Brown and Caldwell

Corrective Measures Implementation
Construction Documentation Report
Ciba Site
Glens Falls, New York

Volume I - Report

October 2004

CORRECTIVE MEASURES IMPLEMENTATION
CONSTRUCTION DOCUMENTATION REPORT
CIBA SITE
GLENS FALLS, NEW YORK

VOLUME I - REPORT

Prepared for:

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and
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Professional Engineer Certification

PROFESSIONAL ENGINEER'S CERTIFICATION
FOR CONSTRUCTION OF THE CORRECTIVE MEASURES
CIBA SITE
GLENS FALLS, NEW YORK

This is to certify that to the best of my knowledge and belief, based on Brown and Caldwell's role (under subcontract to Brown and Caldwell Associates) on the project as described in the project documents and reasonable inquiry of others participating in the project, the construction of the Corrective Measures at the Ciba Site and Areas of Concern associated therewith, in Glen Falls, New York, was completed in accordance with the Drawings and Specifications approved by the New York State Department of Environmental Conservation, as described in the Hazardous Waste Management Permit dated January 6, 1997, modified January 12, 1999 and again modified on December 6, 2000, with changes described herein that do not materially affect the intended function of the design.

(PE Certification is on file in edocs and dated 10/12/2005)

____ _________________________

__________________, P.E. Date
New York P.E. No. ______

EXECUTIVE SUMMARY

This report documents the construction of the Corrective Measures (CM) for the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at the Ciba Site in Glens Falls, New York, including:

Solid Waste Management Units (SWMUs):

(a) Regulated Units - North Lagoon to include north and south waste piles;
(b) Wastewater Treatment - Industrial Sewers;
(c) On-Site Areas - Area North of Delaware and Hudson Railroad Property, and; Area South of Delaware and Hudson Railroad Property.

Areas of Concern (AOCs):

(a) Off-Site Areas – Adjacent Off-Site Surface Water Sediments, and;
(b) On-Site Areas - Soil Underneath Stormwater Impoundment Basin

A Hazardous Waste Management Permit (HWM Permit) was originally issued for the Ciba Site by the New York State Department of Environmental Conservation (NYSDEC), effective September 30, 1991. Modifications were issued to this permit on January 6, 1997 (that selected CM for on-site soils and groundwater) and January 12, 1999 (that selected CM for the Sediments AOC and Adjacent Off-Site Land AOC). It is noted that the Adjacent Off-Site Land AOCs are not discussed in this report, as they were the subject of CM Construction Completion Reports related thereto and submitted to the NYSDEC in February 1999. In January 2002, the NYSDEC extended the HWM Permit, pending completion of the CM construction and submission of required completion documents.

The Final Corrective Measures Design documents were prepared by Brown and Caldwell (BC) in accordance with the terms of the HWM Permit and submitted to the NYSDEC in June 1999. The final design was approved by NYSDEC in September 1999. BC prepared the CM Construction Bid Documents in November 1999, with an Addendum to these documents covering the Ponded & Backwater Area (PBA) in January 2000. The construction contract was awarded to IT Corporation (Contractor) in March 2000.

Construction activities commenced in May 2000. During the CM construction phase, BC provided construction quality assurance (CQA) services and documented the field construction operations.

Synopsis of HWM Permit CM Requirements

Permit Requirement	Related CM Activity	Status
Construct Low Permeability Cap Over CAMU	Constructed RCRA Cap and installed Barrier Wall	Permit Satisfied
Construct Permeable Cover Over SWMUs North and South of Railroad and at the Wastewater Treatment Plant	Demolished specified structures, decommissioned sewerage elements, prepared subgrade, constructed drainage works and installed permeable cover.	Permit Satisfied
Remove Designated Deposits at Riverbank Toe and Stabilize Shoreline	Excavated designated deposits and constructed rip-rap shore protection in specified locations	Permit Satisfied
Remove Designated Deposits in the Ponded & Backwater Area and Backfill with Clean Soil	Excavated designated deposits, backfilled with clean soil, constructed specified drainage works and vegetated surfaces, including wetland areas.	Permit Satisfied
Capture, treat and discharge to the POTW overburden and bedrock groundwater impacted by site contaminants	Installed french drain elements, bedrock extraction wells, forcemains, controls and monitoring equipment as specified, treat as required by the POTW and discharge.	Permit Satisfied
Post-Closure Plan	Developed a post-closure plan, including a groundwater monitoring plan, and submitted to the NYSDEC	Permit Satisfied. CM are now in the O&M phase
Deed Restrictions	Permittee is presently preparing a Deed Notice for submission.	In progress

In November 2001, with roughly 95% of the CM construction essentially complete, the Contractor terminated operations at the Site and, in January 2002, filed for bankruptcy. The Contractor's departure left work to be completed on the startup and troubleshooting of the groundwater extraction systems (GWES), correction of certain punch-list items and the planting of wetland vegetation in the PBA. Following protracted negotiations with the Surety Company holding the Contractor's Performance Bond, the Permittees undertook to complete the outstanding work remaining after departure of the Contractor.

Essential completion of CM construction is deemed to have occurred in August 2004, after the GWES systems became fully operational, punch-list deficiencies were corrected and wetland vegetation planted in the PBA. The project is now considered to have entered the Post-Closure or O&M phase of the CM implementation activities.

1.0 INTRODUCTION

This Corrective Measures Implementation Construction Documentation Report is submitted on behalf of Hercules Incorporated (Hercules) and Ciba Specialty Chemicals Corporation (Ciba) pursuant to the Hazardous Waste Management Permit (HWM Permit) for the Main Plant Site located in the Town of Queensbury, New York (near the City of Glens Falls). The HWM Permit was originally issued by the New York State Department of Environmental Conservation (NYSDEC) with an effective date of September 30, 1991. A Permit Modification was issued on January 6, 1997 to select the Corrective Measures (CM) for on-site soils and groundwater. An additional Permit Modification was issued on January 12, 1999 to select CM for the Sediments Area of Concern (AOC) and Adjacent Off-Site Land AOC. This CM construction completion report includes the following sections:

- Project description including a brief overview of the design components;
- Construction materials and installation;
- Field changes and design changes that occurred;
- Conclusions; and
- References

Corrective Action requirements for Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) are given in Module II of the HWM Permit. The following SWMUs and AOCs are identified in the HWM Permit (Table II-1):

Solid Waste Management Units (SWMUs):

(a) Regulated Units

  (i) North Lagoon to include north and south waste piles

(b) Wastewater Treatment

  (i) Industrial Sewer

  (ii) Pretreatment Plant

(c) On-Site Areas

  (i) Area North of Delaware and Hudson Railroad Property

(ii) Area South of Delaware and Hudson Railroad Property

Areas of Concern (AOCs):

(a) Off-Site Areas

  (i) Adjacent Off-Site Surface Water Sediments

  (ii) Adjacent Off-Site Land

  (iii) Delaware and Hudson Railroad Property

(b) On-Site Areas

  (i) Soil Underneath Stormwater Impoundment Basin

The locations of these SWMUs and AOCs are shown on Drawing 60484-002 of the selected CM Design (Eckenfelder Engineering P.C. – June 1999).

Closure of the "regulated unit" (i.e., the North Lagoon to include north and south waste piles) was accomplished in accordance with 6NYCRR, Subpart 373-2.7 (as cited in Module I of the HWM Permit) by application of a RCRA Cap over the area designated as the Corrective Action Management Unit (CAMU, as defined in the HWM Permit, Module I) and construction of the associated groundwater barrier wall. Areas of the Site outside the limits of the CAMU were not subject to closure, but environmental and human health issues were addressed by implementation of the CM.

Corrective Measures were selected by the NYSDEC for the SWMUs and the On-site AOC, pursuant to the Statement of Basis dated November 5, 1996. Section E.1 of HWM Permit Module II describes the Final Corrective Measures that were implemented for the SWMUs at the Main Plant Site and at the Pretreatment Plant area, as follows:

(a) Construction, operation, and maintenance of a downgradient extraction and treatment system designed to effectively collect contaminated groundwater flowing in the overburden and upper bedrock aquifers (Horizons A and B), at the Main Plant Site with subsequent treatment (as necessary) before discharging to the Glens Falls Publicly Owned Treatment Works (POTW);

(b) Construction and maintenance of permeable covers for the areas north and south of the railroad property at the Main Plant Site;

(c) Construction and maintenance of a low permeability, multi-layered cover consisting of both natural and man-made layered materials placed over the highly contaminated soil/waste material residing in the RCRA Corrective Action Management Unit (CAMU) at the Main Plant Site;

(d) Excavation and removal to the Main Plant Site of contaminated soil at the Pretreatment Plant exceeding cleanup standards;

(e) Implementation of sufficient institutional controls, including deed restrictions (to be prepared after acceptance of CM construction completion by the NYSDEC), that will be protective of human health and the environment; and,

(f) Decommissioning of the Industrial Sewer, except for portions to be used for CM or to be preserved for future use upon redevelopment of the site.

The CM that were implemented for the on-site AOC (Soil Underneath Stormwater Impoundment Basin) are described in Section A.2.(b) of HWM Permit Module II. These measures involve decommissioning the stormwater impoundment basin, removing underlying/adjacent soils, and consolidating excavated soils beneath the Permeable Cover at the Main Plant Site.

Corrective Measures Design and Submittal Requirements were provided in Appendix II-A of the HWM Permit. Institutional controls were described in Section E.2.(e), E.3 and F.1(a)(iii) of Module II of the HWM Permit.

The HWM Permit (page I-1) provided for on-site consolidation of sediments removed from the Adjacent Off-Site Surface Water Sediments AOC (Hudson River, Glens Falls Feeder Canal, Cement Company Pond, and Wetlands West of Main Plant Site). Corrective

Measures were not required for the Glens Falls Feeder Canal in accordance with the Statement of Basis for Off-Site Soil/Sediment/Waste Remediation (NYSDEC, 1999). Corrective Measures for the Hudson River, Cement Company Pond and Wetlands West of Plant Site Sub-Areas of the Sediments AOC were described in Section F.1(a) of Module II of the HWM Permit

Final Corrective Measures were implemented for the Adjacent Off-Site Land AOC in accordance with Section F.1(b) of Module II of the HWM Permit, and involved excavation of soils for on-site consolidation. Implementation of the Corrective Measures is described in the Construction Documentation Report, Corrective Measures Implementation, Adjacent Off-Site Land Area of Concern, Ciba Site, Glens Falls, New York (ECKENFELDER Engineering P.C., February 1999). SWMUs and AOCs remaining after CM for the Adjacent Off-Site Land AOC were affected are the subject of this Report.

2.0 PROJECT DESCRIPTION

2.1 BACKGROUND

The Main Plant Site (MPS) is situated on the north bank of the Hudson River in the Town of Queensbury, New York. The MPS occupies approximately 45 acres. A railroad belonging to the Delaware & Hudson Railway Corp. (Railroad) runs east-west, bisecting the MPS into north and south parts.

The MPS is bordered to the north by the Glens Falls Feeder Canal (Canal), to the west by the Glens Falls Lehigh Cement Company (Cement Company or GFLCC), and to the east by lands now owned by Warren County. A pond (referred to as the Cement Company Pond) and a wetland area (referred to as Wetlands West of Plant Site) are located on the GFLCC property. The Warren County property currently contains a recycling facility and the Warren County Department of Public Works facility. The recycling facility was formerly part of the MPS. Soils removed from this property, as part of a cleanup program prior to transfer of title to the County, were stockpiled on the former Building 41 foundation slab for management during the CM at the MPS.

Other site-related parcels near the MPS include the Pretreatment Plant, North Lot, Sliver Quarry, and Stormwater Impoundment Basin. The Pretreatment Plant and North Lot are located north of the Canal and Lower Warren Street, on the east and west sides of Quaker Road, respectively. The Sliver Quarry is bounded by Lower Warren Street to the north and the Canal to the south. The Stormwater Impoundment Basin was bounded by the Warren County property to the north, east and west, and the Railroad property to the south. These parcels and surrounding features (prior to Corrective Measures) are shown on the CM Design Drawing 60484-002 (Eckenfelder Engineering, P.C. – June 1999).

Topography at the MPS generally slopes towards the south and southeast, towards the Hudson River. Surface elevations range from about +280 at the Canal to about +238 at the crest of the riverbank. The typical river elevation is about +210 (waterline). Elevations used in this report and the accompanying Drawings are in feet and are referenced to National

Geodetic Vertical Datum (1929 NGVD). The railroad embankment is a topographic anomaly, projecting about 10 feet above adjacent grade at the western side of the site and dropping to less than 2 feet above grade at the eastern boundary. Railroad construction (circa 1890) pre-dates industrial development of the site.

Manufacturing activities at the MPS formerly included the production of wallpaper and inorganic pigments. The original topography was modified by excavation and fill deposits associated with construction of manufacturing facilities and site infrastructure, as well as other past plant activities. Demolition of the plant left a surface of construction debris, building foundation slabs and intervening asphalt, gravel, and vegetation. Industrial, sanitary and stormwater sewers and utility conduits that serviced the prior industry remained below grade. Six inactive water supply wells were decommissioned in 1992, as part of Interim Corrective Measures, required by the NYSDEC. Groundwater monitoring wells and piezometers also existed on the site and on adjacent properties. In 1998, several monitoring wells and piezometers (Section 3.11.4) were abandoned as approved by the NYSDEC.

2.2 DESIGN COMPONENTS OVERVIEW

The major Design Components of the approved Corrective Measures Implementation (CMI) are described in the following sub-sections.

2.2.1 Hudson River Deposits Treatment

The Hudson River Deposits element of the CMI included areas along the north shore of the river adjacent to the site and downstream to the Ponded and Backwater Area (Section 2.2.6). This element included an island (located south and east of the former Building No. 45 foundation slab), which is separated from the north shore of the Hudson River by about 30 feet. The Delaware & Hudson Railway Corp. (Railroad) and Niagara Mohawk Power Corporation (NIMO) own portions of the land where deposits were to be removed or where access was required.

CM selected were to excavate the deposits from the riverbanks and to consolidate them onto the MPS. Construction of these CMI consisted of the following major elements:

- Create vehicular access to the river;
- Install sediment controls;
- Perform an initial survey;
- Excavate designated deposits;
- Control the excavation/shore protection limits;
- Dispose of excavated materials upland;
- Perform a post excavation survey;
- Install final shore protection measures; and
- Perform a final survey.

Additional details of the requirements are contained in the Corrective Measures Work Plan, Ponded and Backwater Area, Hudson River Sub-Part, Sediments AOC [Eckenfelder Engineering, P.C., November 2000].

2.2.2 RCRA Cap System

A RCRA Cap was selected as the CM to cover the North Lagoon Area CAMU, which included the North Lagoon, North Waste Pile, South Waste Pile, and approximately 150 feet extending to the eastern property line. Approximately 5 acres of the MPS was covered with the RCRA Cap. Constructing the RCRA Cap CM involved the following major elements:

- Institute measures to control potential releases to air, surface water or off-site soils during material handling and grading;
- Excavate and regrade materials within the RCRA Cap area, as well as deposits removed from the river, to achieve design subgrade elevations;
- Perform a survey of the subgrade prior to RCRA Cap installation;
- Install a groundwater barrier wall along the western side of the cap;
- Construct the RCRA Cap consisting of the following:

1. 12-inch thick cushion layer of granular fill
2. geomembrane (GM) over geosynthetic clay liner (GCL)
3. geocomposite geonet-geotextile drainage layer (GDL) leading to the runoff collection system
4. 18 inches of select fill
5. 6 inches of topsoil
6. Vegetative cover; and

- Perform a final survey.

Additional details of the RCRA Cap CMI elements are contained in the CM Design documents, [Eckenfelder Engineering, P.C., 1999].

Final subgrade surface elevations were field adjusted to accommodate the volume of soil/waste materials derived from the North and South Waste Piles, sludges from the North Lagoon, dewatered sludge from Tank T-110, soils removed from the Pretreatment Plant SWMU, and designated waste deposits excavated from the Hudson River.

2.2.3 Permeable Cover

A Permeable Cover was applied to the SWMUs identified as the Area North of Railroad Property and the Area South of Railroad Property. Together, these SWMUs comprise approximately 40 acres. The Permeable Cover was applied within the boundaries of the SWMUs, which are: the property lines with the Railroad in the interior of the site; the Cement Company or the RCRA Cap limit to the west; the Warren County Property to the east; the Canal to the north; and the ordinary high water mark (OHWM) of the Hudson River to the south. Constructing the Permeable Cover CM involved the following major elements:

- Institute erosion and dust control measures;
- Demolish remnant foundation components that conflicted with planned subgrade elevations;

- Deactivate and demolish the Building 56 GWES and Treatment System;
- Place and grade on-site materials and redeposited materials from other SWMUs/AOCs to achieve subgrade elevations;
- Perform a survey of the subgrade prior to cover installation;
- Construct the Permeable Cover consisting of the following:
  1. 18 inches of compacted select fill in gently sloping areas;
  2. 18 inches of clayey fill placed on the riverbank, in lieu of select fill;
  3. 6 inches of topsoil; and
  4. vegetative cover; and
- Perform a final survey.

Additional details of the Permeable Cover CM are presented in the CM Design documents [Eckenfelder Engineering, P.C., 1999])

2.2.4 Stormwater Management

Stormwater management CM were designed and constructed to accommodate and control stormwater runoff, including water running onto the site from off-site areas (run on) and water draining from on-site areas. Construction of the stormwater management CM included the following major elements:

- Install and maintain erosion and sediment control measures;
- Construct new off site stormwater transition system;
- Decommission Old Weir Brook (OWB) and relocate Weir Brook using a 48-inch diameter HDPE pipe; and
- Construct the on-site surface drainage system (manholes, catchbasins, piping and level spreaders).

The surface drainage system was designed to control erosion and sediment transport, thus protecting the integrity of the vegetative cover and road materials on the Site. This surface drainage system conveys runoff to two level spreaders that discharge, as sheet flow, down the riverbank to the Hudson River.

