction wells with dedicated low flow gear pumps and conductivity probes.

- A mobile NAPL pumping system which includes a pump control module, a generator, an AC-to-DC transformer, and a NAPL collection drum. This system will be skid mounted.

2.7.1 Design Data

Design data for the NAPL Well design is presented below. A detailed description of the NAPL Wells is presented in subsection 2.7.3.

Well - General

• Number	10
• Depth	30 to 50 feet (final grade), includes a 18-inch sump into the Clay/Glacial Till unit backfilled with a six-inch bentonite seal

- Borehole diameter — 24 to 30 inches
- Well diameter — 12 inches
- Locations — per Drawing 594000-30K-01

Well - Construction

- Filter — material: quartz sand; size: Gradation No. 0, Morie Co. (Refer to Specification Section 02012)
- Screen — length: 10 feet; diameter: 12 inches; material: 316-stainless steel wire-wrapped; slot size: 0.020 inches
- Riser casing — length: varies; diameter: 12 inches; material: schedule 5, type 304 stainless steel
- Surface enclosure — 3 feet x 3 feet, locking and removable sheet metal enclosure
- Connection w/ cap — geomembrane/geotextile banded to riser pipe

Well - Pumps

The NAPL pump and controls

- Number — 10
- Type — submersible Tuthill B-9241 nickel alloy 0.25 inch wide gear pump, or equivalent
- Capacity — 0.2 gpm (for specific gravity of 1.6)
- TDH — 60 psi

- Power 12 VDC

Well - NAPL Probe

- Number 10
- Type conductivity

Mobile Pumping System - Pump (Future)

- Number 1
- Type high viscosity drum pump
- Capacity 5 gpm
- TDH 20 feet
- Hp 1
- Power 115V/1 Phase/60 Hz

Mobile Pumping System - Power

- Number 1
- Type gasoline-powered generator
- Capacity 115 volts, alternating current at 60 hertz and 10 amps
- Transformer 115 VAC to 12 VDC

Mobile Pumping System - Collection Drum

- Number 1
- Type FRP, with polyethylene liner

- Capacity 55 gallons

Mobile Pumping System - Trailer (Future)

- Type standard utility trailer

Mobile Pumping System - Operation

- The mobile pumping system will be transported to each well and manually actuated.

2.7.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
• Viscosity	1.5 to 16.1 centistokes
• Specific gravity	1.1 to 1.6
• Chemical Composition of NAPL:	See Table Below

COMPOUND	Weight Percent
Benzene	0 - 1
Chlorobenzene	1 - 2
Dichlorobenzene	0 - 2
1,2,4-Trichlorobenzene	15 - 24
1,2,4,5-Tetrachlorobenzene	32 - 49
Pentachlorobenzene	7 - 13
Hexachlorobenzene	1 - 2
Hexachlorobutadiene	0 - 1
4-Chlorotoluene	0 - 2
1-Chlorododecane	0 - 8
1-Chlorotetradecane	0 - 3
1-Chlorohexadecane	0 - 1
1,1,2,2-Tetrachloroethane	0 - 2
Tetrachloroethene	0 - 3
alpha-HCCH	1 - 2
gamma-HCCH	0 - 1
Other minor constituents	2 - 25

General Criteria

The following factors were considered in preparation of the NAPL well system:

- Characteristics of NAPL are as described in Section 9 of the RI (1990).

- Based on field experience at the 102nd Street Landfill Site, the volume of NAPL recoverable is on the order of 10 gallons per well per month for the first three

months then reducing to 0 to 5 gallons per well per three to six month interval (NAPL Recovery Well Test Report, 1995).

- Occurrence and distribution of the NAPL is as described in the RI (1990).

- The NAPL is accumulating in topographical lows on the top of the Clay or Glacial Till.

- Material compatibility studies related to NAPL have been conducted for the Durez and Hyde Park Sites of OxyChem in Niagara Falls. While the NAPL is specific to its respective sites, they possess the same general chemical makeup as the 102nd Street Landfill Site. These studies were used in the selection of materials of construction. These studies included:

  - Durez Materials Compatibility Study (May 1989).
  - Durez Material Compatibility Study (May 1989).
  - Materials Compatibility Study, Durez Site, Phase I Report (May 1988).
  - Materials of Construction for Handling Hyde Park Leachate (1983 to 1986).

Collection of NAPL from the NAPL wells will be by a mobile collection system described in Section 2.7. Initially, NAPL collected in drums and transported directly off-site for treatment.

Potentially, should the need be demonstrated in the future, NAPL will be collected utilizing the mobile collection system and transferred into a 500 gallon storage tank at the Loadout Facility. The NAPL would be transferred from the loadout facility when the NAPL storage tank at the loadout facility is full, as indicated by the level

indicator, or about every three months, whichever is sooner. The tanker truck operator will connect a flexible hose to the discharge line of the NAPL transfer pump and transfer NAPL from the NAPL storage tank to the truck tank. A low level in the NAPL storage tank will automatically shut off of the NAPL transfer pump, P-311. The volume of NAPL discharged is manually read from the flow totalizer, FQI-6.

2.7.3 Detailed Description

NAPL Extraction Well Locations

The NAPL extraction wells will be located to maximize NAPL recovery based upon the information provided in the RI Report, the supporting Milestone Documents and the PFAR for this Site. Ten locations have been selected for the installation of extraction wells. These locations are primarily based upon the data presented in:

- Figure 9.4, Approximate extent of NAPL, RI Report (1990)
- Figure 1, Approximate Extent of HNAPL, from the Estimate of Recoverable HNAPL Volume, 102nd Street Landfill Project (April 1990)
- Figure 1, Top of Clay/Till, Supplemental NAPL Investigation Report
- Figure 3.15, Top of Glaciolacustrine Clay, RI Report (1990)
- Figure 3.17, Top of Glacial Till, RI Report (1990)

Locations of the NAPL extraction wells are shown on Drawing No. 594000-30K-01. These locations were selected to position the extraction wells in areas of known or expected NAPL accumulation and at or near topographical lows in the Clay/Till layers beneath the Site. The NAPL is expected to pool in these topographical lows, thereby maximizing the NAPL extraction by pumping.

NAPL Extraction Well Construction Details

Details of the NAPL extraction wells are shown on Drawing 594000-30K-06. The 12-inch diameter NAPL extraction wells will be in a 24-inch to 30-inch diameter borehole. Each well will contain a 316-stainless steel wire-wrapped well screen, 12 inches in diameter and 10 feet in length. A coarse sand pack will extend the full length of the saturated thickness. The well riser casing will be schedule 5, type 304 stainless steel.

The individual extraction wells will be drilled and set 18 inches into the underlying Clay/Till layer of the Site. The bottom 6 inches will be filled with bentonite pellets. The remaining 12 inches will serve as a sump to collect NAPL at the well. The annular space between the well borehole and the well screen well within the clay/till strata to one foot above the clay/till interface with landfill material will be filled with gravel to facilitate movement of NAPL toward the pump. The remainder of annular space between the well borehole and well screen/riser within the fill material will be filled to one foot above the water level with course, quartz sand to serve as a filter.

Anticipated depths of the NAPL recovery wells, below the top of finished grade, range from 30 to 50 feet.

Each well-head casing will be enclosed by a three-foot by three-foot by three-foot lockable and removable sheet metal enclosure. The enclosure will house the flexible NAPL pump discharge line, conductivity probe cable and power cable for the pump motor. The enclosure will be lockable to prevent unauthorized access. The landfill barrier/liner will be secured to the well casing. The liner and geotextile will be banded to the well casing to maintain the integrity of the capping system as shown on Drawing 594000-30K-06.

NAPL Pumps and Controls

The NAPL recovery pumping system consists of a Tuthill B-9241 nickel alloy 0.25 inch wide gear pump, a transformer to convert 115 VAC/single phase/60Hz power to 12 VDC current to power the pump, a NAPL probe, control module, and 0.25-inch ID teflon discharge tube. The control module and transformer will be located on the mobile pumping system.

The NAPL recovery system is designed to pump only the NAPL. The presence and thickness will be determined by manually raising and lowering the NAPL probe. Upon detection of NAPL, the pump will be manually actuated. The NAPL pump discharge rate can be controlled by adjusting the voltage to the pump. The pump will be manually deactivated when the NAPL probe no longer detects NAPL or when APL is visually observed in the discharge line.

When the pump is deactivated, liquid in the 0.25-inch ID tube will be retained in the discharge line and will not drain back to the well.

Secondary Containment At NAPL Well Site

The NAPL pump discharge tube will be connected to a double wall flexible hose to discharge the NAPL into the NAPL collection tank. This double wall flexible hose will provide the required secondary containment.

Mobile Pumping System

The mobile pumping system will consist of a gasoline-powered generator, a 115 VAC to 12 VDC transformer, a chemically-resistant 55-gallon with polyethylene liner plus the necessary valves and double walled flexible piping. The mobile pumping system will be skid and transported to each well.

The generator will be a gasoline-powered unit capable of producing 115 volt alternating current at 60 hertz, 10 amps.

Operation of NAPL Collection System

At each well the mobile collection system will be parked adjacent to the well. The NAPL probe will be activated to detect/measure NAPL in the well. If the NAPL thickness is at least 3 inches, the electrical power feed and discharge line will be connected to/from the mobile collection trailer. The generator will be started and the pump manually activated . The probe will be utilized to check the remaining thickness of NAPL. Should the probe cease to detect NAPL, the pump will be manually deactivated. To minimize APL extraction with NAPL, the operator will continually watch the discharge to the NAPL collection tank. If APL is visually observed in the discharge, the pump will be manually deactivated. The probe will be utilized to verify that the NAPL has been removed to below the pump intake. After the removal has been confirmed, the double walled discharge tubing, electrical power to NAPL pump, and probe cable will be disconnected and the mobile unit moved to the next well.

The NAPL extraction wells have been designed with a 12-inch sump extending into the underlying confining soil layer. This feature will enhance the NAPL recovery by providing a reservoir of approximately five gallons of recoverable NAPL. Experience gained from the NAPL Recovery Well Test Program conducted on well NR-05 suggests that recharge rates of on the order of 0 to 10 gallons per well per month may be expected for the first three months of operation then would drop off to 0 to 5 gallons per well per three to six-month period. Actual recharge rates are expected to vary. Actual recharge rates must be confirmed after installation of the extraction wells to finalize the recovery schedule.