2.2.5 Groundwater Extraction System

The CM selected for groundwater is containment. The Groundwater Extraction System (GWES) intercepts groundwater in the Overburden and upper Bedrock water-bearing zones (Horizons A and B), where it may contain constituents at concentrations above Groundwater Protection Concentrations (GWPCs). For the Overburden water-bearing zone, the GWES consists of a french drain positioned north of the Hudson River and installed at the base of the zone. For the Bedrock water-bearing zones, the GWES includes and line of 20 extraction wells, intercepting flow in Horizon A and Horizon B, spaced along the southern side of the site, near the river.

Construction of the GWES CM involved the following major elements:

- Excavate along the top of the riverbank and install french drain;
- Install manholes and sumps along french drain system;
- Decommission pre-existing seep pits;
- Install 14 extraction wells with intake ports in Horizon A and 6 extraction wells with intakes in Horizon B, along the top of the riverbank;
- Install forcemain (including air-release chamber/valves) to convey flow for treatment;
- Install a computer system for GWES monitoring (sensors, instruments, transmitters, data cables, computer and monitoring software);
- Develop extraction wells;
- Perform yield tests to estimate the potential groundwater yield from each well;
- Hydraulic fracturing (hydro-fracing) of intake zone for selected extraction wells based on yield tests, to improve yield, and yield testing of these well post-fracturing;

- Install and develop a network of monitoring wells to supplement the existing network;
- Abandon existing designated wells/piezometers.

Additional GWES CM details are presented in the CM Design documents [Eckenfelder Engineering, P.C., 1999]).

2.2.6 Ponded and Backwater Area

The CM selected for the Ponded and Backwater Area is excavation of designated deposits, consolidation of those deposits onto the MPS and backfilling excavated areas with clean soils. The "Ponded and Backwater Area" (PBA) is a part of the Adjacent Surface Water Sediments AOC as shown on the Record Drawings (Thew Assoc. Drawing Nos. CK2509-08-00-10.1 and 10.2). The PBA is located on lands owned by the Railroad and NIMO. Constructing the CM for the PBA included the following major elements:

- Biota transplanting;
- Construction of access roads;
- Clearing and grubbing of areas with materials designated for removal;
- Removal of designated soil and sediment;
- Backfilling excavated areas with clean fill material;
- Protection of the disturbed surfaces and control of migration of resuspended solids or sediments toward the river;
- Transportation and disposal, at the MPS, of the removed, designated soil and sediment;
- Hydro-seeding of upland areas to develop finished erosion control; and
- Implementation of measures to restore and develop wetlands in accordance with the selected CM and requirements of the USACE.

Details of the CM for the PBA are presented in the Corrective Measures Work Plan, Ponded and Backwater Area, Hudson River Sub-Part Sediments AOC, (Eckenfelder Engineering, P.C., November 2000).

2.2.7 Groundwater Pretreatment System and Discharge

Construction of the CM, as designed, resulted in water removed by the GWES being discharged to the City of Glens Falls Publicly Owned Treatment Works (POTW), after pretreatment. Pretreatment consists of equalization in the wet well chamber of the Effluent Pumping Station (EPS). Effluent is pumped to the POTW via a dedicated pipeline. Current criteria applicable to the discharge of site-related waters to the POTW are addressed in the Pretreatment permit (Glens Falls Water & Sewer Board Permit No. 002C – Effective 6/25/01 to 6/24/06). Monitoring and reporting of discharge water quality is performed in accordance with the POTW Permit.

2.2.8 Cement Company Pond Cover

The CM selected for the Cement Company Pond located on the GFLCC property was a crushed stone isolation cover. Constructing of the CM for the Cement Company Pond included the following major elements:

- Installation of temporary influent water diversion and control features;
- Temporary draining of accumulated water in the pond;
- Removal of surface debris (stumps and wood);
- Placement of geotextile and geogrid; and
- Installation of 12 inches of crushed stone on top of geosynthetics layers.

CM details for the Cement Company Pond are presented in the CM Design documents [Eckenfelder Engineering, P.C., 1999]).

2.2.9 Wetland West of MPS Deposits Removal

The CM for the Wetland West of the MPS was removal of designated deposits, consolidation of removed soil onto the MPS and backfilling with clean soil. GLFCC owns this land. Construction of the CM for this wetland area included the following major elements:

- Temporary draining of wetland;
- Pre-excavation survey of this wetland;
- Clearing and grubbing;
- Excavation to designated depth;
- Deposit excavated soils/materials on MPS below Permeable Cover;
- Post-excavation survey of excavated area;
- Backfilling excavated areas with clean fill material and topsoil;
- Finished grade survey of backfilled area; and
- Seeding to develop permanent erosion control surface (grass).

Additional CM details are presented in the CM Design documents (Eckenfelder Engineering, P.C., 1999).

2.2.10 Stormwater Impoundment Basin (SIB) Soil Removal

The CM selected for the SIB were removal of soil deposits and decommissioning. Constructing the CM at the SIB included the following major elements:

- Sampling and testing of water accumulated in the basin;
- Discharge water in the basin to the river;
- Remove fencing to access the basin area;
- Remove and dispose (off-site) of the basin's membrane liner;
- Decommission outlet pipes from the basin to Outfall 103;
- Excavate soil materials around basin to required depth;

- Transport excavated soil to MPS and dispose beneath Permeable Cover;
- Backfill basin area with clean fill;
- Decommission manholes downgradient of the basin, on or leading to Outfall 103; and
- Construct asphalt pavement over the former basin area.

CM details are presented in the CM Design documents (Eckenfelder Engineering, P.C., 1999).

2.2.11 Miscellaneous Components at the MPS

The following miscellaneous components were addressed in support of the CM construction activities:

- Installation of temporary and permanent erosion and sediment control measures e.g., silt fences/curtains, straw bales, surface vegetation (grass, wetland plants), rip-rap, pavement (over the stormwater impoundment area, after it was decommissioned);
- Adapting pre-existing monitoring wells and piezometers to be preserved by adjusting casings to new finished grades, including installing new protective casings and flush-mount completions with concrete pads;
- Decommissioning of monitoring wells and piezometers not required for CM post-closure monitoring;
- Constructing permanent access roads across the northern and southern sections of the MPS for use during the O&M phase to access the permeable cover areas, the RCRA Cap area, the GWES and other components of the CM; and
- Erecting security fencing to control access to the permeable cover areas of the MPS, including gated and locked fencing around the RCRA Cap area.

2.3 PERMITS, APPROVALS RELATED ACTIVITIES

The permits and/or approvals required and obtained for implementation of the CM and CM activities associated therewith are summarized in Table 2.3-1.

Access agreements were established with the GFLCC, Warren County, Railroad and NIMO to conduct CM construction activities on or adjacent to their properties or to traverse the properties for access to other CM work zones (e.g., the Cement Company Pond, Wetland west of MPS, Hudson River and PBA).

2.4 ROLES AND RESPONSIBILITIES OF PARTIES IN CM CONSTRUCTION

Brown and Caldwell Associates (BC) [previously known as Eckenfelder Engineering, P.C.] provided design services to Hercules and Ciba (Permittees), for the Final Corrective Measures Design for the Ciba Site. The final design was selected by the NYSDEC in 1999. Hercules contracted with IT Corporation (IT) to construct the CM in accordance with the design Specifications and Drawings prepared by BC (Final Corrective Measures Design, dated June 1999). IT served as the General Contractor responsible for construction of the CM per the Specifications and Drawings.

IT subcontracted some work to subordinate firms, as follows:

- GWES Computer Monitoring System – AdvanTech, Fairfield, NJ
- Electric, Plumbing and Mechanical – Hour Electric Co., Ft. Edward, NY
- Geosynthetic for RCRA Cap – Solomax, Ontario, Can.
- Surveying - W.J. Rourke Associates, So. Glens Falls, NY
- Surveying - Thew Associates, Canton, NY
- Manhole decommissioning - Kubricky Construction Corp., Glens Falls, NY
- Concrete crushing – Kubricky Construction Corp.
- Sheetpile driving – Kubricky Construction Corp.
- Well Drilling – Layne-Christiansen Co., Schoharie, NY

IT and/or its subcontractors contracted with a variety of vendors/suppliers for construction materials to be used or incorporated in the work.

Hercules retained BC, on behalf of the Permittees, to perform Construction Quality Assurance (CQA) during the CM construction activities. CQA duties included:

- Pre-construction/start-up;
- Submittals review;
- Design interpretation;
- CQA monitoring and record keeping;
- Conduct progress meetings;
- Review of Contractor's Quality Control (CQC) testing;
- Review and documentation of Contractor's progress; and
- Review of Contractor's progress-payment requests.

Copies of daily observation reports describing tasks observed by BC are included in Appendix C.

TABLE 2.3-1
PERMITS, APPROVALS AND RELATED ACTIVITIES

PERMIT or APPROVAL	EFFECT. DATE	ENABLED or AUTHORIZED ACTIVITY	APPLICABLE CM	STATUS
Discharge to Glens Falls POTW Permit Industrial Wastewater Permit No. 002C	June '01 to June '06	Discharges of treated groundwater to the City of Glens Falls POTW. Requires tracking of: Quality Criteria, Volume Limits, Monthly Reporting.	Weekly Sampling & Testing Totalizing Flow Meters with Daily Monitoring Submission of Monthly Compliance Reports	Actively in Compliance
Article 27, Title 9; 6NYCRR 373: Hazardous Waste Management Permit (5-5234-00008/00096)	9/30/91; Modified 1/6/97; Modified 1/12/99; Modified 12/11/00; Renewal applied for 7/9/01 and is pending.	Post-closure care of the North Lagoon, a closing hazardous waste facility (includes SWMUs and AOCs)	Investigations, evaluations and preparation of Final Corrective Measures (CM) Designs for the North Lagoon, SWMUs and AOCs. Construction of NYSDEC selected CM for the North Lagoon, SWMUs and AOCs. Preparation and submission of CM Construction Completion Report and Certification. Long-term O&M of the Corrective Measures. Continued implementation of the Groundwater Monitoring Plan	CM Designs selected and approved by NYSDEC. CM construction completed. CM completion reports and certification submitted. O&M phase initiated.
SPDES Discharges to Surface Water Permit for point source discharges at the Main Plant Site (No. 0005321)	1984	Discharge of storm runoff and emergency overflow from groundwater seeps and industrial sewer lift station to the Hudson River; includes Outfalls 103, 105, 107, 108, 116 & 117.	Decommissioned each of the point sources (outfalls) originating on the site.	Point source discharges covered by the Permit are decommissioned. Permittee plans to apply to NYSDEC to terminate this SPDES Permit.

TABLE 2.3-1
PERMITS, APPROVALS AND RELATED ACTIVITIES

PERMIT or APPROVAL	EFFECT. DATE	ENABLED or AUTHORIZED ACTIVITY	APPLICABLE CM	STATUS
NYSDEC General SPDES Permit: Permit for Stormwater Discharge Associated with Construction Activity (No. GP-93-06)	8/13/98	CM construction activities that cause soil disturbance provided such work is done in accordance with a Soil Erosion & Sediment Control (SESC) Plan that is compliant with a Stormwater Pollution Prevention Plan (SPPP) for the site.	Permittee submitted application for the SPDES General Permit, accompanied by requisite SPPP. Contractor submitted an SESC Plan conforming to the requirements of the selected CM Design and the SPPP accepted by the NYSDEC with the issuance of the GP-93-06. During the earthwork, erosion and sediment control measures were successfully implemented in accordance with that SESC Plan.	CM construction was completed and the temporary SESC measures related to the GP-93-06 were removed. Permanent SESC measures, conforming to the CM Design, were constructed, are being maintained and will be addressed in O&M reports to the NYSDEC.
Protection of Waters Permit and Section 401 Water Quality Certification	1/12/99 Reissued 12/6/00	Program is administered by NYSDEC and regulates activities that occur in or near protected, navigable waters. Any change, disturbance, modification, excavation or placement of fill in any navigable waters of the State or in wetlands that are adjacent to any navigable waters of the State requires a permit in accordance with 6NYCRR Part 608.	CM construction activities in the Hudson River and the Ponded & Backwater Area that caused disturbance of soil in the water bodies, wetland and upland portions of those areas. Performed work in accordance with an SESC Plan and the SPPP accepted by the NYSDEC with the issuance of the GP-93-06. During the earthwork activities, erosion and sediment control measures were implemented in accordance with that SESC Plan.	CM construction was completed and the temporary SESC measures related to the GP-93-06 were removed. Permanent SESC measures, conforming to the CM Design, were constructed, are being maintained and will be addressed in O&M reports to the NYSDEC.

TABLE 2.3-1
PERMITS, APPROVALS AND RELATED ACTIVITIES

PERMIT or APPROVAL	EFFECT. DATE	ENABLED or AUTHORIZED ACTIVITY	APPLICABLE CM	STATUS
U.S. Army Corps of Engineers (USACE) Nationwide General Permit (NWP) No. 38 Permit #2000-00587-YN. Enforcement Case No. 2004-071	7/6/99 for river deposits removal; 6/12/01 for PBA deposits removal. 6/16/04 Order to Remediate	Activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials ordered by a government agency, including: disturbance, alteration and mitigation of wetland areas within the Waters of the United States, specifically in the Hudson River and PBA.	Removed designated deposits, backfilled and graded the impacted areas with specified fill materials and constructed shoreline protection (rip-rap) consistent with the CM Designs. Grading of the PBA was performed such that additional wetland area was created, as required by the USACE. Implemented wetland mitigation requirements of the USACE with the planting of wetland areas of the PBA with vegetation species approved by the USACE.	CM construction is complete and the care of the shoreline protection and PBA is now in the O&M phase. Annual reporting to the USACE will be performed in accordance with regulations.
Soil Erosion and Sediment Control Plan	3/99	Construction activities if greater than 100 cubic yards of rock, soil, or vegetation is to be excavated. Activities to be done in accordance with GP-93-06 with construction of permanent erosion control devices in accordance with the Stormwater Pollution Prevention Plan (SPPP) for the site.	Submitted an SESC Plan conforming to the requirements of the selected CM Design, the SPPP and GP-93-06. During the earthwork operations, erosion and sediment control measures were implemented in accordance with that SESC Plan. Permanent erosion controls consisting of perennial grass, dense graded aggregate roadways, rip-rap and stormwater drainage structures (swales, piping, manholes and level spreaders) were constructed in accordance with the selected CM Design.	CM construction was completed and temporary SESC measures were removed. Permanent SESC measures were constructed, are being maintained and will be addressed in O&M reports to the NYSDEC.

TABLE 2.3-1
PERMITS, APPROVALS AND RELATED ACTIVITIES

PERMIT or APPROVAL	EFFECT. DATE	ENABLED or AUTHORIZED ACTIVITY	APPLICABLE CM	STATUS
State Environmental Quality Review Act	9/16/98	The CM activities at this site are considered "unlisted" and, therefore, required submission of the Short Environmental Assessment Form.	In accordance with 6 NYCRR 617, this form was submitted to NYSDEC as part of the Joint Application for the Nationwide 38 Permit (8/14/98) and the application for Protection of Waters Permit.	Based on the submitted form the NYSDEC determined (9/16/98) that a draft environmental impact statement was not required
State Historic Preservation Act	9/16/98	A Structural Archaeological Assessment Form (SAAF) was required to be submitted to NYSDEC along with the Joint Application for the Nationwide 38 Permit.	The SAAF was submitted along with the Joint Application on August 14, 1998.	NYSDEC – Environmental Permits confirmed (9/16/98) that there are no historic areas affected by CM construction.
Canal Work Permit		A work permit is required for construction work that extends onto Canal property	Work permits were obtained during the design investigation phases of the project, in order to access the canal property as part of the studies. CM construction operation did not have to be performed on canal property, thus, a Canal Work Permit was not needed.	Permits associated with the investigations have expired.

3.0 CONSTRUCTION MATERIALS AND INSTALLATION

3.1 HUDSON RIVER DEPOSITS

3.1.1 Access to Work Area (Hudson River Sub-Area of the Sediments AOC)

An existing boat ramp in the MPS was widened, improved and, as necessary, realigned to provide access for the equipment used to remove the designated deposits along the river. Near the toe of the riverbank, the access road was extended east and west to provide a path for the excavation equipment. Near the eastern end, the access road was built out into a narrow channel separating the toe of the slope from a small island (consistent with the CM Design drawings). East of the island, the access road was realigned along the toe of the riverbank slope, not on the island. The width of the access road in the river was approximately 16 feet. Top elevation of the access road in the channel was about Elev. +212, or about 1.5 feet above the typical high-water level at the time the work was undertaken. The upland portion of the temporary access road was constructed of crushed stone. Those portions of the road in the channel were constructed using rip-rap, which was later used in constructing the shoreline protection. The ramp and road were removed after work in the river was completed.

The access road advanced eastward as the designated deposits were removed. Record drawings show the access road, bathymetry, and location of the deposits that were excavated (Rourke Assoc. drawings entitled “Ciba/Bath” [bathymetry], Sheets 1 through 7 and Thew Assoc. dwg. nos. CK2509-08-00-15.1 & 15.2).

3.1.2 Turbidity Controls and Monitoring

A Materials Removal and Rip-Rap Placement Plan describing the sediment control measures (materials and procedures) for work in the Hudson River Sub-Area was prepared consistent with specification requirements. Sediment curtain containment barriers (manufactured by Brockton Equipment/Spilldam, Inc.) were deployed in the river around each active removal area. Silt curtains were deployed in heights ranging from 8 to 16 feet, with a floatation element at the top. The height of the curtains deployed depended on river bottom topography and anticipated changes in the river level. Sections of curtains (each about 50 feet long) were linked together to form continuous units ranging in length from about 150 to 400 feet, as needed to enclose a work area. Assembled strings of silt curtains were towed into position using a small powerboat. Many curtains were replaced after being torn by wood slash or other debris on the river bottom. The sediment curtains were anchored at the shoreline on the upstream side and, extended offshore a sufficient distance to complete the work. Offshore distances were sufficient to enclose the excavation equipment, the limits of the deposits to be removed and to dissipate waves from excavation activities. Some curtain deployment and securing difficulties were encountered at the start of the work. When necessary, curtains were re-deployed and re-secured. In some instances, a second line of turbidity curtains were deployed. River work was coordinated with Orion Holdings (an upstream power company). When practicable, work on the river was scheduled to coincide with low discharge from upstream flow-control dams. This coordination helped to reduce water depths and current velocities and to facilitate deploying and anchoring the sediment curtains while removal work was conducted on the river. .