Transfer of NAPL to Treatment

NAPL will be transferred directly to the off-site treatment facility at the end of each day when NAPL is recovered.

Access Roads to NAPL Wells

Light duty roads will be constructed to provide access to each of the NAPL extraction wells. The roads will be a total width of 10 feet with appropriate turn around for maneuvering a pickup truck. The width of these access roads is based on passage of a standard pickup truck. Turn-around are being provided at the end of the roads, near the NAPL extraction wells, to allow the truck and trailer to exit from the well area. The inside radius of these turnarounds will be 20 feet.

Maximum grades are five percent where the roads pass over the landfill cap. The minimum radius of curves in the alignment is 30 feet.

The cross section of the light duty access roads consists of 10-foot wide aggregate pavement composed of six inches of densely graded and compacted aggregate, overlying a woven geotextile (Mirafi 600X or equivalent), placed on top of a minimum of 18 inches of select cover fill.

Characterization of 102nd Street Landfill Site NAPL

Upon completion of Remedial Construction activities at the Site, the extraction wells will be individually tested to determine the amount of NAPL that can be pumped from each and the rate of recharge to the wells. This information will be used to finalize the pumping schedule for the wells. The volume of NAPL collected for this purpose should be less than 10 gallons.

Once a representative amount (approximately 50 gallons) of NAPL has been collected, it will be sampled and characterized pursuant to EPA RCRA Permit (EPA I.D. No. NYD000824482) and New York State Part 373 (I.D. No. 90-86-0707), which contain approval for OxyChem to incinerate NAPL from the 102nd Street Landfill Site. Laboratory analysis will be performed, as required by the permit, on the sample.

2.7.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for the NAPL recovery system.

Drawing No.	Title
594000-30K-01	Master Site Remediation Plan
594000-30K-02 through 05	Site Remediation Plan - Areas 1 through 4
594000-30K-06	APL, NAPL, and Monitoring Wells and Misc. Details
594000-25J-01	APL and NAPL System - Flow Diagram
594000-25J-03	Piping & Instrumentation Diagram - NAPL System

Drawing No.	Title
594000-10U-01	Master Site Grading Plan

Specification No.	Title
02012	NAPL Well Installation

2.8 POST-CLOSURE MONITOR WELLS, POST-CLOSURE BEDROCK MONITORING WELLS AND PIEZOMETERS

General

A post-closure monitoring program will be implemented at the Site subsequent to completion of remedial activities. The program consists of the following tasks:

- groundwater monitor well and piezometer installation,
- groundwater sampling and testing, and
- groundwater elevation monitoring.

The field program activities shall be implemented by the Companies in conjunction with protocols set forth in the Site Specific Health and Safety Plan and its appendices.

The objective of the post-closure monitoring program is to satisfy requirements of the ROD and provide performance monitoring of the remedial containment system, which includes:

- water level measurement to monitor inward gradient, and
- water quality sampling and testing outside of the perimeter slurry wall.

Ten post-closure piezometers will be located inside and Ten post-closure monitor wells will be located outside of the perimeter slurry wall to compare water level elevations inside and outside the perimeter slurry wall. Additionally, three post-closure bedrock monitoring wells will be installed outside of the slurry wall to provide a comparison of the water level in the landfill with the piezometric water level in the bedrock. The monitor wells will also be used to collect water samples for water quality testing. Review of the water quality and water levels should provide a reliable indicator of remedial system effectiveness.

2.8.1 Design Data

Design data for the monitor wells and piezometers are presented below. A detailed description of the monitor wells is presented in subsection 2.8.3.

Wells - General

• Number	10 outside perimeter slurry wall in alluvium 3 outside perimeter slurry wall in bedrock
• Depth	Varies
• Borehole diameter	10 inches (nominal) Bedrock Wells: 5 5/8 inches (nominal)

- Locations — per Drawing 594000-30K-01

Wells - Construction

- Filter — material: quartz sand
  size: based on grain size of surrounding soil

• Screen	length: varies diameter: 2 inches material: SCH 5, type 304 stainless steel, wire wrapped, flush joint threads slot size: 0.006 inch
• Casing Riser	length: varies diameter: 2 inches material: SCH 5, type 304 stainless steel, flush joint threads
• Outer casing (fill/alluvium)	length: varies diameter: 10 inches material: SCH 10, type 304 stainless steel, welded joint
• Inner casing (till/clay)	length: varies diameter: 6 inches material: SCH 10, type 304 stainless steel, welded joint
• Surface enclosure	4- to 6-inch ID protective casing with lockable cap
• Connection w/ cap	geomembrane/geotextile sealed to protective casing pipe

Piezometers - General

• Number	10 inside perimeter slurry wall
• Depth	varies
• Borehole diameter	10 inches
• Locations	per Drawing 594000-30K-01

Piezometers - Construction

• Filter	material: quartz sand

	size:	based on grain size of surrounding soil
• Screen	length: diameter: material: slot size:	Varies 2 inches SCH 5, type 304 stainless steel wire wrapped, flush joint threads 0.006 inch
• Casing riser	length: diameter: material:	varies 2 inches SCH 5, type 304 stainless steel, flush joint threads
• Surface enclosure	4- to 6-inch ID protective casing with lockable cap	
• Connection w/ cap	geomembrane/geotextile sealed to protective casing	

2.8.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
APL - pH	6 to 8
APL chemical concentrations	per Section 5.0, RI Report (1990)

2.8.3 Detailed Description

Location

Ten post-closure monitor wells (two on east, three on west, two on south, and three on north side) shall be installed outside the perimeter slurry wall at the locations shown on Drawing 594000-30K-01. Similarly ten post-closure piezometers (two on east, three on west, two on south, and three on north side) shall be installed inside the perimeter slurry wall at the locations shown on Drawing 594000-30K-01.

Three post-closure bedrock monitoring wells will be installed outside of the slurry wall at the locations shown on Drawing 594000-30K-01. One will be located just to the north of the slurry wall along Buffalo Avenue and the other three will be paired with the three piezometers located to the south of the slurry wall along the Niagara River.

Depth

All post-closure monitor wells shall be installed fully penetrating the water table aquifer (i.e., all post-closure monitor wells shall be screened from the top of the confining Clay/Till layer to at least one foot above the water table). Depths of post-closure monitor wells range from 8 to 30 feet. Anticipated depths and screen lengths of individual wells are listed on Drawing 594000-30K-06.

All piezometers shall be installed to fully penetrate the water table aquifer. The piezometers will be fully screened from the top of the confining Clay/Till layer to at least one foot above the steady-state water level inside the slurry wall after completion of the Remedial Action. Depths of piezometers range from 13 to 30 feet. Anticipated depths and screen lengths of individual piezometers are listed on Drawing 594000-30K-06.

All post-closure bedrock monitoring wells will be installed 15 feet into the bedrock strata. Depths of these wells are expected to be approximately 60 feet total with 10-foot screen length. Anticipated depths of individual wells are listed on Drawing 594000-30K-06.

Construction Materials

Well riser casing and screens for piezometers and monitoring wells shall be schedule 5, type 304 stainless steel. Details of other materials for the post-closure monitoring wells and piezometers are provided in Specification 02011.

Post-Closure Sampling

A groundwater sampling and monitoring program will be conducted at the Site to provide post-remedial performance monitoring of the containment system. A field sampling plan will be prepared to describe the field work to be performed at the Site

as part of the Post-Closure Program. This plan will make use of protocols set forth in the Site Operations Plan (SOP) and Quality Assurance Plan (QAP) where appropriate; and the Health and Safety Plan (HASP) and the Addendum prepared for this program.

The primary objectives of the field sampling plan are to:

- Determine the effectiveness of the groundwater gradient control/APL collection system by monitoring groundwater elevations within the post-closure monitoring wells and piezometers.

- Determine the effectiveness of the containment system by collecting groundwater samples from post-closure monitoring wells and analyzing them for Site Specific Indicators (SSI) as presented in Table 3.1 of the QAPP (September 1995).

- Confirm the continuation of an upward gradient from the bedrock aquifer.

The proposed frequency of water level measurements will be monthly during the first two years following completion of the remedial actions. Thereafter, the measurements will be made quarterly.

The proposed frequency of sampling and monitoring will be quarterly during the first two years after completion of the remedial action. The frequency of sampling shall be decreased to semi-annually for the next eight years and once every five years for another 20 years.

Testing

All the groundwater samples collected shall be analyzed for SSIs as presented in Table 3-1 of the QAPP (September 1995).

2.8.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for post-closure monitoring wells.

Drawing No.	Title
594000-30K-01	Master Site Remediation Plan
594000-30K-02 through 05	Site Remediation Plan - Areas 1 through 4
594000-30K-06	APL, NAPL, and Monitoring Wells and Misc. Details

Specification No.	Title
02011	Monitoring Well and Piezometer Installation

2.9 SEDIMENT EXCAVATION

General

The embayment sediments between the line delineating sediments above SSI survey levels (SSI Line) and a line approximately 5 feet inside of the slurry wall will be excavated. Prior to offshore activities a silt curtain will be installed beyond the limit of work along the river channel.

A temporary cofferdam will be constructed in the Niagara River south of the bulkhead location just within the SSI Line. The remedial activities of excavating the embayment sediments and constructing the bulkhead will be protected from the Niagara River by this temporary cofferdam. The cofferdam will also reduce potential inflow/seepage of river water. The area between the cofferdam and the existing shore will be dewatered to the extent needed to allow for sediment excavation and construction of the bulkhead.

The cofferdam will be either of earthen construction, steel sheet piling or Water Structure or a combination of the alternatives. The actual selection will be determined by the Remedial Action Team. Certification of design will be required as a submittal with the bid.

The cofferdam will be a temporary structure and will be removed after the sediments have been excavated and the bulkhead has been constructed.

Sediments lying within areas of elevated chemical concentration are to be excavated to a depth of three feet. Sediments lying within the remaining areas will be excavated to a depth of two feet. Upon completion of the sediment excavation, the area will be backfilled (two feet in areas of elevated chemical concentration and one foot in remaining areas. The backfill will consist of silty sand. Upon placement of the clean fill, vegetation (wild celery) will be planted as outlined in the Habitat Restoration and Enhancement Plan. The sequence for these elements of construction are outline in drawing 594000-10Q-01.

2.9.1 Design Data

Design data for the cofferdam design are presented below. A detailed description of the cofferdam is presented in subsection 2.9.3.1.