For the channel between the riverbank and the island (Section 3.1.1), turbidity was controlled by constructing rip-rap berms at each end of the channel and securing sediment curtains on the exposed faces of each berm. These berms and sediment curtains help to reduce the flow velocity through the channel and facilitated containment of turbidity during work in the channel.

Straw-bales were installed as sediment and erosion control barriers to control run on from upland areas in accordance with Specification Section 02931 and the Materials Removal and Rip-Rap Placement Plan. These sediment controls intercepted run on from upland areas, filtered soil-fines that may have been present, and acted as a velocity-break for water entering the disturbed area of the riverbank. These sediment controls were advanced sequentially as the waste excavation progressed from area to area.

Visual monitoring of turbidity was conducted in the river outside each work area in accordance with the Materials Removal and Rip-Rap Placement Plan. Excavation was stopped, pursuant to the Protection of Waters (POW) Permit, when turbidity outside the confined work area exhibited "substantial visible contrast to the natural condition, or results in a deposition of settleable solids". There were some occasions when water currents and/or river levels breached the silt curtains. However, such events were infrequent and, when they did occur, work was suspended until the sediment curtains were re-deployed and turbidity was brought under control in accordance with the POW Permit. Occasionally a secondary line of sediment curtains was deployed, outside the original line, to enhance turbidity control.

3.1.3 Initial Topography Survey

The initial topographic and bathymetric surveys were conducted by W.J. Rourke Associates. The initial survey shows the work area and adjacent areas of the riverbanks and riverbed. With the minor exceptions noted in Section 4, the survey was performed to the requirements of the Specifications. The pre-excavation topographic/bathymetric survey maps are included with the Record Drawings: (Rourke Associates drawing "Ciba/Bath" [bathymetry before excavation], Sheets 1 through 7).

3.1.4 Excavation and Disposal of Deposits

Designated deposits were excavated from the riverbank and near-shore areas working generally from west to east (i.e., in the downstream direction). A trackhoe was used to excavate the deposits. The trackhoe operated from the access road (Section 3.1.1). During excavation, free water was drained near the place where the deposits were excavated. Removed material was loaded directly into off-road dump trucks and hauled to RCRA Cap Area (Section 3.2).

Limits of the designated deposits were established in the field based on the CM Design Drawings and field observations of excavated materials and exposed surfaces. Due to the distinctive color and texture of the deposits designated for removal, visual control of removal limits was effective and thorough. The estimated quantity of deposits to be removed from the shoreline in the river (exclusive of the Ponded & Backwater Area) was

12,000 c.y. (CM design). By the Contractor's truck-count, the quantity of deposits removed is estimated to be between 11,500 and 12,000 c.y.

3.1.5 Post-Excavation Survey

Post-excavation topographic and bathymetric surveys of each work area were performed. Two surveyors were involved in the post-excavation surveying. These were the original surveyor, W. J. Rourke Associates and, their replacement, Thew Associates. The Record Drawings bear the title block and seal of the surveyor-of-record that performed the work. With the minor exception discussed in Section 4, the surveys were performed to the requirements of the Specifications. Applicable drawings are as follows:

- Rourke Assoc. dwg. "Ciba/Bath-Exc" [bathymetry after excavation], Sheets 1 through 7; and
- Thew Assoc. dwg. nos. CK2509-08-00-15.1 & 15.2.

3.1.6 Geotextile and Rip-Rap Installation

After excavating and surveying were completed, soil portions of the riverbank areas were covered with a geotextile, followed by a protective layer of erosion-resistant rip-rap. Where bedrock was exposed at the excavation limit, geotextile was not installed. The following materials were used:

- Geotextile: non-woven, continuous filament fabric, weighing 6 oz./s.f. and having an Apparent Opening Size (AOS) of 100, in compliance with the Specification Section 02200;
- Rip-rap: a mixture of hard, durable, angular stone particles, with a maximum particle size of 12 inches and a D_{50} = 6 inches (size which at least 50 percent of stones by weight are greater than), in accordance with the Specification Section 02200.

Disturbed areas of the riverbank toe and riverbed were covered with rip-rap in a layer having a minimum thickness of 2 feet. Rip-rap shore protection extended to or above the Ordinary High Water Mark (OHWM; approximate elevation +210, as defined by the USACE) on the island shoreline and to Elev. +215 along the toe of the riverbank at the north shore of the river.

After designated deposits were removed from the channel area, the access road was removed and rock was re-used as rip-rap along the riverbanks. In this manner, the access road was removed as the permanent shore protection was installed. In accordance with the selected CM, excess rip-rap (less than 1-foot in thickness) was left on the riverbed in the channel area, below the waterline.

3.1.7 Final Survey

A final topographic and bathymetric survey was performed after the shoreline was restored and the temporary construction elements were removed. With the minor exceptions discussed in Section 4, the final survey was performed to the requirements of the specifications. Final survey maps are shown on the following Record Drawings:

- Rourke Assoc. dwg. "Ciba/Bath-RR" [after rip-rap placement], Sheets 1 through 7
- Thew Assoc. dwg. nos. CK2509-08-00-15.1 & 15.2.

3.2 RCRA CAP SYSTEM

3.2.1 Primary Construction Elements

The RCRA Cap extends over the area formerly containing the North Lagoon Area CAMU, which included the North Lagoon, North Waste Pile, South Waste Pile, and approximately 150 feet of property to the east. The RCRA cap covers approximately 5 acres of the MPS. The subgrade for the cap includes: material re-graded from the North and South Waste Piles, sludge from the North Lagoon, sludge dewatered from Tank T-110, soils removed from the Pretreatment Plant SWMU, designated deposits excavated along the riverbank and existing surface soils. Consistent with the CM Design, the cap is comprised of the following major elements:

- Cushion soil Layer;
- Geosynthetic Clay Layer
- Geomembrane;
- Geosynthetic Drainage Layer;
- Protective Soil Layer; and
- Vegetation Support Layer.

Steel sheetpiles were installed as a groundwater barrier wall along the western side of the RCRA Cap to limit potential groundwater migration toward the Cement Company Pond. While not a part of the RCRA Cap, the barrier wall is included in this section.

3.2.2 Materials Used in Construction of RCRA Cap System

3.2.2.1 Sheet-Pile Barrier Wall.

- Steel sheetpiles: ProfilARBED AZ® steel sheetpile section.
- ROXAN Sealant System®. The sealant system uses Adeka P-201, a mono-component mastic made from urethane pre-polymers.

These sheet-pile sections have proprietary interlocking joints. Sealant is injected into the female joint to partially fill the interlock in each sheetpile. When exposed to water, the sealant expands to fill the joint with a material having a permeability, as reported by the manufacturer, of about $3x10^{-7}$ cm/sec.

To facilitate installation, pairs of sheetpiles were joined and the common interlock was welded to form a sheetpile pair. Sheetpile pairs were driven using a vibratory drive hammer, free-hanging from the crane. A total of 224 individual sheetpiles (welded into pairs) were driven to form a barrier wall 464 feet long. Sheetpile pairs were driven to refusal (concluded to be bedrock), with driven-lengths ranging from 11 to 20 feet. The location and profiles (top and bottom) of the barrier wall are shown on the Record Drawings (Rourke Assoc. dwg. no. ASB-23).

3.2.2.2 Subgrade – Waste Materials. Standing water from the North Lagoon was drained and pumped to the on-site Pretreatment Plant for processing and discharge to the POTW. The North Lagoon overflow system and underdrains were decommissioned in accordance with Specification Section 02060.

Sludge materials in the lagoon and from Tank T-110 (at the on-site Pretreatment plant) were blended with soil/waste material from the North and South Waste Piles, which were of a lower moisture content, to achieve mechanical strength properties to support construction of the cap components. Designated deposits excavated from the Hudson River were also blended and used as subgrade for the cap. Blended materials were graded and densified in the cap area to reduce post-construction settlement and to form a stable subgrade for the cap. Free-water and/or runoff was collected and pumped to the on-site pretreatment plant in accordance with Specification Section 02228.

The limits and contours of the cap subgrade are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-1.1).

3.2.2.3 Cushion Soil Layer. A cushion soil layer was installed as the lowest layer of the RCRA Cap. It consisted of:

- Sandy fill material; minimum 12-inches in thickness, meeting the requirements of Specification Section 02200 and NYSDOT § 2.03-2.02E, (with the added restriction that the maximum particle size was limited to one inch, to protect the overlying geosynthetics layer).

Throughout the work, cushion soil was imported from an off-site source operated by Jointa Galusha, a local supplier of borrow materials. Laboratory test data (Appendix E) demonstrated that the material complied with the specified requirements. Cushion soil was placed over the subgrade (Section 3.2.2.2), where the cap was to be installed. The subgrade and cushion soil was inspected and certified by the installer of the geosynthetic components.

The limits and contours of the Cushion Soil Layer are shown in the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-4.0).

3.2.2.4 Geosynthetic Layers. Geosynthetics were installed by Solmax Geosynthetics, Inc (Ontario, Canada). Installation and quality control activities are described in a separate report "Report of Quality Control Procedures conducted on Site By Solmax Geosynthetics Inc.", prepared by Solmax Geosynthetics, Inc., dated October 2001 (Appendix F).

In accordance with the selected CM Design and Specification Section 02233, geosynthetic components of the Cap are as follows (in ascending order):

- Geosynthetic clay liner (GCL): GCL was manufactured by Bentofix Technologies, Inc., supplied by the Contractor and installed by Solmax Geosynthetics (Solmax).

- Geomembrane (GM): GM installed is 40 mil, Linear Low-Density Polyethylene (LLDPE) geomembrane, manufactured by Solmax International, Inc. (Quebec, Canada). Smooth LLDPE GM was installed on the gently sloping top surface of the RCRA Cap area and textured LLDPE GM was installed on the more steeply sloping (i.e., 4 horizontal to 1 vertical, or steeper) sides of the cap area.

- Geosynthetic drainage layer (GDL): GDL selected for this project is TENDRAIN™ 70-2 Double Sided Drainage Composite (a tri-planer geonet structure), manufactured by TENAX Corp. (Baltimore, MD).

TRI/Environmental, Inc. (Austin TX) conducted interface friction angle testing of pre-construction geosynthetic and soil components for the cap in accordance with Specification Section 02233. These test results (Appendix F) verified that interface friction angles complied with the specified values.

Geosynthetic Clay Liner

The manufacturer submitted quality control test data before the GCL material was delivered to the site. Test results demonstrated that the material conformed to the requirements of Specification Section 02233.

A representative of Solmax inspected the subgrade in the cap area and verified that 100% of the subgrade was suitable for placement of the GCL. Installation of the GCL began at the northwestern corner of the cap area and progressed southward (along the west slope of the cap), then eastward along the slope bordering the Glens Falls Feeder Canal property, then southward and eastward until the entire cap area was covered. Panels were installed in accordance with a Panel Drawing and were accepted by the CQA team. Adjacent panels were overlapped by 12 inches and a continuous bead of granular bentonite was applied to the edge of the underlying panel. On side slopes of the cap, seams were constructed perpendicular to the slope. Approximately 225,635 square feet (s.f.) of GCL were installed.

Geomembrane

The GM was placed over the GCL and seamed, such that at the end of each day, the GM protected the GCL from precipitation. Installation the GM panels followed the same pattern and sequence as the GCL. Prior to installation of GM at the site, trial seam-welding tests were performed by Solmax to calibrate welding equipment used to install the GM. Peel adhesion and shear strength tests were conducted on specimens of welded seams for evaluation of seam-welding techniques and comparison of seam strength/adhesion characteristics with requirements stated in Specification Section 02233. Trial tests were performed each day the GM seaming took place, at a frequency consistent with that specification. Approximately 225,635 s.f. of GM were installed.

During installation and seaming of the GM, the continuity of all seams was verified by non-destructive testing procedures. Air-pressure tests or vacuum-box tests were performed in accordance with Specification Section 02233. Each seam passed the non-destructive testing (Appendix F).

Geocomposite Drainage Layer

A GDL was constructed above the GM and consisted of a composite geonet-geotextile (i.e., geonet with non-woven geotextile heat-bonded to both sides). The GDL provides a pathway that promotes drainage of percolating surface water (from precipitation, snow or frost melt, etc.) and enhances stability. This GDL meets or exceeds the transmissivity, strength and other performance requirements stated in Specification Section 02233. Solmax installed the GDL. The GDL panels were installed in the same pattern and sequence as the GCL and GM.

As each GDL panel was installed, the geonet components of adjoining panels were overlapped by 3 to 5 inches and tied with plastic cable ties at intervals defined in Specification Section 02233. The geotextile components of adjoining GDL panels were overlapped by approximately 3 to 5 inches and thermally bonded (Appendix F). About 225,635 s.f. of GDL were installed.

Geosynthetics Anchor Trench

The geosynthetic components (i.e., GCL, GM and GDL) were terminated on all four sides in anchor trenches. These anchor trenches were constructed to dimensions and configuration equal to or greater than specified in the CM Design. Approximately 2 to 3 feet of the edge of the geosynthetics were extended into the trench (down one side and across the bottom) and the trench was backfilled with the material used for the Cushion Soil layer (Section 3.2.2.3). The geosynthetic components were anchored in this manner to secure the components and reduce the potential for excessive displacement during construction of overlying soil elements of the RCRA Cap.

Cap Drainage Components

The surface of the Cushion Soil layer was graded to create v-shaped swales, along drainage paths, in the geosynthetic material overlying that soil. These swales are situated at the toe of the east, south and west side slopes of the cap. Another swale bisects the gently sloping, plateau-like area of the cap. The latter swale slopes downward generally from west to east. At the inverts of each swale, above the geosynthetic components of the cap, perforated HDPE drainage pipes (6-inch diameter) were installed. These drainage pipes are surrounded by a 6-inch layer of Crushed Stone (per Specification Section 02200), which is wrapped in a geotextile (consistent with the CM Drawings and Specification Section 02200). The GDL drains into these pipes. These cap drainage pipes convey percolation water above the GM to a surface outlet at the southeast corner of the RCRA Cap area. The locations of these drainage features are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-4.0).

3.2.2.5 Select Fill Layer. A protective layer of Select Fill, 18 inches thick, was placed, graded and compacted above the geosynthetic components. Select Fill was supplied by Jointa Galusha. Geotechnical test results (Appendix E) show that the select fill conformed to Specification Section 02200. During the placement of this layer, no construction equipment was allowed above the geosynthetics until at least 12 inches of soil separated the equipment from the geosynthetics. Then, only low ground pressure (LGP) grading equipment was allowed to spread and compact the protective fill layer.

3.2.2.6 Topsoil Layer. A layer of topsoil, 6 inches in thickness, was installed and graded above the Select Fill layer. This topsoil layer provides suitable media to develop and sustain vegetation. In accordance with Specification Section 02200, this vegetative support soil layer (topsoil) is as follows:

- Topsoil – loam type soil, free of deleterious material and conforming to the material requirement of NSYDOT œ 713.01.

Certificates of clean fill (Appendix D) and laboratory geotechnical test results (Appendix E) were submitted for this material. Results indicated the soil complied with the specified criteria and it was accepted for use at the site. Topsoil was supplied by Jointa Galusha.

3.2.2.7 Vegetative Cover. A vegetative cover was developed to stabilize the surface of the topsoil layer against erosion by water and wind and to protect the underlying soil components in accordance with the approved CM and Soil Erosion and Sediment Control Plan. The vegetative support layer was seeded with moderately deep-rooted plants (i.e., grasses). Fertilizing and seeding were performed in accordance with New York Guidelines for Urban Erosion and Sediment Control and Specification Section 02925. Hydroseeding methods were used to apply the seed. The hydroseed mix applied to topsoil conformed to the following:

Components	Application Rate
Wood Fiber Cellulose	2,000 lbs/acre
Fertilizer 5-10-10	600 lbs/acre
Seed Mixture	33 lbs/acre
	2,633 lbs/acre

The seed mixture consisted of the following:

Common White Clover	25%
Tall Fescue	60%
Perennial Ryegrass	15%

The seeded areas were watered when necessary until a healthy, uniform growth was established over the RCRA Cap area.

3.2.2.8 Cap Drainage. The surface of the cap was graded to direct runoff as overland (sheet) flow to the adjacent GLFCC pond on the west, and to drainage swales on the south and east sides. The swale south of the cap is graded to flow to the east. The swale east of the cap is graded to flow to the south. At the confluence of these swales, runoff is directed into a larger drainage swale in the Permeable Cover Area. Ultimately, the runoff is directed toward the East Level Spreader (Section 3.4.2.3), which discharges to the Hudson River. The surface runoff swales associated with the RCRA Cap are grass-lined, sized and sloped in conformance with the CM Design documents. These features are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 & 4.0).

Percolating water in the RCRA Cap area, drains down to the GDL component of the geosynthetics layer, then laterally to the perforated drainage collection pipes (Section 3.2.2.4). These Cap Drainage Components are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-4.0). These subsurface drainage pipes are sloped to drain to the south and east and to discharge where the surface drainage swales converge from the east and south sides of the cap. At the confluence of the surface and subsurface drainage elements from the RCRA Cap, the receiving swale (in the Permeable Cover Area) is protected from erosion by a rip-rap layer (D_{50} = 6 inches), 12 inches in thickness, in accordance with the CM Design.