Cofferdam - Dimensions

- Crest elevation — 568 feet (10-year flood)
- Length — approximately 1,860 feet

• Allowable Seepage	5,000 gallons per day

Silt Curtain - Dimensions

• Height	3 to 5 feet (varies with water depth)
• Length	approximately 1,900 feet

Silt Curtain - Materials

• Silt curtain	Mirafi 700X, Exxon GTF-400EO, or equivalent

2.9.2 Design Basis/Criteria

2.9.2.1 Design Basis/Criteria - Cofferdam

Specific Criteria

Parameter	Value
Cofferdam stability {minimum factors of safety (F.S.)}	
• End of construction	F.S. = 1.1

General Criteria

The following factors were considered in preparation of cofferdam design.

- The seepage of river water through the alluvial sediments, beneath the cofferdam should be minimized or will be kept separate from sediments above SSI survey levels.

- The construction of the cofferdam in the Niagara River will meet the requirements of the EPA and U.S. Army Corps of Engineers.

2.9.2.2 Design Basis/Criteria - Sediment Excavation

Specific Criteria

Parameter	Value
Soil	Fine sand to silty fine sand
Backfill	Silty sand

2.9.3 Detailed Description

2.9.3.1 Detailed Description - Cofferdam

Water Barrier

A water barrier will be incorporated into the cofferdam design to reduce potential inflow/seepage of river water into the sediment excavation and bulkhead areas. Seepage analysis, refer to Appendix A.7, indicates that if flow paths through the Alluvium are 25 feet to 50 feet in length, the seepage beneath the cofferdam may be 5,000 gallons to 10,000 gallons per day, respectively, for the entire length of the cofferdam.

Silt Curtain/Fish Screen

A silt curtain will be installed in the Niagara River to confine sediment within the project area. The silt curtain will trap sediment migration during construction of the

cofferdam. The curtain will be a geotextile fabric weighed down to be in continuous contact with the river bottom. The curtain will be supported by steel posts driven into the river bottom. The silt curtain will be a Mirafi 700X, Exxon GTF-400E, or equivalent.

The silt curtain/fish screen will be installed within 10 days after the ice is off the river in order to shut off access to potential spawning grounds. The construction sequence includes the earliest possible installation of the silt curtain. Upon completion of the cofferdam and initial de-watering, an assessment will be performed to determine the presence of northern pike or muskellunge within the contained area. Consultation with the on-site Agency representatives will be undertaken to determine whether fish presence is sufficient to require removal and to select the appropriate trapping methods. Typically fish can be trapped or collected using a seine or electr-shock techniques.

2.9.3.2 Detailed Description - Sediment Excavation

Surface water trapped between the cofferdam and shoreline will be decanted to the river based on turbidity. Excavation may be with conventional equipment such as tracked excavators. The sediment will be removed to a depth of approximately two feet. The excavated material will be transported to the designated bermed area

within Area 2, Drawing 594000-10U-06, spread in thin lifts, mixed with fill and compacted.

Based on examination of river embayment sediment samples and review of geotechnical laboratory test data, these sediments consist of fine sand to silty sand, and should dewater under the influence of gravity.

2.9.3.3 Detailed Description - Water Treatment

The RA of the Site requires the removal of embayment sediments and the construction of groundwater collection systems. Water draining from the sediments and some surface water will be treated prior to discharge. An on-site treatment system will be constructed to treat these waters and will include a holding tank, sand filters and a carbon filtration system.

Rainfall surface runoff from the majority of the Site will not come in contact with Site chemicals and only suspended sediment removal is required. This runoff will flow to a sedimentation pond and through a filter curtain into a clear pond. Erosion control measures will be provided on the Site during construction which will reduce the amount of flow and sediment to the sedimentation pond. The contents of the sedimentation pond will be periodically pumped to the Niagara River. All treatment facilities will be used for temporary service since construction is scheduled to be completed in approximately two years. Minimal work will be performed during the winter months and the treatment facility will be shutdown during these periods. Total operating time of the water treatment plant will be approximately 12 months.

A "mud" pump will be placed at the low point within an area isolated by the cofferdam after the surface water has been decanted to transfer the water draining

from the sediment to the holding tank. After allowing for settling, the contents will be tested and discharged to the river or transferred to the water treatment facility depending on the test results. Periodic samples will be collected from the discharge line to the river and analyzed to verify that the desired discharge limits are not being exceeded.

The water treatment system (WTS) consists of a 250,000 gallon decant tank (holding tank), a sand filter and a carbon adsorption system. The holding tank is sized to provide surge volume and equalization for continuous and intermittent (stormwater) flows. The tank will be open top construction with an interior polyethylene liner. Three valved withdrawal points will be provided on the tank at 2, 4 and 6 feet above the bottom of the tank. A bottom drain will also be provided. The inlet to the tank will be located opposite the outlet.

Water from the holding tank will be pumped to the mixed media pressure filter. The filter diameter will be five (5) feet to provide a surface loading rate at average flow of two (2) gpm/square foot. The filter will be backwashed periodically from a filtered water tank. Backwashing will be at a rate of 10 to 15 gpm/square foot.

The carbon system will consist of two five (5)-foot diameter columns in series. No backwashing will be provided for the carbon system. Clean water from the effluent will be discharged to a clear well and then be pumped to the Niagara River.

2.9.4 Reference Drawings and Specifications - Cofferdam

The following tables list the pertinent engineering drawings and specifications for the cofferdam, sediment excavation and water treatment.

Drawing No.	Title
594000-30K-01	Master Site Remediation Plan
594000-30K-03 and 05	Site Remediation Plan - Areas 2 and 4
594000-10S-02	Cap Sections & Details

Specification No.	Title
02200	Earthwork

2.10 42-inch STORM DRAIN

General

A 42-inch diameter reinforced concrete storm drain, owned by the City of Niagara Falls and known as the 100th Street Storm Sewer Outfall, traverses the Site along an alignment from Buffalo Avenue to the Niagara River, where it discharges.

This storm drain outfall will be replaced with a hydraulically equivalent pipeline routed around the eastern boundary of the Site to the river. The existing line will be grouted and abandoned in place.

2.10.1 Design Data

The 42-inch storm drain design is summarized below. A detailed description of the storm drain design is presented in subsection 2.10.3.

Existing Storm Drain

•	Diameter	42-inch diameter (ID)
•	Type	reinforced concrete pipe (RCP)
•	Alignment	per Topographic Maps dated August 7, 1992 prepared by McIntosh & McIntosh and drawings received from City of Niagara Falls, NY.

- Invert (upper) elev. = 563.2
- Invert (lower) elev. = 562.5

Hydraulic Equivalent

Within Buffalo Avenue R.O.W.

- Diameter 54-inches ID
- Type RCP, ASTM C76, Class III
- Alignment Refer to Drawing 594000-30K-04C

Outside of Buffalo Avenue R.O.W.

- Diameter 48-inches ID
- Type HDPE (Spirolite), ASTM F894, Class 40
- Alignment Refer to Drawings 594000-30K-04C & 05C

Abandonment

- Grout lean concrete
- Plug concrete, both end

2.10.2 Design Basis/Criteria

Specific Criteria

Parameter	Value
Storm event	2-year, 24-hour

General Criteria

The following factors were considered in preparation of design for relocation of the 100th Street Storm Sewer Outfall.

- The original as-built vertical alignment of the RCP has not been significantly altered by settlement or subsidence.
- The existing system is undersized based on present design standards and is subject to surcharging during rainfall events and siltation during periods of low flow. The relocated outfall will be hydraulically equivalent to the existing 42-inch outfall line.

2.10.3 Detailed Description

Abandonment

Grouting with lean concrete will start near the existing outfall and proceed toward Buffalo Avenue. Construction quality control will be assured by verifying the volume of grout injected versus the volume of the annular space, every 100-foot of pipe length.

Storm Drain Extension

In order to maintain discharge of the storm sewer into the Niagara River during sediment removal operations, an HDPE line will be extended approximately 220 feet beyond the proposed outfall structure (Refer to drawing 594000-30K-05C). The temporary pipe will be installed to convey any storm water flow until the sediment removal and bulkhead construction are complete.

Headwall

The new headwall will be constructed near the shoreline at the southeast corner of the Site. This headwall will be concrete with a ductile iron flap gate. Refer to Drawing 594000-30K-13 for details of the headwall.

2.10.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for relocation of the 100th Street Storm Sewer Outfall.

Drawing No.	Title
594000-30K-01C	Master Site Remediation Plan
594000-30K-04C & 05C	Site Remediation Plan - Areas 3 and 4
594000-30K-11	Utility Relocation - Section & Details
594000-30K-13	Storm Drainage - Sections & Details
594000-30K-14	Storm Drain - Sections & Details

Specification No.	Title
02110	Clearing and Grubbing
02200	Earthwork
02731	HDPE Pipe
03300	Cast In-Place Concrete
03400	Precast Concrete

2.11 UTILITY RELOCATION

General

Five utilities are currently located along the south side of Buffalo Avenue which are within the proposed limits of remediation activities at the 102nd Street Landfill Site. Relocation of these utilities will eliminate disturbance of the landfill cap and slurry wall, should any of the utilities require future maintenance and/or upgrading.

These utilities are listed below.

Utility	Owner
Two-inch gas line (G)	National Fuel Gas Corp.
Six-inch city water line (W)	City of Niagara Falls, NY
Telephone cable (UT)	New York Telephone
Overhead Power line	Niagara Mohawk Power Corp.
Overhead Cable TV	Niagara Frontier Cable Television

The temporary overhead power cable extends onto the Site. All other utilities are beyond the fence that borders the north perimeter of the Site, and are within the right-of-way of Buffalo Avenue.

The gas and water mains will be relocated to the north of Buffalo Avenue and the existing underground utility lines abandoned in place.

All utility relocations will be designed to meet the requirements of the owning utility. OxyChem/Olin will be responsible for relocation of the water line; however, all of the other utilities will be relocated by the utility owners.

2.11.1 Design Data

Design data for the utility relocation design are presented below. A detailed description of the utility relocation design is presented in subsection 2.11.3.