3.3 PERMEABLE COVER AREA

3.3.1 Primary Construction Elements

Permeable Cover was applied to the SWMUs at the MPS (Section 2.2.3) in accordance with the CM design. The primary construction components for the Permeable Cover included the following:

- Subgrade preparation – clearing and grubbing; demolishing designated structures; demolishing the Building 56 GWES and treatment system; decommissioning manholes and catchbasins for the stormwater, industrial and sanitary sewers; and, regrading near surface soil and other materials to approximate the subgrade topography;
- Surface drainage features and structures;
- Select Fill and Clayey Fill;

- Topsoil (vegetation support) layer;
- Vegetation for long-term erosion control; and
- Rip-rap erosion protection at the toe of the riverbank.

3.3.2 Materials Used in Construction of Permeable Cover

3.3.2.1 Subgrade Preparation. Subgrade materials used in the Permeable Cover Area (PCA) were derived from existing materials within that area, plus about 15,000 c.y. of soil excavated from the PBA (Section 3.6).

Trees, brush and other growth were cleared and grubbed within the limits of the PCA in accordance with the CM Design. Most of these plant materials were chipped. Large tree stumps were shredded using a tub-grinder. The wood chips and shredded stumps were mixed with on-site rubble and soil materials for use in the subgrade.

Remnants of former concrete structures (e.g., walls, floors, piers and similar items) that interfered with the subgrade topography were removed to below the subgrade level (using bulldozers, track hoes, jackhammers, or other method). Concrete and other masonry products derived from this operation were processed through a portable on-site crusher that reduced the particle sizes to 6" or less. Crushed concrete and masonry were disbursed among the soil and other on-site materials being redistributed to achieve the subgrade topography in the CM Design. Three former building floor slabs (former Buildings 41, 45 and 56 with reinforced concrete, and drilled-pier foundation support) were to remain as part of the PCA in accordance with the CM Design.

Approximately 153 manholes/catchbasins were decommissioned in accordance with the CM Design documents or as identified during CM construction. These manholes (MH) and catchbasins (CB) were part of the now-inactive stormwater and industrial/sanitary sewer systems. To avoid the potential risks associated with confined space entry, each MH/CB was decommissioned by pouring stiff (low slump) concrete 6 to 12 inches above the crown of the highest pipe. The MHs/CBs were successfully decommissioned. High parts of a

MH/CB that projected above the planned subgrade level were demolished below the level for the subgrade.

The subgrade topography illustrated on the CM Design drawings reflected a balance of cuts and fills in the PCA. Earthwork operations in the PCA started south of the railroad and progressed from west to east. It began with laying-back the riverbank slope to 2.5 horizontal to 1 vertical, as called for in the CM Design. Soil and other material generated by cutting the riverbank were used to fill low areas of the PCA south of the railroad. As the riverbank was regraded, construction proceeded on the French Drain. In addition, designated deposits at the toe of the riverbank were removed (Section 3.1.4). Soil and other material excavated from the French Drain trench, not used as trench backfill, were also used as subgrade fill in the PCA south of the railroad. About half of the soil stockpiled on the floor slab for former Building 41 was used as subgrade fill for the area south of the railroad.

Subgrade preparation for the PCA north of the railroad also progressed from west to east. Subgrade was achieved by regrading soil, crushed masonry and other materials within the area north of the railroad, reusing about half of the soil stockpiled on the slab for former Building No. 41 and distribution of about 15,000 c.y. of soil/designated deposits excavated from the PBA (Section 3.6).

Surface drainage swales were shaped to the approximate locations, configurations and slopes called for in the CM Design. The topography of the completed subgrade in the PCA is presented in the Record Drawings (Thew Assoc. Dwg. nos. CK2509-08-00-1.1 through 1.4). These contours reasonably approximate the subgrade contours illustrated in the approved CM Design.

3.3.2.2 Select Fill and Clayey Fill Layers. As required by the CM Design and Specification Section 02200, the cover material over the subgrade in the PCA is one of two types, depending on location.

- Select Fill - sand to silty-sand soil, supplied by Jointa Galusha (a local soil source/broker). The Contractor submitted clean fill certificates (Appendix D) and laboratory geotechnical test results (see Appendix E) for samples of this material. Results indicated the soil complied with the specified criteria and it was accepted for use at the site. Periodic laboratory testing was performed as Select Fill was brought to the site, consistent with the Specifications to verify its continued compliance.

- Clayey Fill - clayey sand to silty sand soil, supplied by Jointa Galusha. Clean fill certificates (Appendix D) and laboratory geotechnical test results (Appendix E) for samples of this material were submitted. Results indicated compliance with the specified criteria and the fill was accepted for use. Laboratory testing was repeated as the Clayey Fill was brought to the site, consistent with the Specifications to verify its continued compliance.

Except along the riverbank slope, the PCA subgrade was covered with 18 inches of Select Fill. Select Fill was placed in layers and compacted using a vibratory drum compactor. Atlantic Testing, Inc. performed field density testing of the compacted Select Fill and verified compliance with Specification Section 02200.

Clayey Fill was placed as the subgrade cover on the riverbank slope, from the crest of slope down to Elevation +215, which marked the top of rip-rap shore protection applied between Elev. +210 and +215 (Section 3.1). This Clayey Fill was placed in layers and compacted using a vibratory drum compactor. Atlantic Testing, Inc. performed field density testing of the compacted Clayey Fill and verified its continuing compliance with Specification Section 02200.

Surveys were conducted after placement and compaction of the Select Fill and Clayey Fill. The survey contours are shown in the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-2.1 & 2.4). The topography of the top of the Select Fill and Clayey Fill was compared to the topography of the subgrade (Thew Assoc. dwg. nos. CK2509-08-00-1.1 and 1.4) in the PCA. This comparison confirmed that thickness of Select Fill or Clayey Fill equaled or exceeded 18 inches, consistent with the CM Design. There were a few limited spots where either the subgrade or top of Select Fill grades were not measured by the surveyor, usually because soil stockpiles obscured the view. At these few locations, field observations indicated that an adequate thickness (i.e., 18 inches or greater) of Select Fill was placed.

3.3.2.3 Topsoil Layer. A layer of topsoil, 6 inches or greater in thickness was installed on top of the fill materials (Section 3.3.2.2). This topsoil (vegetative support) layer was installed, in accordance with Specification Section 02200, to provide a suitable media to develop and sustain vegetation. It consists of the following:

- Topsoil – loam type soil, free of deleterious material and conforming to the material requirement of NSYDOT œ 713.01. Clean fill certificates (Appendix D) and laboratory geotechnical test results (Appendix E) showed the topsoil complied with the specified design criteria. It was accepted for use at the site. Topsoil was supplied by Jointa Galusha.

3.3.2.4 Vegetative Cover. A vegetative cover was developed to stabilize the surface of the topsoil layer against erosion by water and wind and to protect the underlying soil components in accordance with the CM Design and Soil Erosion and Sediment Control Plan. This vegetative cover is consistent with descriptions in Section 3.2.2.7. The area was watered as necessary until a healthy, uniform growth was established over the entire PCA. Seeding was completed in the late summer of 2001. Since that time, vegetative growth has remained healthy.

3.4 STORMWATER MANAGEMENT SYSTEMS

3.4.1 Primary Construction Elements

Three primary elements were constructed to manage stormwater at the MPS, as follows:

- The permanent off-site stormwater transition system – This system intercepts surface water from off-site sources (waters of the state) outside the potentially contaminated materials at the MPS and conveys these waters through the site to the Hudson River, via an isolated piping system. It includes New Weir Brook Culvert and its branches to the Cement Company Pond and the Old Stone Culvert.

- Permanent surface drainage system for on-site stormwater runoff – This system distributes runoff flow to the downgradient surfaces in a manner that controls erosion. It includes the following:

    - Swales to collect surface runoff from the RCRA Cap;
    - Shallow collection pipes that capture the flow from the GDL;
    - Drainage swales in the PCA;
    - Manholes and isolated piping that convey surface runoff to its discharge points; and
    - Level spreaders.

- Temporary stormwater runoff controls during CM construction – This consisted of runoff control measures in compliance with the accepted Soil Erosion and Sediment Control Plan. During construction, runoff that contacted potentially contaminated soil materials was captured in ditches/swales and pumped to the on-site water treatment plant for processing and ultimate discharge to the local POTW, under existing Permit No. 002C. Non-contact runoff waters (i.e., runoff that did not come in contact with potentially contaminated materials on-site) were filtered through silt fences and/or straw bales, to remove sediment before the water exited the work zones.

3.4.2 Construction of Stormwater Systems

3.4.2.1 Materials of Construction. Materials used to construct the stormwater systems are as follows:

- Off-site stormwater transition system piping – 12" to 48" dia. HDPE, SDR 26 pipe;

- Off-site stormwater transition system manholes – 48" to 72" dia. HDPE, fitted with a 30" diameter cast iron rim and cover, set on a pre-cast concrete rim support collar;
- On-site stormwater conveyance system piping – 12" to 24" dia. HDPE, SDR 26 pipe;
- On-site stormwater conveyance system manhole – 48" dia. HDPE, fitted with a 30" diameter cast iron rim and cover, set on a pre-cast concrete rim support collar;
- On-site stormwater conveyance system catchbasins– 12" to 24" dia. HDPE, fitted with cast iron rim and inlet grate;
- Cross-drains under access roads – 12" dia. corrugated polyethylene (CPE) pipe;
- Protective sleeve over Cement Co. Pond branch pipe – 30" dia. segmented RCP;
- Pipes and manhole bedding and backfill – Pipe and Manhole Bedding complying with Specification Section 02200; and
- Concrete headwalls – Pre-cast reinforced concrete, per Specification Section 03410.

3.4.2.2 New Weir Brook Culvert

The New Weir Brook (NWB) culvert and its branch lines were constructed to receive water from the following:

- Sluice chamber used to drain the Glens Falls Feeder Canal (canal);
- Cement Company Pond on the adjacent GFLCC property to the west; and
- An historic drain feature beneath the canal (referred to as the Old Stone Culvert)

These waters are conveyed through the site to the Hudson River, where the former Weir Brook culvert discharged. These waters formerly fed the Old Weir Brook (OWB) culvert. Changes were made to the horizontal and vertical alignment during CM construction to accommodate field conditions (Section 4.3).

This new system is constructed of HDPE pipe and manholes. These pipes and manholes are supported on and backfilled with Pipe and Manhole Bedding, consistent with Specification Sections 02200, 02607 and 02700. Pipe sections were joined by thermal fusion to preclude infiltration or exfiltration at the joints. Components of the manholes (except for the rim and cover) were fabricated from HDPE in accordance with Specification Section 02607 and joined by thermal fusing. Pipe runs were connected to the manholes by flanged, gasketed and bolted HDPE fittings to preclude infiltration. The locations of NWB, the Cement Company Pond branch line, and the Old Stone Culvert branch line are shown on Record Drawings (Thew assoc. dwg. no. CK2509-08-00).

The main barrel of the NWB culvert begins at the sluice chamber, which is part of the canal, and extends southward, below grade, to exit at a reinforced concrete (R/C) headwall at the toe of the riverbank. Two manholes (each 72" in diameter) are situated along the pipe; one is just north of the railroad embankment and the second is just north of the crest of the slope at the riverbank. The entry end of the 48" pipe (at the sluice chamber) is cast into the reinforced concrete south wall of the chamber. The former 48-inch diameter reinforced concrete pipe (the OWB culvert) was removed from the south wall of the chamber to accommodate the new pipe. The annulus between the new pipe and the opening for the former pipe was formed and filled with concrete to re-seal the joint. Where the new Weir Brook culvert crosses the railroad embankment, a 52-inch inside diameter (ID) steel sleeve (with ¾" wall) was jacked through the embankment, embankment fill material was removed from within the sleeve and the 48-inch HDPE NWB pipe was slipped through the steel sleeve. At each end of the steel sleeve, the annulus between the HDPE pipe and steel sleeve was sealed with non-shrink grout. Construction activities on the Railroad property were performed with the permission of the Railroad and applicable access agreements.

The branch line tying the Cement Company Pond to the main barrel of new Weir Brook extends from a new reinforced concrete (R/C) headwall at the inlet end (west end of the pipe), on the east side of the pond, to the manhole on the main barrel of new Weir Brook culvert just north of the railroad embankment. This branch line passes beneath the RCRA Cap area. One MH is located along this branch, just east of the RCRA Cap. This MH is 48 inches in diameter. Pipes entering and leaving this MH are attached by flanged, gasketed and bolted joints. The segment of this pipe that lies beneath the cap is constructed inside a 30-inch diameter reinforced concrete pipe (RCP). The protective RCP is supported on Pipe and Manhole Bedding bearing on bedrock or dense soil overlying bedrock. The 24-inch diameter HDPE pipe lengths were joined by thermal fusion and slipped through the RCP. The barrel of the 24-inch pipe was fabricated with HDPE alignment lugs (centralizers), attached (by thermal fusion) at 120° spacing around the pipe and at 50-foot intervals along the pipe, to center it within the 30-inch RCP. After the HDPE pipe was in its final position, the annulus was pressure grouted to fill the void. This branch passes through the sheetpile barrier wall, which is oriented north-south and located near the western side of the RCRA Cap. Where the pipe penetrates the barrier wall, a hole (about 48 inches in dia.) was cut through the sheetpile wall using an acetylene torch. The 30-inch RCP protective sleeve was inserted through the hole. Concrete collars were formed and poured around the RCP and abutting the sheetpile wall, forming a seal.

A branch line was constructed to connect the Old Stone Culvert to the Cement Company Pond branch line just east of the RCRA Cap area. The Old Stone Culvert branch line was constructed of 12-inch diameter HDPE pipe, with thermally fused joints. One MH (48" dia.) was installed along this branch, near the southern tend of the Old Stone Culvert. The pipes were attached to the manhole by flanged and bolted joints. A R/C headwall was poured-in-place to connect the Old Stone Culvert to the 12-inch HDPE pipe.

Two headwalls were constructed as part of the new Weir Brook stormwater management system. One headwall was installed at the inlet end of the branch of Weir Brook culvert that connects to the Cement Company Pond. This headwall is constructed of precast concrete and was fabricated to accommodate the 24" diameter HDPE drainage pipe. It was precast at the facility of LHV Precast (Kingston, NY), in accordance with the Specification Section 03410. The second headwall was installed at the discharge of NWB to the Hudson River. This unit was precast by LHV Precast, at their Kingston, NY facility and was fabricated to accommodate the 48-inch diameter HDPE culvert pipe. Each R/C headwall was put in place using a crane. The annulus between the HDPE pipe and the opening cast in each headwall was sealed with non-shrink grout. Locations of these headwalls are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-6.0).

3.4.2.3 On-Site Stormwater Management System. Surface runoff drains from the cap as sheet-flow to a series of swales constructed with appropriate grading and cover soils. The side slopes and bottoms of these swales are constructed of Select Fill (18" in thickness) and Topsoil (6" in thickness) (per Specification 02200), stabilized with perennial grass (per Specification 02925). Geotextile and rip-rap were installed as erosion controls at the confluence of the swales along the south and east sides of the cap. These were installed consistent with the CM Design and in accordance with the New York State Guidelines for Erosion and Sediment Controls. The rip-rap has a D_{50} equal to 6 inches. Locations of the swales and erosion control features are illustrated on the Record Drawings (Thew Assoc. dwg. no CK2509-08-00-3.1).

Surface runoff from the embankment adjoining the Canal is controlled by a shallow drainage swale on north side of the North Access Road. This swale directs flow to two catchbasins (CB) which feed cross-drains (CBs connected to 12" CPE pipe) under the access road. Each cross-drain leads to a level spreader, which distributes the runoff to the downgradient vegetated ground surface as sheet flow with non-erosive velocities. These features are illustrated on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 and 3.2).

A relatively deep runoff collection swale was constructed along the north side of the railroad embankment. This swale was constructed to collect runoff from the south and east sides of the RCRA Cap area and from the PCA south of the North Access Road. Swale flow from this area is carried south under the railroad by a new, 24-inch diameter HDPE pipe. The pipe drains a new CB near the east end of this swale and discharges to a new MH south of the railroad. This manhole also receives flow from a shallow swale constructed along the north side of the Building 45 slab that captures runoff accumulating between the slab and the edge of the railroad property. A CB was constructed near the center of this swale, with its outlet (a 12" diameter HDPE pipe) leading west to the MH. Flow from this MH is directed southward through a new 24" dia. HDPE pipe to the East Level Spreader, which is located on the riverbank. A CB was constructed along the 24-inch pipe where it intersects the swale along the South Access Road.

Another runoff collection swale was constructed on the north side of the of the South Access Road west of Building 56 slab. A CB was installed at the low point of this ditch, with a 12" dia. HDPE outlet pipe leading southward to the West Level Spreader.

HDPE pipes, MHs and CBs used in the construction of the on-site stormwater management system are bedded on at least 6" of Pipe and Manhole Bedding, consistent with Specification Sections 02200, 02607 and 02700). Backfill around the MHs and CBs and around and above the HDPE pipes also consists of Pipe and Manhole Bedding installed to the limits and requirements of the CM Design Drawings and Specifications. Above the Pipe and Manhole Bedding material, pipe trenches are backfilled with Select Fill and Topsoil consistent with the Drawings and in the Specifications.

The major components of the on-site stormwater management system are illustrated on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through 3.4).

3.4.2.4 Level Spreaders. Four level spreaders were constructed during the CM activities. Two are located in the Area North of Railroad Property and distribute flow from the cross-drains that pass under the North Access Road. These two level spreaders are of similar construction. Each is 20 feet long and 1 foot deep, with 3H to 1V side slopes. The sides and bottom are constructed of a Rip-Rap (D_{50} = 6") layer, 12 inches in thickness, underlain by geotextile.

The 3rd and 4th level spreaders are constructed on the riverbank. One is located southwest of the Building 45 slab. The other is at the southwest corner of the Building 56 slab. The level spreaders are of similar construction. Each level spreader is 40 feet long and 3 feet deep (from invert to crest of overflow), with side slopes of 2.5H to 1V on the upstream side and 3H to 1V on the downstream side and the ends. The sides, ends and bottom are constructed of rip-rap (D_{50} = 6"), 2 feet in thick and underlain by geotextile. Each of these level spreaders is constructed with a discharge apron extending down the riverbank, from the level spreader to the edge of the river. Each apron spreads from 40 feet wide at the level spreader to 60 feet wide at the edge of the river. These aprons are constructed of rip-rap (D_{50} = 6"), 24 inches in thickness, and are underlain by geotextile.

The level spreaders are constructed, in conformance with Specification Section 02200 and the CM Design Drawings. Location and features of the level spreaders are illustrated on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through 3.4).

3.4.2.5 Temporary Stormwater Controls During CM Construction. Temporary erosion and sediment control and stormwater management measures were used during construction. In accordance with the Specifications, sediment barriers, including geotextile silt fences and staked straw bales, were utilized to provide sediment control until permanent erosion control features were constructed and vegetative cover established. A Soil Erosion and Sediment Control (SESC) Plan was prepared and submitted before starting earthwork. This plan conformed to the requirements of the CM Design and to the Stormwater Pollution Prevention Plan (SPPP) required under the NYSDEC General Construction Stormwater Permit. Erosion and sediment control measures were implemented in accordance with that SESC Plan.

3.5 GROUNDWATER EXTRACTION AND MONITORING SYSTEMS

3.5.1 Primary System Elements

The groundwater extraction system (GWES) has two major sub-systems:

- Overburden groundwater extraction system, which consists of the French Drain and related elements; and
- Bedrock groundwater extraction system, which is comprised of extraction wells installed in Horizons A and B and related components.

The overburden system includes a French Drain, about 2,100 feet long, 6 manholes and 3 sumps. Location, alignment, profile and features of the overburden extraction system are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-8.0 and CK2509-08-00-8.1).

The bedrock groundwater extraction system includes 14 extraction wells installed in Horizon A and 6 extraction wells in Horizon B. Well locations and other features of this system are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-7.1 and CK2509-08-00-7.2) .

3.5.1.1 French Drain and Sumps Elements. The primary components of the French Drain are as follows:

- Trench excavated into the lacustrine clay unit;
- Perforated collection pipe – 6" dia. perforated HDPE in accordance with Specification Section 02700;
- Crushed Stone – porous media surrounding the perforated collection pipes, in compliance with Specification Section 02200 and to the minimum limits required by the CM Design;
- Geotextile Envelope – separation and filtering media surrounding the crushed stone and separating the crushed stone from adjacent soil or waste materials;
- Manholes (6) – pre-cast concrete manhole units, 4 feet square, in compliance with Specification Section 03410, fabricated by LHV Precast at their Kingston, NY facility, in accordance with the CM Design;
- Sumps (3) – pre-cast concrete manhole units, 4 feet square, in compliance with Specification Section 03410, fabricated by LHV Precast at their Kingston, NY facility, in accordance with the CM Design ;
- Manhole and Sump Covers – fabricated aluminum doors and frames, supplied and cast into the sumps and manholes by LHV Precast at their Kingston, NY facility, in accordance with the CM Design; and
- Pumps, motors, level controls, valves and meters, in accordance with the CM Design.

3.5.1.2 French Drain and Sump Construction. The system is located near the top of the riverbank along the Hudson River near the downgradient boundary of the MPS. It is comprised of a French Drain, which is installed at or below the base of the overburden water-bearing zone (i.e., into the top of the clay unit or at the top of the bedrock surface where the clay is absent). The alignment is shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-8.0). The trench excavation to install the drain generally followed the top of the riverbank. A profile of the drain as constructed, and with the approximate soil stratigraphy along the trench are shown in Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-8.1). The top of the clay, which is shown on the profile, was based on visual observations and survey measurements made during the excavation of the trench. Elevation of the top of the porous stone media that surrounds the perforated collection pipe is based on survey measurements made during construction.

A large flow of water was encountered near OWB during construction of the French Drain. The impact of this flow and actions taken to manage it are discussed in Section 4.7.

Underground pipes were cut where they crossed the trench. Caps were placed over the northern (upgradient) ends. The southern (downgradient) ends side were plugged and sealed with grout.

The depth of the trench ranged between about 12 and 30 feet, with the deeper excavations being at the sump locations. Most of the trench was an open cut and a trench box was used where the combination of depth and lateral space limitations led to potentially unstable conditions. In those locations, notably south of Building 56 slab, pre-benching was used to decrease the height of the side walls, thereby increasing the trench stability and avoiding the need for stacked trench boxes.

Dewatering was performed during the trench excavation and construction of the French Drain system. Dewatering was conducted consistent with Specification Section 02228. Water from the dewatering operations was pumped to the pre-existing Industrial Lift Station (later decommissioned), which transferred it to the on-site Pretreatment plant. The water was treated to meet discharge permit requirements and then was pumped to the Glens Falls POTW.

Groundwater in the overburden is collected in three sumps (Sumps A, B, and C) positioned along the French Drain. Each sump contains a pump and ancillary equipment (i.e., level switches, valves, flow meters and electrical power components) to control the pump. A 1 HP, 15 gpm submersible pump (Grundfos Model No. 16E9), is installed in each sump. As discussed in Section 4.7, a secondary 5 HP pump is also installed in Sump B. These pumps lift the water to the EPS through a forcemain. Each pump is controlled by electronic level sensors, which activate and deactivate the pump to control the water level in the sump within a preset range. The discharge line from each sump is equipped with an electronic flow meter that tracks instantaneous and totalized flow. Flow data are sent to the computer monitoring system. Specifications and installation data for sump pumps are presented in the CM Groundwater Monitoring Plan [GWMP] (BC 2004).

3.5.1.3 Extraction Well Elements. The extraction well sub-system is made up of the following:

- Fourteen extraction wells with intake ports in Horizon A, spaced approximately 75 feet apart, near the crest of the river bank along the south side of the site beginning approximately 60 feet east of the western property boundary;

- Six extraction wells with intake ports in Horizon B, spaced approximately 300 feet apart, along the same general alignment as the Horizon A wells, and also beginning about 60 feet east of the western property boundary.

Locations for these wells are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-7.1). Well completion information and a well log for each well are presented in the CM GWMP (BC 2004). The extraction wells were constructed and developed in accordance with Specification Section 02610. Eight of the new extraction wells were hydraulically fractured (hydro-frac) to enhance performance. These wells exhibited low yield during development and initial testing. Hydro-fracing was successful in improving the yield of these wells to a satisfactory rate.

The 20 extraction wells are outfitted with pumps and ancillary equipment (i.e., level switches, valves, flow meters and electrical power components). Each well is equipped with a 0.5 HP, 7 gpm submersible pump (originally Grundfos Model No. 16E4, but changed to Grundfos Model No. 7S05-11, to increase the output head capacity). These pumps convey groundwater from the wells to the EPS through a forcemain. Each pump is controlled by electronic level sensors, which activate and deactivate the pump to control the water level to within a preset range. The discharge line from each well is equipped with an electronic flow meter that tracks instantaneous and totalized flow. Flow data are sent to the computer monitoring system. Specifications and installation data for extraction pumps are presented in the CM Groundwater Monitoring Plan (BC 2004).

3.5.1.4 Monitoring Wells. Twenty-six (26) monitoring wells and piezometers were added to the monitoring network to assess hydraulic performance of the GWES. In the overburden, four (4) new monitoring wells were installed. In Horizon A, 10 new monitoring wells were installed. In Horizon B, 12 new monitoring wells were installed. One (1) additional monitoring well was installed in Horizon C to replace an older well that was abandoned because it lay within the path of the French Drain. Each new monitoring well was constructed by Layne-Christensen Drilling Co (Schoharie, NY). These new monitoring wells were constructed and developed in accordance with Specification Section 02620. Locations for these wells are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through CK2509-08-00-3.4). Well completion information is summarized in the CM GWMP (BC 2004).

3.5.1.5 Forcemain. A forcemain system is used to convey groundwater from the GWES to the EPS. The forcemains are installed in trenches excavated to an average depth of about four feet below finished grade. Materials of construction for the forcemain are as follows:

- Main pipeline – 2-inch dia. HDPE Driscopipe 1000 (manufactured by Phillips Driscopipe, Inc.), in conformance with Specification Section 02700, with pipes and fitting joined by thermal fusion;
- Branch lines to wells and sumps - 1-inch dia. HDPE Driscopipe 1000 (manufactured by Phillips Driscopipe, Inc.), in conformance with Specification Section 02700, with pipes and fitting joined by thermal fusion; and
- Bedding and backfill – Pipe Bedding and Backfill, in accordance with Specification Section 02200 and to the limits called for on the CM Design Drawings.

The forcemain system begins at the well vault for extraction well numbers EW-A1 and EW-B1 (a double well vault) and extends approximately 3,200 feet east to the EPS. The alignment and profile for the forcemain are presented on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-7.1 through CK2509-08-00-7.4). As shown on the drawings, an air-release chamber is located at the high point of this forcemain, approximately 520 feet west of the EPS. The chamber for the air-release valve consists of a 48” dia. HDPE manhole, fabricated in accordance with Specification Section 02607, by Lee Supply Co. (Charleroi, PA). The forcemain and the air-release chamber are bedded on and backfilled with Pipe and Manhole Bedding, in compliance with Specification Section 02200 and the CM Design. After installation, the line was pressure tested in accordance with the provisions of Specification Section 02700 and passed the test requirements.

The forcemain alignment near Building 56 slab was altered during construction to addresses field conditions. The Record Drawings reflect the as-built alignment. The basis and rationale for this field modification are discussed in Section 4 of this report.

Flow control valves were installed on the forcemain inside the EPS. These valves allow the discharge to be directed to the POTW, bypassing the wet well chamber, if needed. As currently set, these valves direct discharge from the GWES into the pre-existing wet well chamber of the EPS for equalization. From the wet well, water is conveyed to the Glens Falls POTW by pumping equipment that was part of the sanitary sewage system that pre-dated CM construction. In the future, if in accordance with the conditions of the Permit issued by the Glens Falls POTW, positioning of the valves in the EPS could enable discharge from the groundwater extraction systems to flow directly into the dedicated pipeline to the POTW.

3.5.1.6 Electronic Data Monitoring. The computer-controlled monitoring system was designed, supplied and documented in accordance with the CM Design Drawings and Specification Section 16600 and other applicable section or sub-sections of Division 16. The designer of the monitoring system was AdvanTech Corporation, (Fairfield, NJ). AdvanTech fabricated the system, acquired the instrumentation and delivered the components to the project site. Hour Electric (Ft Edward, NY) installed the electronic equipment. The computer system is installed in the EPS. The principle components of this monitoring system are as follows:

- Central Work Station (CPU and touch-screen monitor);
- Local I/O Cabinets;
- Modem (for remote access to performance data);
- Application and Utility Software;
- Software Licenses;
- Field Instrumentation (digital flow meters and liquid level sensors);
- Signal Cables; and
- Electrical Power Supply Components.

Digital flow meters and water level sensors were installed in the extraction wells and French Drain sumps by R. F. Gordon Mechanical, Inc. (South Glens Falls, NY). Gordon Mechanical also installed the well and sump pumps, valves, piping, meters and related appurtenances. Hour Electric installed the monitoring equipment, communication lines and electrical power supply inside the EPS. Hour Electric also laid the data cable to each well and sump, and wired the flow meters and sensors in each well and sump. AdvanTech programmed the monitoring system, tested and debugged the software and instrument setup, and continues to provide troubleshooting assistance for this system.

The monitoring system is equipped with automated dial-out features to notify offsite personnel should alarm conditions be encountered. These features were selected in the event site operations were to become part time. The dial-out features are currently turned off as the site is operated with a full time operator. This feature would need to be turned on, if a decision is made in the future to go to a part time operator. At this time, site conditions are not consistent with use of automated dial-out features.

The monitoring system tracks and records the following data:

- Instantaneous flow (gpm) from each well and sump pump;
- Total flow from the 20 extraction wells and 3 sumps to the EPS;
- Operating status (on or off) of each of these pumps; and
- Status of alarms (high or low water level) at each well and sump.

Operational data are recorded by the monitoring system and is stored on the hard drive. Real-time remote access is available to onsite and offsite users via PC-Anywhere software.

3.6 PONDED AND BACKWATER AREA

3.6.1 Primary Construction Elements

The primary elements of the CM construction in the Ponded & Backwater Area (PBA) are as follows:

- Temporary Access and Egress for Construction;
- Temporary Turbidity, Sediment and Erosion Controls;
- Topographic Surveying;
- Biota Transplanting;
- Clearing and Grubbing;
- Excavation of Designated Soil and Sediment;
- Pond Linking and Stream Rerouting; and

- Final Grading and Surface Treatments.

3.6.1.1 Access and Egress. An access ramp was constructed from the southeast corner of the Warren County Recycling Center Property, across the railroad and down the embankment into the northwest part of the PBA. This access road was constructed at approximately the location called for on the CM Design Drawings. Equipment for excavating, filling and grading used this access ramp. Deposits excavated from the PBA and used as subgrade were hauled to the MPS and clean fill was brought to the PBA over this access road. Access agreements were negotiated with the affected property owners along the access route and in the PBA.

3.6.1.2 Temporary Turbidity Controls and Monitoring. Temporary turbidity control measures were used to minimize migration of suspended sediments into the river outside the work area. Turbidity, erosion and sediment controls were installed in accordance with Specification Sections 02080 and 02931. Silt fences, straw bales, and filtering berms were installed at the eastern and western ends of the removal areas to filter fine particulates from the water column. Monitoring was performed on a daily basis during construction, in accordance with Specification Section 02082.

Straw bales were installed in upslope areas to intercept run on, filter soil-fines and act as a velocity-break for water entering the CM work zone. Sediment controls were advanced sequentially as the excavation of designated deposits progressed from west to east.

Visual monitoring for turbidity was performed, pursuant to the Protection of Waters Permit, during excavating, filling and other activities involving moving or importing soil materials. The turbidity, erosion and sediment controls functioned adequately during the construction in the PBA and there were no known sediment or turbidity releases to the river during this work.

3.6.1.3 Topographic Surveys. Three topographic surveys were conducted as part of sediment excavation in the PBA:

- Initial survey;
- Post-Excavation; and
- Finished Grade.

The surveys were performed by Thew Assoc.

Initial Survey

An initial topographic survey of the PBA was performed before starting work. The survey was completed to the requirements and limits in Specification Section 02082. The initial survey established a baseline for subsequent earthwork and follow-up surveys (i.e., post-excavation and finished grade surveys). The initial survey was used to prepare a pre-construction map of the work area, with contour intervals of 1 foot. This survey was used to establish the locations for the access/haul road route into the PBA, the area of the gabion channel capturing drainage from the stormwater pipe through the railroad embankment, and the limits of PBA excavations. The initial survey of the PBA is presented on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-10.1 and CK2509-08-00-10.2).

Post-Excavation Survey

A post-excavation topographic survey was performed after designated materials were excavated to the limits of the deposits in the PBA. Survey transects were spaced along the baseline at the intervals used for the initial survey and to the same contour interval and accuracy as the initial survey. Results of the post-excavation survey demonstrate that designated deposits were removed to the horizontal and vertical limits required by the selected CM Design and applicable Permits. The results of this post-excavation survey are presented on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-11.1 and CK2509-08-00-11.2).

Finished Grade Survey

A survey of the finished grades was performed after construction in the PBA was completed. Survey transects were again spaced along the baseline at the intervals used for the initial survey and to the same contour interval and accuracy as the initial survey. Results of the finished grade survey were plotted to demonstrate that the finished surfaces and features (i.e., gabion channel alignment, dimensions and elevations; and topography of the deposits removal area) complied with requirements of the CM Design and applicable Permits. The results of this finished grade survey are presented on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-13.1 and CK2509-08-00-13.2).

3.6.1.4 Biota Transplanting. Biota transplanting operations were performed in open water areas (i.e. ponds and backwater) of the PBA to capture large game fish, reptiles, amphibians and other large organisms. These biota capture and relocation activities were conducted in each of the two elongated ponds from June 5 through June 8, 2001 one week before the start of earthwork operations in the PBA. Aquatic organisms were collected using a backpack electroshocker, 100-foot beach seine, turtle traps and dip nets. A total of 24 organisms were captured in the ponds and successfully relocated to the Hudson River. Biota transplanting activities were performed by Normandeau Associates, Inc. [Normandeau] (Bedford, NH). A report of the biota transplanting activities is contained in Appendix B.

3.6.1.5 Clearing and Grubbing. Clearing and grubbing activities were completed on about 2.8 acres mostly located in the western half of the PBA (about 5.4 acres). Clearing and grubbing was performed within the CM limits to remove the trees and stumps, as well as smaller undergrowth and brush. Wetland and upland areas were included in the work area. Dominant trees in the upland area were green ash, elm, cottonwood and boxelder trees, ranging in size from saplings to mature trees with trunks up to 2 feet in diameter. In the wetland, the dominant trees were elm and boxelder. Clearing and grubbing work was conducted between June and September 2001. Trees, stumps and brush removed during clearing and grubbing of the PBA were taken off-site (i.e., not disposed at the MPS) for disposal.

3.6.1.6 Excavation. Mechanical excavation methods (i.e., backhoe and front-end loader) were used to remove the designated deposits within the PBA, in accordance with the CM Design and the Specifications. Excavation was performed using land-based equipment, operating from the access/haul road. In the western 800 (±) feet of the PBA, the access/haul road was located in the upland portion of the PBA. In the eastern area, the access/haul road was constructed in water (i.e., ponds and backwater), in accordance with the selected CM Design and Specification Section 02082.