Utility Owners and data

- Natural Fuel Gas Corp. has completed the rerouting/replacement of the existing two-inch gas line and the subsequent abandonment of the existing two-inch gas line as depicted on the plans.
    - Depth 3 feet
    - Length 550 feet

- New York Telephone, Inc., has abandoned the existing underground telephone cable.
    - Depth 3 feet
    - Length 1770 feet

- New York Telephone, Inc., will relocate the overhead guy wire and utility pole located at the northeast corner of the Site prior to additional remedial activities at the Site.
    - Length 300 feet

- City of Niagara Falls has approved the plans and specifications for the replacement of the existing six-inch water line and the subsequent abandonment of the six-inch water line in place. This work is underway and will be completed in the summer/fall, 1995.
    - Depth 4 feet
    - Length 1780 feet

- The locations of the existing utilities are as depicted on the topographic map (McIntosh & McIntosh, P.C., August, 1992).

2.11.2 Design Basis/Criteria

The utilities will be relocated in kind according to current criteria (capacity), except for the City water line which will be upgraded to an 8-inch line.

2.11.3 Detailed Description

Two-inch Gas Line (G) - Relocation

The gas line has been relocated to along the right-of-way north of Buffalo Avenue as depicted on the drawings.

Two-inch Gas Line (G) - Abandonment

The existing gas line has been abandoned in place.

Eight-inch City Water Line (W) - Relocation

The existing six-inch city water line will be replaced with an eight-inch line and relocated to along the right-of-way north of Buffalo Avenue. The existing fire hydrants will also be replaced with new hydrants located to north of Buffalo Avenue. The relocated eight-inch city water line will be connected to the existing six-inch city water line at the intersection of 102nd Street and Buffalo Avenue. Layout, construction requirements and tie-in locations for the new eight-inch water line will conform to the requirements of the City of Niagara Falls.

Six-inch Water Line (W) - Abandonment

After installation of the new eight-inch city water line, approximately 1,750 feet of the existing six-inch city water line will be abandoned in place.

Telephone Cable (UT) - Relocation

The existing underground telephone service has been replaced by an aerial cable along LaSalle Expressway north of Buffalo Avenue.

Telephone Cable (UT) - Abandonment

The existing underground telephone duct bank/cable has been abandoned in place.

Overhead Guy Wire and Utility Pole - Abandonment/Removal

Approximately 300 feet of the overhead guy wire and a utility guy pole located at the northeast corner of the landfill will be removed prior to removal of the perimeter soils.

2.11.4 Reference Drawings and Specifications

The following tables list the pertinent engineering drawings and specifications for relocation and abandonment of the utilities.

Drawing No.	Title
594000-30K-01A	Master Site Remediation Plan - Utility Relocation
594000-30K-02A through -05A	Site Remediation Plan, Areas 1 through 4
594000-30K-07	Utility Relocation Details
594000-30K-11	Utility Relocation - Section & Details

Specification No.	Title
02200	Earthwork

2.12 SITE ACCESS CONTROL

Access to the Site will be controlled during the remedial action construction and during post-closure. A chain link fence will encircle the Site, along the property line on the north, east and west sides and along the bulkhead on the south side. The

fence will be a standard six-foot high fence. A gated access to the Site, from Buffalo Avenue, will be locked and will permit authorized access. The alignment of the chain link fence is depicted on Drawing 594000-30K-01. Refer to Section 7.0 of this report for a discussion of access control during remedial action construction.

3.0 PERMITTING (STATUS)

The Permitting Plan for the remediation of the 102nd Street Landfill Site, Niagara Falls, NY was submitted to EPA on September 17, 1992. It identifies and presents the schedule for submitting and obtaining permits, approvals, access agreements and notifications necessary for the remediation of this site.

The process of obtaining the permits is in progress.

4.0 CONSTRUCTION SEQUENCING/SCHEDULE

General

Preliminary construction sequencing plan and schedule have been developed and are presented at the end of this section. These documents presented herein will be used as the basis for the Construction Schedule. The Companies will undertake the preparation of the schedule for the completion of the construction activities. The formal detailed project schedule to be followed for implementation of remedial activities will be prepared by the Site Manager in conjunction with input from the Remedial Action Team.

The work is planned to be completed in two stages, essentially corresponding to two work seasons (April through October). The placement of imported non-hazardous material by the Companies is an ongoing activity and spans both stages but generally will follow the sequence presented on Drawing No. 594000-10U-06. Work activities to be completed in each stage are presented on Drawings 594000-10Q-01 and 594000-10Q-02.

Relocation/Abandonment of Public Utilities will be completed by fall, 1995. The installation of the new 8-inch water line is complete.

Verification sampling and testing for establishing the depth of removal of perimeter soils is complete. A report of the analytical result is scheduled to be complete in 1996.

The work activities are listed below in accordance with their general order and stage that the activity will be completed.

4.1 STAGE I - CONSTRUCTION SEQUENCE

1. Install silt curtain/fish screen as soon as ice is off the River.

2. Install security fencing around work zone along construction easement line. Remove existing fencing. Install support facilities including equipment and personnel decontamination facilities.

3. Install silt fence around perimeter of site along limits of earthwork. Construct diversion berm/swale along river bank and construct sedimentation pond, filter trap, and "Clear" pond.

4. Install Water Treatment Facility.

   Note: Activities 1, 2, 3 and 4 may be completed concurrently.

5. Excavate and transport perimeter off-site soils to designated placement cell on the Site. Coordinate backfill of excavation with installation of storm drainage.

6. Install new 54/48-inch storm drain to replace the 100th Street Storm Sewer. Install new storm drainage along Buffalo Avenue.