Excavation in the PBA progressed from west to east, with construction of the access road, followed by excavation of designated deposits along the sides of the road. Designated deposits along the road alignment were excavated ahead of the road construction. The access road was then built over the excavated area. Road fill material was not placed over deposits designated for removal. Road fill material met the backfill requirements so it could be re-graded when excavation was complete and did not have to be removed.
Designated deposits excavated from the work area were loaded directly into dump trucks and hauled, via the access/haul road and existing traffic routes outside the PBA, to the PCA, where they were used as subgrade (Section 3.3). Off-road dump trucks with enclosed-rear bodies were used to transport material excavated from the PBA. Trucks were only partially filled to prevent loss of solids and liquids during transport. Excavation of designated deposits in the PBA began in July 2001 and was completed by the end of August 2001. By the Contractor's truck count, the volume of designated deposits removed from the PBA was approximately 15,000 c.y., which is consistent with the volume estimated in the CM Design.

3.6.1.7 Post Excavation Survey Findings. Comparison of the initial survey (Thew's drawing #CK2509-08-00-10.1) and post-excavation surveys (Thew's drawing #s CK2509-08-00-11.1 and CK2509-08-00-14.1) shows that excavation was carried to the required depths at 233 out of 235 surveyed points) This comparison also showed that the post-excavation grade at 2 baseline station grid points (Stations 4+50, 50'L and 5+00, 50'L) was above the targeted depth. These points are in the area where 2 feet of designated deposits were to be removed. At Station (Sta.) 4+50 – 50' north (left) of the baseline, the surveys show the post-excavation grade to be 1 foot above the initial grade. At Sta. 5+00 – 50' left of the baseline, pre- and post-excavation grades are the same. However, review of field records from July 23 to August 3, 2001 (when this part of the PBA was excavated and backfilled), indicated that the required 2 feet of designated deposits were removed and that the required depth was confirmed by the Contractor's field measurements, using a transit and level, rod, as the excavation progressed. While field observations differ from the post-excavation survey results at these 2 points, further evaluation lead to the conclusion that disturbed, fine-grained sediments probably sloughed from the sides of the excavation before the final survey was conducted.

3.6.1.8 Backfilling. Clayey Fill was placed and graded by mechanical means and equipment to the approximate lines, grades and limits in accordance with the CM Design and Specification Section 02200. Clayey Fill was placed as backfill in the excavated areas of the PBA. Track-mounted grading equipment (i.e., dozer and front-end loader) was used to compact the fill, until the soil beneath the tracks of the equipment did not significantly yield under load of the equipment. Topsoil meeting the requirements of Specification Section 02200 was placed and graded to the required 6-inch thickness in those areas requiring a vegetation support layer. Topsoil was placed in a single lift over the underlying soil layer. Topsoil was prepared for planting in accordance with Specification Section 02925 or 02935 depending on its location in either upland or wetland, respectively.

3.6.1.9 Finished Grade Survey Findings. Subsequent to performing specified construction in the PBA (including the gabion channel construction, deposits removal and placement and grading of backfill soils in the deposits removal areas), the finished grades were surveyed. Results of the finished grade survey were plotted and demonstrated that the finished surfaces and features (gabion channel alignment, dimensions and elevations; and topography of the PBA) met the requirements of the CM Design and applicable Permits. Some small differences were found between the design and the finished grade elevations. These differences resulted in the upper wetland boundary (i.e., the Elev. +212 contour) being configured differently than illustrated in the CM Design, but providing slightly greater actual wetland area. Based on the post-CM topography, the emergent wetland area in the PBA work zone is approximately 2.23 acre, compared to 1.43 acre before CM. This increase in emergent wetland of 0.8 acre exceeded the compensatory increase of 0.57 acre presented in the CM Work Plan for the PBA (BC, March 2001) approved by the USACE. The free water wetland area also increased from 1.44 acre to 1.97 acre as a result of the CM construction. The final grade elevations and differences were reviewed by the USACE and were accepted. A revised Wetland Mitigation Plan was submitted to the USACE for the wetland configuration on April 2, 2004. An order to perform the mitigation was issued by the USACE on June 16, 2004. Planting of the wetland vegetation and installation of the required staff gauge was completed on July 14 through July 16, 2004. Results of the finished grade survey of the PBA are presented on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-13.1 and CK2509-08-00-13.2).

3.6.1.10 Wetland and Upland Seeding. Where finished grades in the PBA are above the OHWM (Elev. +212), which are in the western 800 feet of the PBA, the upper 0.5 feet of the backfill is Topsoil (Specification Section 02200) to promote development of new vegetation. Upland surface treatment consisted of planting perennial grass (Section 3.2.2.7) meeting the requirements of Specification Section 02925. Seeding of the upland area was completed in October 2001. Observation during subsequent growing seasons (2002, 2003 & 2004) indicated that the grass is healthy and sustaining

Wetland areas temporarily disturbed by CM activities were restored by planting wetland species per agreements with the NYSDEC and USACE. Wetland plants included a combination of seeds and plugs, as appropriate to the location. Wetland plantings were prepared or grown and installed by Southern Tier Consultants, Inc. (West Clarksville, NY), in July 2004. Wetland plants were installed where finished grades in the PBA were between elevations +210 and +212. The wetland vegetation was installed as required by the USACE, per their original Permit (No. 2000-00587-YN, dated June 12, 2001) and later 'Ordered' by Enforcement Case No. 2004-071, dated June 16, 2004. The selected plugs and seeds were distributed over the mitigation area designated by the USACE, which covered about 0.4 acre of the emergent wetland created by the CM construction. Other portions of the emergent wetland within the CM work zone were already populated with plant species deemed acceptable to the USACE during their reconnaissance visit to the PBA on April 12, 2004. Planting/seeding was performed in accordance with Specification Section 02935. Numbers of plants were determined based upon the areas to be planted. The planting schedule was as follows:

Herbaceous	Quantity	Condition
Acorus calamus	229	BR
Carex comosa	229	PLUG
Juncus effuses	229	BR

Peltandra virginica	230	BR
Scirpus validus	229	PLUG
Scirpus cyperinus	229	BR
Scirpus fluviatilis	230	BR
(BR = bare root)		
Specialty Seed Mix	12 lbs.	SEED

The health and establishment of these wetland species will be monitored, as required by the order from USACE. Monitoring and reporting status of this restored wetland is to be in accordance with the Special Conditions attached to the notification letter issued by the USACE (dated June 12, 2001) that the CM were authorized under NWP-38. At the time of planting, the area was fully inhabited by species typical of the Hudson River valley in the area of the site. The first annual wetland monitoring (September / October 2004) will document the initial conditions in the mitigation area.

3.6.1.11 Storm Drain Extension and Gabion Channel. Near the western end of the PBA, prior to CM construction, a 42-inch diameter R.C.P. stormwater drainage conduit penetrated the railroad embankment (north to south) and discharged to an existing surface swale leading to the PBA. As part of the CM work, this 42-inch pipe was extended and supported southward in order to construct the temporary access road leading to the PBA, as called for in the CM Design. Clayey Fill material was placed and compacted (Specification Section 02200) to build the subgrade to support the extension to the pipe. At the southern end of the extended 42-inch R.C.P., a pre-cast concrete headwall (Specification Section 03410) was installed, in accordance with the CM Design. The precast headwall was fabricated by LHV Precast, Inc. at their facility in Kingston, NY. Following construction of the pipe extension and headwall installation, they were backfilled to the grades called for by the CM Design and to support the access road to the PBA.

Downstream of the concrete headwall, a gabion channel was constructed to contain and guide the stormwater flow from the 42-inch pipe to the drainage pathways in the PBA. Clayey Fill material was placed and compacted (Specification Section 02200) to build the subgrade to support the gabions forming the bottom and sides of the new channel. Gabion baskets were fabricated by Maccaferri, Inc. (Williamsport, MD). Baskets were sized in accordance with the CM Design requirements, with a nominal, wire fabric mesh size of 2.5 inches. A geotextile (Specification Section 02233) was placed over the Clayey Fill subgrade. Gabion baskets were set on the geotextile at the appropriate location along the channel. Each gabion basket was put in place, opened, filled with broken stone (graded in size from 3 to 6 inches), then wired closed. Adjoining baskets were wired together to form an interlocked structure. The gabion channel extends about 96 feet, from the end of the headwall to its discharge point in the PBA. The alignment, limits, dimensions and elevations of the storm drain extension and gabion channel conformed to the requirements of the CM Design and are presented on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-13.1).

3.7 CONTACT WATER MANAGEMENT DURING CM CONSTRUCTION

3.7.1. Contractor's Pretreatment Plant

The Contractor's pretreatment plant was constructed and operated to manage groundwater during construction activities at the MPS. By agreement, the Contractor was permitted to make use of some components of the pre-existing on-site pretreatment system, to avoid unnecessary duplication of infrastructure. Components of the existing system utilized in the Contractor's Pretreatment system included the following:

- Piping and manholes of the industrial sewer system – as the CM work progressed on the MPS, portions of these components were decommissioned.

- Industrial lift station (ILS) – potentially contaminated water collected in the construction work zones was conveyed to the ILS either via the pre-existing industrial sewer system or by pumps and hoses leading from work zones to the ILS. The ILS was decommissioned after construction of the RCRA Cap and Permeable Cover on the MPS, when no more contact water was being generated.

- Forcemain – pipe from the ILS to the Equalization Tank (T-110) at the on-site pretreatment plant. Pumps in the ILS conveyed collected water from the MPS to the pretreatment plant via a pre-existing 16-inch pipeline. This line was cut and capped outside the ILS, when it was no longer needed; i.e., at the decommissioning of the ILS.

- Tank T-110 – equalization and storage tank, providing nearly 500,000 gallons of holding capacity for potential contact water received from the MPS. This tank was equipped with a chemical feed system to inject ferrous sulfate or ferric chloride into the tank to aid in solids precipitation.

- Influent feed pumps and filtration equipment – these included the duplex sand-filters and bag-filter assemblies.

- Discharge pump – this pumped treated effluent from the pretreatment plant back to the EPS wet well, from which flow was subsequently batch-pumped to the POTW.

The following new processing equipment was installed between the influent feed pumps and the discharge pump:

- Anion Exchange System – this unit was to treat the elevated levels of sulfate typically present in the site related waters, before the water reached the next process unit in the treatment train (the Metall:X™ units). A strong base anion exchange resin, supplied by Resin Tech (Cherry Hill, NJ), was used to remove sulfates from the influent water and prolong the useful life of the Metall:X™ Contactors downstream of the anion exchange units.

- Metall:X™ Contactor Assemblies – manufactured by SolmeteX Corporation (Billerica, MA). This is a skid-mounted system of two vessels in series, each containing 3,400 pounds of proprietary resin, through which site water was pumped, and which removed multi-valent anionic metal species (the contaminants of concern [principally cyanide and chromium] in the site contact water) from the aqueous stream.

The modified water treatment plant (WTP) was designed for a flow rate of 200 gpm and the anticipated concentrations of the contaminants of concern (COC). The flow rate of 200 gpm was chosen so as to treat up to about 100,000 gallons of contact water per 8-hour day; or roughly twice the anticipated average daily rate (estimated at 43,000 gallons) of contact water collection. Variations in the influent water volumes were handled by adjusting flow rates through the WTP, changing operational time for the system and/or altering the volume being stored in tank T-110. In general, the WTP processed enough water so that the volume stored in T-110 was at or below 100,000 gallons at the end of the operating day. This approach provided a surge capacity of 350,000 gallons in T-110 to accommodate unanticipated high flow from the contact water collection systems or interruption of the WTP operation (e.g., due to malfunction, maintenance, process media change-out, or similar conditions).

3.7.2 WTP Process Operations

The WTP was installed and tested. Operating staff was trained during a one week training period. The WTP operating staff consisted of personnel employed by Hercules. Supervision and assistance with daily operations were provided by the Contractor. This supervisory role included physical and mechanical assistance, review of daily operations, troubleshooting, sampling oversight, coordination of media change-outs, reporting, and conducting major maintenance and repairs. The Contractor also completed and submitted analytical reports to document quality and quantity of process water sent to the POTW.

3.7.3 Influent and Effluent Monitoring

A monitoring program was established and implemented to document water discharged from the WTP to the EPS. Monitoring included sampling the influent water. Results were used to document compliance with the existing POTW permit, monitor WTP efficiency, and monitor contaminant loading of the filter media. Samples were collected at the influent and effluent points of the WTP and at a composite sampler located at the POTW. Water sampling at the WTP was performed at a minimum of once a week. Composite sampling was done in compliance with the POTW Permit. Collected water samples were analyzed for the following parameters:

Antimony; Arsenics; Boron; Cadmium; Calcium; Total Chromium; Copper; Iron; Lead; Manganese; Mercury; Nickel; Silver; Zinc; Cyanide; Ammonia; Benzene, Toluene, Ethyl benzene, Xylene; 1,1,1 Trichloroethane; Chloroform; Methylene Chloride; Naphthalene; Total Phenols, and pH (instruments at the WTP also monitored this on a continuous basis).

Sample results were documented and stored on-site for historical purposes and for preparing monthly reports to the POTW. The data documented the performance and efficiency of the WTP equipment.

During the course of the CM construction, there were no violations of the POTW permit concentration limits. The analytical data demonstrate the treatment processes maintained a relatively high level of efficiency throughout CM construction.

3.7.4 Effluent Discharge

Waters (contact or non-contact) were collected at the MPS, pumped to T-110 and processed through the WTP, then pumped to the EPS wet well. Transfer pumps (two 150 gpm pumps operating individually or in tandem) in the EPS subsequently discharged the treated effluent to an existing 20-inch diameter dedicated pipeline to the POTW. This discharge system operated successfully during the CM construction period.

3.7.5 Termination of WTP Operations

Only waters from the GWES (i.e., French drain and wells) were sent to the POTW, after the RCRA Cap and Permeable Cover were constructed. Analytical data from the WTP confirmed that the components added to the process train during construction were no longer needed to meet the POTW discharge criteria. Consequently, the Anion Exchange Units and Metall:X™ Contactor Assemblies were removed from the process train and the treatment process returned to its approximate pre-construction configuration. Continued monitoring of water from the GWES revealed the influent to the treatment plant consistently met the POTW discharge criteria (i.e., constituent concentration compliance was achieved without ion exchange or metals treatment) over an extended period of continuous operation (greater than one year). These findings were presented to the POTW. A permit modification was obtained (February 11, 2002). This modification permits water from the GWES to be equalized in the wet well of the EPS, then pumped to the POTW. This method of operation has been on-going since November 5, 2003, without an exceedance of the discharge limits. Sampling of the effluent and periodic reporting to the POTW continues in accordance with the Permit requirements.

3.8 CEMENT COMPANY POND COVER

3.8.1 Cover Requirements

CM for the Cement Company Pond (CCP) consisted of placement of suitable fill material (i.e., crushed stone) to a thickness of 12 inches over the bottom of the pond. A layer of geotextile was required below the crushed stone to isolate the stone from the pond sediments.

3.8.2 Pond Dewatering

The pond was dewatered by constructing a small dam to divert seepage from the canal and pumping the impounded water to a manhole on the NWB culvert. This dam was constructed using cast concrete blocks installed upstream of the pond inlet. Sediment controls were installed around the pond area to minimize pumping particulates to the new culvert. Standing water in the pond was pumped to NWB, removing water to the practicable lower limit, which exposed the bottom of the pond.

3.8.3 Pond Bottom Preparation

Wood debris (i.e., downed trees and remnant stumps) was found at the bottom as the pond was dewatered. The wood debris was removed, to the extent practicable, to prepare the pond bottom for the cover materials (i.e., geotextile and stone). A geogrid (geosynthetic reinforcement material; Tensar BX 1100, Manufactured by Tenax Corp. [Pittsburgh, PA]) was spread over the exposed sediment surface as additional support for the cover materials. The geogrid enabled use of low ground pressure (LGP) equipment to spread the crushed stone on top of the geotextile layer. Without the geogrid layer, placement of stone by equipment based outside the pond and manual spreading would have been necessary. A field demonstration was held to show that the combination of a geogrid and geotextile under the crushed stone adequately supported LGP equipment needed to spread the stone. Permission was granted to use this technique.

3.8.4 Pond Cover Construction

The geogrid was placed over the pond subgrade and adjacent panels were tied together in accordance with manufacturer's instructions. Above the geogrid, a geotextile conforming to Specification Section 02233, was laid out in rolls, with adjacent panels overlapped by 12 inches, covering the area of the pond to receive a stone cover. A layer of Pipe and Manhole Bedding material (Specification Section 02200), 12 inches in thickness, was spread and graded over the geosynthetic layers, atop the exposed pond subgrade.

3.8.5 Pond Restoration

The pond was restored after the stone protective cover was placed. Flow was restored to the pond when dewatering operations stopped and the temporary dam was removed. The outlet from the pond to NWB culvert was completed before the pond cover was placed. The invert elevation of the outlet pipe was set at one-foot above the prior pond outlet to compensate for the thickness of stone cover placed over the pond area. As a consequence, the completed pond maintained approximately the same water depth and surface area as the pre-CM construction pond.

CM work in the CCP began in July 2000, with the installation of the influent water diversion devices. Dewatering operations continued through the summer and fall, into the winter of 2000-2001. In January 2001, CM construction in the pond area commenced. CM construction in the CCP was completed and flow was restored in February 2001.

Visual observation by the CQA team during construction of the cover layers indicated that an adequate thickness (12 inches) of crushed stone was placed. Survey data were not provided for this area.

3.9 WETLAND WEST OF MPS DEPOSITS REMOVAL

3.9.1 CM Requirements

Soils in the Wetland West of the MPS were required to be excavated to a pre-defined depth and excavated soil placed as subgrade material in the PCA in accordance with the CM Design. The resulting excavation was to be backfilled with clean soils and the surface stabilized with vegetation.

3.9.2 CM Construction Activities

Soil was excavated to the vertical and horizontal limits as required by the CM Design and as shown on the Drawings. In May 2001, a trackhoe was used to excavate to the required depth of 2.5 feet below the pre-existing surface, over an area of approximately 0.24 acre. Soils excavated from this area (approximately 2,900 cubic yards) were transported by off-road trucks and were deposited and spread as subgrade material in the PCA south of the railroad embankment. The excavated area was backfilled with two fill layers. The lower 2 feet consisted of Select Fill conforming to Specification Section 02200. The upper 0.5 foot was Topsoil (the vegetation support layer), also conforming to Specification Section 02200. Backfill materials were placed and graded. The final surface closely approximated the pre-CM surface. After fine grading, the topsoil layer was seeded with perennial grass by the hydroseeding method (Section 3.2.2.7), in accordance with Specification Section 02925.

Seeding was completed in the summer of 2001. A healthy growth of grass has continued in this area each growing season.

3.9.3 Surveys

Pre-excavation, post-excavation and finished grade surveys of this CM activity area were performed and are presented in the Record Drawings (Thew Associates dwg nos. CK2509-08-00-5.1 and CK2509-08-00-5.2.

3.10 STORMWATER IMPOUNDMENT BASIN SOIL REMOVAL

3.10.1 Removal Programs

The Stormwater Impoundment Basin (SIB), formerly used to collect on-site stormwater, was decommissioned as part of CM construction, in accordance with the CM Design. The SIB was decommissioned after construction of the on-site surface water drainage system (Section 3.4), when the SIB was no longer needed.

3.10.2 Decommissioning Activities

The following steps were used to decommission the SIB:

- Accumulated water in the SIB was sampled, analyzed and found to be in compliance with the SPDES discharge criteria, and was released;
- Chain link fencing along the north, east and west side of the SIB was removed and disposed off-site;
- The membrane liner was removed and disposed of off-site;
- Soil within the SIB was excavated down to a plane formed by a surface at 4 feet below the grades at the perimeter of the basin (where the bottom of the basin was greater than 4 feet below the perimeter elevations, no additional soil was removed);

- Excavated soil was transported and deposited below the subgrade level in the PCA at the MPS;
- Existing underground pipes exposed during the above steps were plugged and sealed at the sides of the basin or excavation;
- The excavation was backfilled with Select Fill (Specification Section 02200), placed in 12-inch lifts and compacted, to approximately 3 inches below adjacent (asphalt surface) grades;
- A surface asphalt pavement was constructed over the former area of the basin and blended into the adjacent pavement grades; and
- Manholes containing drainage piping connecting the SIB to Outfall 103 (that formerly drained the SIB to the river) were decommissioned in accordance with Specification Section 02060.

3.10.3 Surveys

The limits of CM activities for the SIB and finished pavement topography are shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-9.0). Survey measurements of the post-excavation surface in the SIB area were not taken by the contractor. Observations by the CQA during the decommissioning of the SIB indicate that the excavation likely reached the required depth.

3.10.4 Consequences to Outfall 103 Flow

Subsequent to decommissioning of the SIB and associated drainage manholes, field observations revealed a residual water discharge from Outfall 103 to the river. Initial investigations into the source of this flow indicate that it is likely the result of infiltration of water in the pipe bedding through loose joints in the pipe sections. Residual water discharge stopped when segments of the pipe were excavated, exposed pipe ends were grout-sealed and bedding material was disrupted in August 2004. This is discussed further in Section 4.10.

3.11 MISCELLANEOUS COMPONENTS

3.11.1 Erosion and Sediment Controls

Temporary erosion control measures were used until permanent erosion control features [e.g., vegetation, rip-rap, road stone, asphalt] were established as required in the CM Design documents (including referenced guideline and permits). The primary erosion and sediment controls were silt fences and straw bales, with straw mulch used over seeded areas during vegetation development. These were augmented, where appropriate, with temporary swales, temporary surface grading and dewatering operations. The erosion control plan followed during CM construction met with requirements of the following documents:

- Specification Section 02931;
- New York State Guidelines for Urban Erosion and Sediment Control;
- SPDES Stormwater Regulations; and
- SPPP for the Site.

Over the course of the construction, there were no known instances of significant deviation from the erosion and sediment control requirements.

3.11.2 Permanent Access Roads

Two permanent access roads were constructed to provide general site access routes across the PCA and RCRA Cap areas of the MPS. One road extends from the northeast corner of the PCA north of the railroad embankment to the northwest corner of the RCRA Cap. The other access road enters the PCA along the north side of the railroad, crosses the tracks (north-south) at grade just inside the property line, then traverses the PCA south of the railroad, extending almost to the western property line. Each of these access roads is approximately 24 feet wide. The access road construction materials include the following:

- Geotextile layer (Specification Section 02233); and

- Crushed Stone (Specification Section 02200).

Construction consisted of laying geotextile over the graded Select Fill along the alignment of each access road, then placing, grading and compacting 12 to 18 inches of Crushed Stone over the geotextile. Side slopes of the Crushed Stone are graded downward at 3 to 4 horizontal to 1 vertical to intersect adjacent grade. The alignment, limits and topography of the access roads conformed to the requirements of the CM Design and are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through CK2509-08-00-3.4).

3.11.3 Security Fencing

Site security fencing was installed around the MPS, in accordance with the CM Design and HWM Permit. This fence is made of galvanized steel, is 8 feet in height, with posts set at 10 feet on-centers, except at gates and corners. Fence posts, rails, gates, fabric, fittings and associated components were in compliance with Specification Section 02831. Security fences surround the following:

- North Lagoon Area CAMU (RCRA Cap area) – fenced on all 4 sides, with a 16-foot wide, double swing gate on the east side, where the north access road enters the cap area;

- Area North of Railroad Property SWMU (part of the PCA) – fenced on the north (canal), east (Warren Co. property) and south (Railroad) sides, with the west side common with the east side of the fence around the CAMU), with a 16-foot wide, double-swing gate on the east side, where the north access road begins; and

- Area South of Railroad Property SWMU (part of the PCA) – fenced on the north (Railroad), east (Railroad) and south (along the crest of the riverbank slope, which is part of the Area South of Railroad Property SWMU) and west Property line between the MPS and GFLCC. Two 16-foot wide, double-swing gates on the south side, provide access to the Level Spreaders on the riverbank (Section 3.4.2.3).

The alignment of the security fence and the locations of gates are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through CK2509-08-00-3.4).

3.11.4 Monitoring Well and Piezometer Adjustments and Abandonment

Several monitoring wells and piezometers were abandoned during CM construction. These wells and piezometers were abandoned by Layne-Christensen in accordance with Specification Section 02630. Abandoned wells/piezometers are listed on Table 3.11.4-1, which also includes summary information regarding reasons for and dates of abandonment, and whether or not a replacement was installed. Note that this table includes wells/piezometers that were abandoned (by others) in 1998 in anticipation of their replacements being installed as part of the CM construction.

The extraction wells associated with the former Building 56 area groundwater extraction system also were abandoned as part of the CM construction activities. This extraction system was kept operational as long as possible. CM construction activities necessitated termination of the Building 56 area groundwater extraction system during the summer of 2000. The abandoned extraction wells downgradient of Building 56 are identified in Table 3.8.7-1 with the prefix WMW.

As necessary, casings were adjusted for monitoring wells and piezometers (i.e., casings extended or cut down and new protective cover installed) in accordance with details shown on the CM Design Drawings. These adjustments were performed by Layne-Christensen. The location, casing elevation data and well identification designation for wells and piezometers remaining after CM construction are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-3.1 through CK2509-08-00-3.4).

3.12 CONFORMANCE TESTING

Soil materials and geosynthetic materials used in the CM construction complied with designated standards and/or project-specific criteria. Materials testing data formed the basis for accepting the soil and geosynthetic materials for use in CM construction.

Soil test data were provided for the following materials:

- Cushion soil;
- Clayey fill;
- Select Fill;
- Topsoil;
- Pipe & Manhole Bedding;
- Coarse Stone; and
- Coarse Aggregate.

Soil materials test data supporting use in CM construction are presented in Appendix E.

Geosynthetic test data were provided for the following materials:

- Geomembrane;
- Geocomposite Drainage Layer; and
- Geotextile.

Geosynthetic materials test data supporting use in CM construction are included in Appendix F.

TABLE 3.11.4-1

ABANDONMENT PROGRAM FOR MONITORING WELLS AND PIEZOMETERS

Well/Piezometer Approved for Abandonment (a)	Zone Monitored	Reason for Abandonment (b)	Year Abandoned	Well Replaced?	Replacement Well#
AW-B6	Horizon B	5	1998	No	
AW-C3	Horizon C	5	1998	No	
AW-C4	Horizon C	5	1998	No	
Aw-C5	Horizon C	5	1998	No	
AW-C 6	Horizon C	1	1998	Yes	AW-C11
IP- 1	Overburden	3, 5	1998	No	
IP- 2	Overburden	2, 3, 5	1998	No	
IP- 3	Overburden	2, 3, 5	1998	No	
MW- 4	Undefined	5	1998	No	
MW- 5	Overburden	5	1998	No	
MW- 6	Horizon A	1	1998	Yes	AW-A14
MW- 7	Overburden	1	1998	Yes	MW-OB25
MW-13	Undefined	1, 4	1998	No	
MW-14	Overburden	1	1998	Yes	MW-OB26
MW-16	Overburden	3, 5	1998	No	
MW-20S	Horizon A	2, 3	1998	Yes	AW-A16
MW-34	Undefined	4, 5	1998	No	
MW-35D	Horizon B	1, 5	1998	No	
MW-35S	Horizon A	1, 5	1998	No	
MW-OB 3	Overburden	3, 5	1998	No	
MW-OB 4	Overburden	3, 5	1998	No	
MW-OB 6	Overburden	2, 3	1998	Yes	MW-OB24
MW-OB10	Overburden	1	1998	Yes	MW-OB27
MW-OB11	Overburden	1, 5	1998	No	
MW-OB12	Overburden	2, 3, 5	1998	No	
P-46	Overburden	3, 5	1998	No	

TABLE 3.11.4-1 (Continued)

ABANDONMENT PROGRAM FOR MONITORING WELLS AND PIEZOMETERS

Well/Piezometer Approved for Abandonment (a)	Zone Monitored	Reason for Abandonment (b)	Year Abandoned	Well Replaced?	Replacement Well#
P-53	Overburden	5	1998	No	
P-71	Overburden	5	N/A (c)	No	
P-A2	Undefined	3, 4, 5	1998	No	
P-A3	Horizon A	3, 5	1998	No	
WMW- 1	Overburden	1, 5, 6	2001 (d)	No	
WMW- 2	Overburden	1, 5, 6	2001 (d)	No	
WMW- 3	Overburden	1, 5, 6	2001 (d)	No	
WMW- 4	Overburden	1, 5, 6	2001 (d)	No	
WMW- 5	Overburden	1, 5, 6	2001 (d)	No	
WMW- 6	Overburden	1, 5, 6	2001 (d)	No	
WMW- 7	Overburden	1, 5, 6	2001 (d)	No	
WMW- 8	Overburden	1, 5, 6	2001 (d)	No	
WMW- 9	Overburden	1, 5, 6	2001 (d)	No	
WMW-10	Overburden	1, 5, 6	2001 (d)	No	

(a) Approved for abandonment by NYSDEC

(b) Reasons for abandonment:

1. Proximity to french drain excavation.
2. Located in drainage swales.
3. To facilitate activities in RCRA Cap area.
4. Well did not monitor a discrete water-bearing zone.
5. Well position not needed to evaluate system performance or potentiometric surface mapping.
6. Extraction well for decommissioned existing (Building 56) collection system.

(c) Well not located

(d) Extraction well for decommissioned Building 56 Area Groundwater Extraction System-abandoned during CM construction

4.0 FIELD CHANGES

4.1 RELOCATED WEIR BROOK

4.1.1 Description of Field Change

The design alignment for NWB Culvert was shown on Drawing No. 60484-008 and the proposed profile on Drawing No. 60484-009 (Eckenfelder Engineering P.C. – June 1999). This planned alignment connected the existing sluice chamber at the drain for the Glens Falls Feeder Canal (canal) to a headwall at the Hudson River. The design utilized an old structural stone tunnel, founded on bedrock and running under the railroad embankment. An alternative alignment was proposed that eliminated one of the manholes and used a steel sleeve, which was to be jacked through the railroad embankment (as opposed to going through the old tunnel). This proposal included modifying the design profile of relocated NWB Culvert to cross beneath the railroad at a depth much shallower than the bottom of the stone tunnel. Other than the realignment, altered profile and elimination of one manhole, no other changes were proposed to the designed culvert.

4.1.2 Rationale for Change

The following elements formed the basis for the change:

- Deep excavations (on the order of 20 to 25 feet in depth) to access the existing tunnel under the railroad embankment would be eliminated, along with the extensive measures that would have been needed to mitigate the risk of destabilizing or undermining the railroad embankment.

- Using a jacked steel sleeve as the protective conduit for the 48-inch diameter HDPE culvert pipe would enable crossing the railroad at the minimum depth permissible by the Railroad, thereby greatly reducing the volume of excavation necessary to install the culvert.

- Working in shallower trenches would result in less dewatering and reduced risk to workers.

- By using a sleeve to cross the railroad, the culvert alignment could be straightened somewhat, shortening its overall length.

- The proposed alignment enabled elimination of one manhole from the culvert system.

- The proposed alternative would reduce overall time needed to construct this culvert.

4.1.3 Impacts to Approved CM

The proposed changes to the alignment and profile did not compromise the basis or functionality of the design, nor would these changes adversely alter the performance of NWB. Consequently, the proposed alternative was accepted and constructed. The "as-built" configuration and profile of NWB culvert is shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-6.0, CK2509-08-00-6.1 and CK2509-08-00-6.2).

4.2 SOUTH TUNNEL CHAMBER BYPASS TO NEW WEIR BROOK

4.2.1 Description of Field Change

The NWB piping system was designed to intercept upgradient waters, where they enter the site and to convey them to the Hudson River (CM Design Drawings 60484-008). After construction of NWB, the OWB piping system (including manhole and catchbasin components), which formerly conveyed these waters, was decommissioned by plugging pipes and blocking flow through manholes and catchbasins. However, as CM construction proceeded, significant flow continued along the old alignment. This flow was ultimately collected in the French Drain, which transects the OWB System alignment, just south of the crest of the riverbank slope. Observed flows along the OWB System exceeded the design flow of the French Drain.

Observations indicated flow north of the railroad was accumulating in the tunnel under the embankment, which is a low local segment of the system. Observations indicated that water level rose in the tunnel chambers and would have overflowed to the ground surface, unless pumping was started. During power failures, either electrical or fuel related, the pumps shutdown and the chambers and tunnel filled with water that overflowed to the French Drain excavation. After it became apparent that continuous pumping would be necessary, it was agreed that a temporary bypass pipe would be constructed connecting the South Tunnel Chamber to the NWB. Based on observations at the South Tunnel Chamber, flow was estimated to be in the range about 50 gpm to 500 gpm. A 12-inch diameter HDPE pipe, at a slope of 0.57% was constructed as a gravity line to keep the chamber from flooding thereby eliminating the need for continuous pumping. The bypass joins NWB just south of manhole WMH-5. The location and invert elevations of this bypass line are illustrated on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-6.0).

4.2.2 Rationale for Change

The construction bypass was needed to relieve water accumulating in the tunnel and its chambers (north and south), which threatened to overflow the south tunnel chamber after the outlet from this chamber to OWB was plugged. Overtopping the chamber would have the potential to cause surface erosion and scour in areas downgradient of the chamber. Gas and electric pumps had proven unreliable for controlling incoming water on a continuing basis. A gravity drain from the south chamber to NWB was deemed to be an effective and reliable method to continuously drain water from the chambers and tunnel.

4.2.3 Impacts to Approved CM

Presently, the bypass conveys waters accumulating along OWB, mostly north of the railroad. This water has flowed through bedrock or other materials beneath the Site and into OWB. Therefore, some quantity of site contact water is co-mingled in NWB.

The bypass diverts flow that would otherwise be collected by the GWES. The diverted flow appears to be in the range of 50 to over 500 gpm (depending in part on climatic conditions). If not diverted, this flow would exceed the design capacity of the GWES and would probably result in overflow of the French Drain. Efforts are expected to continue to find a solution to the water influx from offsite areas.

4.3 FRENCH DRAIN ALIGNMENT AND GRADES

4.3.1 Description of Field Changes

The alignment of the French Drain was shifted to the south by up to about 5 feet between MH-2 and MH-3. Between Sump B and MH 5, the alignment gradually shifted south of the design path by about 3 feet, then north by an equal amount to rejoin the design alignment.

Invert elevation of the french drain pipes at the manholes and sumps are consistent with the CM Design. However, the grades of the pipes between manholes/sumps differ somewhat from the straight line alignment shown in the design.

4.3.2 Rationale for Changes

The alignment was adjusted between MH 2 and MH 3 to provide access for construction equipment where the alignment passed directly to the south of the Building 56 pad, which was to remain intact. Between Sump B and MH 5, the alignment was adjusted to avoid a large, buried, concrete foundation that was encountered during excavation.

Localized minor changes in the grades and alignment of the French Drain occurred during construction.

4.3.3 Impacts to Approved CM

The groundwater collection pipes are below the top of the adjacent lacustrine clay unit and above the typical river stage, as called for in the CM design. The changes in alignment and grades are not expected to have adverse impacts on the function or performance of the French Drain. The "as-built" alignment and profile of the French Drain are shown on the Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-8.0 and CK2509-08-00-8.1).

4.4 GWES FORCEMAIN AND POWER/DATA CABLE ALIGNMENT

4.4.1 Description of Field Changes

From forcemain Station 0+00 to Sta. 5+50, the alignment of the forcemain, power cable and data cable was changed from the path shown in the CM Design. The forcemain, power cable and data cable were moved from south of the well chambers to a parallel routing north of the well chambers and South Access Road.