7. Construct cofferdam in River. Complete the cofferdam in phases with closure legs to shore to allow sediment removal to proceed using smaller work area segments without installation of the total length of cofferdam.

8. Decant surface water from impoundment between cofferdam and shoreline in phases.

9. Excavate sediment from 5 feet inside perimeter slurry wall alignment to contour line of SSIs above survey levels. Sediments lying within areas of elevated chemical concentration are to be excavated to a depth of three feet. Sediments lying within the remaining areas will be excavated to a depth of two feet. Spread sediment in thin layers in bermed cells within Zone 2. Cover/mix with soil or gypsum. Transfer muddy water draining from sediment to holding tank. Treat water and discharge.

10. Construct bulkhead to elevation 570± (Zone 3 - work platform for slurry wall construction) in phases.

11. Remove sections of cofferdam as corresponding sections of the Bulkhead are completed to elevation 570±, and replacement of clean fill (two feet in areas of elevated chemical concentration and one foot in remaining areas).

12. Install APL Collection Trench along shoreline as bulkhead fill is brought above the water level in the river.

13. Extend new 48-inch storm drain beyond cofferdam with 48-inch HDPE.

    Note: The following activities, No. 14, 15 and 16, can be completed concurrently with activities No. 7 through 9.

14. Install onshore sections of perimeter slurry wall and APL collection trench.

15. Install retaining wall along Buffalo Avenue. Place fill and form perimeter berm in Zone 1. Install capping system (liner, drainage zone and vegetation zone) on exterior slope of berm and seed.

16. Install permanent fence along Buffalo Avenue and landfill perimeter.

17. Install offshore section of perimeter slurry wall.

18. Complete Bulkhead to finish grade and place riprap on face.

19. Remove remaining cofferdam section(s) and silt curtain, as necessary. Habitat Restoration (replanting vegetation). Planting of vegetation in embayment may be delayed until the spring season.

4.2 STAGE II - CONSTRUCTION SCHEDULE

1. Complete fill in Zone 2 and begin preparation for capping. Fill work to progress north to south in interior section.

2. Install sediment filter traps (5 locations).

3. Fill in sedimentation pond (Area 4). Continue filling to capping system subgrade from north to south.

4. Complete APL wet wells and piping to Loadout Facility.

5. Complete wet wells and piping to loadout facility.

6. Construct loadout facility.

7. Install main access road to top of aggregate base. (cap must be complete before installation).

8. Install NAPL well access roads and NAPL wells in area after each area is brought to finish subgrade (prior to liner installation) and after primary settlement has occurred.

9. Decommission decon facility and place demolition material on landfill.

10. Finish installation of cap (including seed, fertilize, and mulch).

11. Install post closure monitoring wells/piezometers.

12. Install telephone/instrumentation.

13. Install power feed to loadout facility and APL wells.

14. Pave main access road. Access roads to NAPL wells shall only be paved if system is installed.

15. Demobilization.

6.0 VALUE ENGINEERING

General

During preliminary and intermediate design, the design concepts presented in the Feasibility Study Report (July 1990) and the ROD, were reviewed to evaluate alternative design approaches that could be utilized to enhance the effectiveness of the selected remedy and reduce remedial construction costs. The results of this evaluation are presented below.

APL Collection Trench

Design of the APL collection system considered individual groundwater extraction wells versus a collection trench. Due to the relatively low hydraulic conductivity of the Fill/Alluvium, e.g., 10^{-4} cm/sec, and the small radius of influence for an individual well, up to 50 wells might be needed to create/maintain the inward gradient across the perimeter slurry wall. The collection trench provides a continuous extraction system, along its length. The collection trench is also more reliable, since it is continuous and is inherently redundant. The estimated cost for the collection trench is almost half the estimated cost for the extraction well alternative.

Based on the analyses presented in Appendix A.1, Section 7.0, the length of the APL collection trench was reduced from an original length of approximately 3000

feet to approximately 2300 feet. This provided a reduction in construction costs, while maintaining the effectiveness of the one-foot inward gradient.

Capping System

A comparison was made between a two- to three-foot low permeability clay layer versus a geosynthetic clay liner (GCL) under the geomembrane in the cap. Based on this evaluation, it was determined that the GCL provided superior performance over the compacted clay at comparable or less cost. The GCL is also significantly thinner than the compacted clay, thereby reducing the height of the cap and potential cap settlement. During construction, quality control of the GCL is easier to monitor and maintain. The GCL also has comparable to superior performance as a barrier to infiltrating precipitation. On this basis, the GCL was selected over a compacted clay layer.

Bulkhead

Based on geotechnical data gathered during the predesign field activity (PFA), the slopes of the bulkhead were reduced from about 3H:1V to 2H:1V, while maintaining sufficient factors of safety against failure. This reduced the volume of embankment fill material required and reduced material and construction costs.

7.0 TEMPORARY SUPPORT FACILITIES

The area to the west of the Site will be used for locating Temporary Support Facilities to support the construction activities. Office space will be provided in Trailers for the EPA/State and their overview contractor, the Companies Representatives and the Site Manager. A separate paved entrance and paved parking (30 spaces) will be provided for the these facilities. The area around the trailers will be covered with crushed/washed stone to control mud/dust.

An area will also be set aside for the construction workers. The entrance will be paved for a distance of 100 feet. The remainder of access roads within the area will be gravel/crushed stone surfaced.