4.4.2 Rationale for Changes

The alignment was moved to reduce the risk of accidental damage by ongoing construction activities along the riverbank south of the well vaults.

4.4.3 Impacts to Approved CM

Changes to the alignment of the forcemain, power cable and data cable were found to have no adverse impact on the function or performance of the CM Design. The "as-built" alignment and profile of the forcemain, power and data cables are shown on the record drawings (Thew Assoc. dwg. nos. CK2509-08-00-7.1 through CK2509-08-00-7.4).

4.5 RELOCATION OF WEST LEVEL SPREADER ON RIVERBANK

4.5.1 Description of Field Change

Construction of the west level spreader on the riverbank was shifted approximately 65 feet to the west from the location in the CM Design. Dimensions of the level spreader, as well as spreader and pipe invert elevations, were not changed.

4.5.2 Rationale for Change

Excavation along the western side of the Building 56 pad revealed that its southwest corner was partially buried, obscuring its view during design. The buried corner was discovered during construction. The level spreader was relocated 65 feet to the west to avoid having to cut the pad.

4.5.3 Impacts to Approved CM

Shifting the west level spreader on the riverbank does not affect its function or performance of the CM design. The final location avoids the buried corner of Building 56 pad and is compatible with the alignment of the storm drain entering the level spreader. The "as-built" location of this level spreader is shown on the Record Drawings (Thew Assoc. dwg. no. CK2509-08-00-3.3).

4.6 SUBGRADE AND FINISHED GRADE CONTOURS

4.6.1 Location and Extent of Grading Changes

<u>RCRA Cap Area</u>

The RCRA area was capped in accordance with the CM Design. Subgrade elevations in the RCRA Cap area were achieved by grading materials within its footprint and by bringing in designated deposits removed from the shoreline of the Hudson River. The design drawings and specifications recognized that final subgrade contours would vary from those shown on the drawings due to uncertainties about the volume of material to be put under the cap and how those materials would compact. The performance-type specification required a subgrade generally parallel to contours shown on the Drawings, but not necessarily at the same elevation. The Record Drawing show the as built RCRA Cap subgrade, top slope and side slopes generally parallel the contours in the CM Design.

Permeable Cover Area

Permeable cover was installed in accordance with the CM Design. Subgrade elevations in the PCA were achieved by grading materials within the footprint of the PCA and by bringing in soil excavated from the SIB and designated deposits removed from the PBA. The design drawings and specifications recognized that actual subgrade contours would vary from those shown on the drawings due to uncertainties about the volume of materials generated from demolition and earthwork activities on the MPS, or excavated from the PBA, and how those materials would compact. The performance-type specification required a subgrade generally parallel to contours shown in the CM Design, but not necessarily at the same elevation. The Record Drawings (Thew Assoc. dwg. nos. CK2509-08-00-1.1 through CK2509-08-00-1.4) show the PCA subgrade. Top and side slopes are essentially parallel to the contours shown in the CM Design.

4.6.2 Rationale for Changes

Small differences in the final elevations and contours were anticipated in the CM Design. Subgrade contours were constructed to be relatively uniform so final cover materials could be put down as required. The subgrade contours were adjusted slightly, as needed, to balance the cut and fill for soil (and other site materials, such as, crushed masonry from former structures), deposits removed along the edge of the Hudson River (put in the RCRA Cap area) and the PBA (placed in the PCA). Changes in the subgrade contours resulted in a corresponding change to the finished grade contours. Finished grade contours were established by applying the required thickness of cover material (RCRA Cap or Permeable Cover soil) above the constructed subgrade.

4.6.3 Impacts to Approved CM

Preparation of the subgrade and distribution of cut and fill materials did not vary greatly from those anticipated during design. Consequently, "as-built" subgrade contours are consistent with the CM Design. Cover soils were placed and graded to the required thickness. Finished grade contours are also consistent with the design. Minor differences between the "as-built" finished grade contours and those in the CM design do not adversely impact the performance of the completed CM construction.

4.7 SECONDARY PUMPING EQUIPMENT IN FRENCH DRAIN SUMP B

4.7.1 Description of Change

A secondary pumping system was installed in Sump B to manage additional flow encountered along the French Drain in the area of OWB. Water level response to dewatering efforts during construction indicated that the design pump (1 HP, 10 to15 gpm) would not be adequate to draw the water level in the vicinity of Sump B down below the top of the lacustrine clay unit. Flow emanating in the vicinity of OWB was estimated to be about 50 to 60 gpm. To manage this additional flow, a 5 HP, 75 gpm (Grundfos Model No. 75S50-8) secondary pump was installed in Sump B and wired with level controls and a flow meter. This secondary pump discharges to a separate 2-inch dia. forcemain, which was installed parallel to the design forcemain. The forcemain from the secondary pump is constructed of HDPE pipe with thermally fused joints and fittings and is buried at a depth of approximately 4 feet below grade. Materials of construction are the same as for the design forcemain (Section 3.5.1.5). The secondary forcemain is bedded and backfilled in accordance with Specification Section 02200. This forcemain was successfully pressure tested in accordance with Specification Section 02700.

4.7.2 Rationale for Change

Groundwater flow to Sump B exceeded the capacity of the design pump. Additional pumping capacity was needed to achieve capture of overburden groundwater. Flow rate estimates made during construction indicated that additional pumping of 50 to 60 gpm (against its operating head) were needed to control water levels in the sump within the desired range. An additional pump, controls, instrumentation and discharge forcemain were installed. Concurrent with this report, plans are in process to design and construct a larger (e.g., 4-inch) forcemain to handle flow from the secondary pump in Sump B.

4.7.3 Impacts to Approved CM

Installation and operation of the secondary pump in Sump B supports the intended performance of the constructed CM. Performance of the pumping systems in Sump B are being monitored.

4.8 RIP-RAP SCOUR PROTECTION ON RIVERBANK

4.8.1 Description of Change

Scour/erosion gullies developed at three locations along the riverbank slope following major precipitation events. The first was on the riverbank southwest of Building 45 pad. The second was on the riverbank southwest of Building 56 pad. The third was about 50 feet southeast of the generator station (near the railroad grade-crossing at the east side of the PCA). At each location, precipitation runoff concentrated and caused scour and erosion of the topsoil layer down to, or into, the underlying Clayey Fill. Several attempts to reconstruct the Clayey Fill, Topsoil and vegetation in the affected areas failed when more heavy rain fell before vegetation could develop and resist erosion.

Subsequently, geotextile and rip-rap were installed to increase the resistance to erosion. The topsoil layer was removed in each of the affected areas, down to the underlying Clayey Fill. The surface of the Clayey Fill was graded, as needed, and a geotextile (per Specification Section 02200) was placed to cover the exposed soil surface. A 2-foot layer of rip-rap having a D_{50} = 6” (per Specification Sections 02200 and 02570) was placed to cover the areas being repaired.

4.8.2 Rationale for Changes

Localized scour/erosion near the top of the riverbank indicates runoff, during heavy rainfall, was focused by micro-topographic features. Geotextile and rip-rap were installed as cost-effective solutions to resist the scour and erosion. The rip-rap placed on the affected areas of the river bank provides long-term erosion protection to the surface as required by the Erosion and Sediment Control specifications (Section 02931).

4.8.3 Impacts to Approved CM

Installation of geotextile and rip-rap mitigates potential erosion and scour where installed along the top of the riverbank and does not adversely impact performance of the CM.

4.9 RIP-RAP SCOUR PROTECTION IN SWALE

4.9.1 Description of Change

Several scour/erosion gullies developed along the north slope of the swale north of the railroad, after heavy rain events, while vegetation was rooting. At each location, runoff was concentrated and caused erosion of the topsoil layer where the flow velocity increased down the side of the swale. After several attempts to repair the gullies, geotextile and rip-rap were installed to mitigate potential for further scour and erosion. The Topsoil layer was removed in the affected areas, down to the underlying Select Fill. The exposed surface was covered with geotextile and a 6-inch thick layer of rip-rap (having a D_{50} = 6") (per Specification Section 02200).

4.9.2 Rationale for Change

Localized scour/erosion along the swale indicates runoff, during heavy rain, was focused by micro-topographic features. Geotextile and rip-rap were installed as cost-effective solutions to resist the scour and erosion. The rip-rap placed along the north swale provided long-term erosion protection to the surface as required by the Erosion and Sediment Control specifications (Section 02931).

4.9.3 Impacts to Approved CM

Installation of geotextile and rip-rap mitigates potential erosion and scour where installed along and does not adversely impact performance of the CM.

4.10 RESIDUAL FLOW FROM OUTFALL 103

4.10.1 Description of Change

The intent of the CM Design was to decommission Outfall 103 by plugging it downgradient of the SIB. However, a residual flow of about 5 to 15 gpm was observed end of Outfall 103 after plugging former SIB outlet pipes and manholes. In August 2004, two segments of the pipe were excavated at two locations along the outfall pipe, upgradient of the SIB. Bedding material was disrupted to impede flow along the pipeline. After the pipe segments were removed, the exposed ends of the remaining pipe were plugged with flowable grout and each excavation was backfilled. Removing these pipe segments, disrupting the bedding and plugging the pipes stopped flow to the outfall. Subsequently, the fiberglass weir at the riverbank end of the pipe was removed and the area filled with rip-rap.

4.10.2 Rationale for Change

Plugging the manholes failed to stop flow from the Outfall 103. CCTV survey of the interior indicated that some water was infiltrating the piping. Because of a potential to develop hydrostatic pressure in the pipe if plugged near the end, the method of decommissioning was modified. It was concluded that by blocking infiltration and the flow along the pipe (through bedding material) discharge could be eliminated as well as the likelihood of causing hydrostatic pressure in the pipe. Stopping the infiltration required removing sections of the pipe, plugging open ends and disrupting the surrounding material. The ends of pipes remaining in place were plugged with flowable grout.

4.10.3 Impacts to Approved CM

The residual water discharge stopped when segments of the pipe were excavated and bedding material was disrupted. Decommissioning of Outfall103 was completed in August 2004, fulfilling a requirement of the CM Design. The discharge flume at the riverbank was removed and rip-rap was placed along the bank to slow surface erosion protection in that area.

4.11 PBA WETLANDS MITIGATION AREA

4.11.1 Description of Change

Final grading of the western 800 (±) feet of the PBA wetlands mitigation area differed from the CM Design. Portions of this area were slightly higher than designed while other parts were lower. These slight elevation differences (generally on the order of 1/2 foot or less) resulted in the following changes to the CM Design.

- Location of the mitigation area was further west and closer to the main river channel than planned (CM Work Plan, BC, 2001);
- Shape of the mitigation area was somewhat broader than planned;
- Area for mitigation was slightly larger (Section 3.6.1.9), and;
- Some micro-topographic depressions were left following remediation (per USACE request).

4.11.2 Rationale for Change

The final grades did not differ greatly from the design, but, due to the gentle slopes, small changes in elevation resulted in significant horizontal changes in the position of the final contours. Comparison of pre-and post excavation surveys verified the designated deposits were removed to the CM requirements. Further, evaluation of the finished grade survey drawings revealed that the net increase in emergent wetland area exceeded that which was required by the selected CM Design. Based on these findings, the remaining concern was whether or not the configuration of the mitigation area satisfied the requirements of the USACE. During a site reconnaissance on April 12, 2004, USACE agreed to:

- Accept substitute "as-built" location for wetland mitigation;
- Accept to substitute "as-built" area between elevation +210 and +212, for the configuration and area in the CM Design;
- Most of the plant species that presently inhabited the wetland area could remain;
- Certain wetland species (e.g., purple loosestrife) that could impede development of species to be planted according to the approved CM might have to be culled; and
- Existing micro-topographic depressions and vegetation therein are desirable and should remain.

4.11.3 Impact to Approved CM

The "as-built" wetlands mitigation area, configuration and grades are acceptable to the USACE. Differences from the CM Design have no material impact on the wetland mitigation.

4.12 PBA ACCESS DETERRENT DEVICES

4.12.1 Description of Change

The CM Design called for installation of pipe bollards in an earthen berm across the former access Road into the PBA, adjacent to the railroad. In lieu of the berm and bollards, precast concrete blocks were stacked, in pyramid style across the access road, extending the edge of the railroad ballast to the steep portion of the riverbank.. Signs advising "NO

TRESPASSING" were also installed uphill of the precast blocks and local law enforcement was notified of the access restrictions.

4.12.2 Rationale for Change

Observation made by site personnel during and after the CM construction activities noted that "dirt bikes" and "quads" were entering the PBA via the access road. These observations suggested that a berm and bollards might not provide sufficient deterrent to such vehicles. Use of stacked, precast concrete blocks would, on the other hand, present a near vertical obstacle to passage of such vehicles.

4.12.3 Impact to Approved CM

Substitution of stacked precast concrete blocks for an earthen berm and pipe bollards as an access deterrent has no adverse impact on the performance of the CM.

5.0 CONCLUSIONS

The conclusions presented below are based on daily observations made and records prepared by the CQA team; submittals and other documents (e.g., progress statements, photographs and work schedules) prepared by the Contractor during the progress of the CM construction; and record drawings supplied by the surveyors after construction was completed. Relying on these data sources, BC presents the following conclusions regarding the construction of the major elements of the CM design:

- CM construction is complete and the Site is now in the Post-Closure (O&M) phase of Corrective Measures Implementation (CMI).

- The major elements of the CM construction, described individually in preceding sections of this report, are constructed to the lines, grades and limits intended by the CM Design Drawings and Specifications, are consistent with the intent of the selected CM Design and are in conformance with requirements of the HWM Permit and other applicable permits.

- Certain components of the CM as constructed differ in minor aspects from the CM Design (Section 4.0). Except as noted in Section 4.2 (South Tunnel Chamber Bypass to New Weir Brook), the changes from the design do not alter the performance of the affected component with respect to the intent of the CM Design. Approaches for addressing the flow in the bypass are being considered. Until an approach to address this flow is implemented, it will be necessary to continue operation of the bypass.

- O&M activities associated with the CM are in progress, as follows:

    - The Post-Closure Plan (ECKENFELDER Engineering P.C.,. Corrective Measures Design, June 1999, Attachment D) is the CM guidance document for O&M operations at the Site.

- The CM Groundwater Monitoring Plan (a component of the Post-Closure Plan) is the guidance document for monitoring and reporting the performance of the GWES, as well as groundwater quality in bedrock Horizon C and the overburden. An updated Groundwater Monitoring Plan was submitted to NYSDEC on April 5, 2004.

- O&M activities for the GWES and other components of the constructed CM are in progress. At present, these are being managed by Hour Electric, Inc., as the contracted operations firm.

- Wetlands monitoring and annual reporting will continue for five years in accordance with the USACE Order issued June 16, 2004.

- Point source discharges formerly associated with the Site, under SPDES Permit No. 0005321, are terminated. The Permittee plans to make application to withdraw this permit.

- In accordance with the HWM Permit, Module II.E.2(e), the Permittee will prepare and file a Deed Notice restricting future activities at the Site as stipulated in the HWM Permit.

6.0 REFERENCES

Brown and Caldwell Associates, 2004, Corrective Measures Groundwater Monitoring Plan (GWMP) and Groundwater Monitoring Data Evaluation, Ciba Site, Glens Falls, New York, April 2004.

ECKENFELDER Engineering, P.C., 2000, "Corrective Measures Work Plan, Ponded and Backwater Area, Hudson River Sub-Part Sediments ACO, Ciba Site, Glens Falls, New York" November 2000.

Brown and Caldwell Associates., 1999. "Corrective Measures Design (including the Engineering Report, Drawings, and Specifications), Ciba Site, Glens Falls, New York," June 1999.

ECKENFELDER Engineering P.C., 1998. "Construction Documentation Report, Corrective Measures Implementation, Adjacent Off-Site Land Area of Concern, Ciba Site, Glens Falls, New York," February 1999.

ECKENFELDER Engineering P.C., 1998. "Construction Documentation Report, Corrective Measures Implementation, North Lot, Ciba Site, Glens Falls, New York," February 1999.

New York State Department of Environmental Conservation, December 11, 2000. Modifications to Hazardous Waste Management Permit, Ciba/Hercules Main Plant Site, Corrective Measures Implementation – Including Ponded Backwater Area, Town of Queensbury, Warren County, New York, DEC Permit Number: 5-5234-00008/00096 (Part 373) and 5-5234-00008/00099 (Protection of Waters); EPA Identification Number: NYD002069748

New York State Department of Environmental Conservation, January 12, 1999. Statement of Basis for Ciba Specialty Chemicals Corporation and Hercules Incorporated Off-Site Soil/Sediment/Waste Remediation, Main Plant Site, Lower Warren Street, Glens Falls, New York, 12801, EPA I.D.: NYD002069748.

New York State Department of Environmental Conservation, January 12, 1999. 6NYCRR Part 373 Permit Modification and Statement of Basis Fact Sheet for Ciba Specialty Chemicals Corporation and Hercules Incorporated Off-Site Soil/Sediment/Waste Remediation, Main Plant Site, Lower Warren Street, Glens Falls, New York, 12801, Town of Queensbury, Warren County.

New York State Department of Environmental Conservation, SPDES General Permit for Stormwater Discharges from Construction Activities that are Classified as "Associated with Industrial Activity", Permit No. GP-93-06.

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U.S. Army Corps of Engineers, June 12, 2001, Permit No. 2000-00587-YN.

US Army Corps of Engineers, Nationwide Permit 38, Cleanup of Hazardous and Toxic Waste, Reissued 12/96.

New York Codes, Rules and Regulations, Title 6 (6 NYCRR), Subpart 360-2.7, Solid Waste Management Facilities, Landfills, Engineering Report.

New York Codes, Rules and Regulations, Title 6 (6 NYCRR), Subpart 373-Hazardous Waste Management Facilities.

New York Codes, Rules and Regulations, Title 6 (6 NYCRR), Subpart 608, Use and Protection of Waters.

New York Guidelines for Urban Erosion and Sediment Control, Third Printing, October 1991.