TIERRA SOLUTIONS, INC.

Transmitted Via Federal Express

March 20, 2013

U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, New York 10007-1866
Attn: Elizabeth Butler

Re: Administrative Settlement Agreement and Order on Consent for Removal Action, USEPA Region 2 CERCLA Docket No. 02-2008-2020 – **Final Construction Report – Phase I Removal Action**, *CERCLA Non-Time-Critical Removal Action – Lower Passaic River Study Area*

Dear Ms. Butler:

Tierra Solutions, Inc. (Tierra; funding and performing, on behalf of Occidental Chemical Corporation, the subject Administrative Order on Consent [Removal Action AOC]) is hereby submitting the Final Construction Report for the Phase I Removal Action to U.S. Environmental Protection Agency (USEPA). This Final Construction Report has been prepared pursuant to the Removal Action AOC to document the work performed during the Phase I Removal Action and to describe the achievement of the established design objectives and the substantive requirements established in the permits and permit equivalencies.

If you have any questions about this submittal, please feel free to contact Rob Reed of ARCADIS at (315) 671-9457.

Sincerely,

Tierra Solutions, Inc.

Paul J. Bluestein
Project Coordinator
On behalf of Occidental Chemical Corporation
(as successor to Diamond Shamrock Chemicals Company)

Enclosures

Hard Copies:

1c: New Jersey Department of Environmental Protection
Site Remediation Program
401 E. State Street
P.O. Box 028
Trenton, New Jersey 08265-0028
Attn: Mike Burlingame

1c: ARCADIS
6723 Towpath Road
P.O. Box 66
Syracuse, NY 13214-0066
Attn: Robert A. Reed

1c: The Intelligence Group
126 N. Salina St.
Syracuse, NY 13202
Attn: Bob Romagnoli

Electronic Copies

1e: USEPA Facilities, Region 2
Raritan Depot
2890 Woodbridge Avenue
Mail Code: MS211
Edison, NJ 08837-3679
Attn: Michael Hoppe

Final Construction Report

Lower Passaic River Study Area

Phase I Removal Action

Tierra Solutions, Inc.

East Brunswick, New Jersey

March 2013

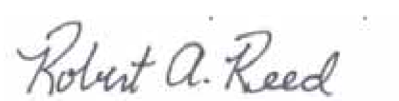
Final Construction Report

CERCLA Non-Time-Critical
Removal Action
Lower Passaic River Study Area

March 2013

Barry Kellems
Principal Engineer, ARCADIS U.S., Inc.

Matthew Bowman
Construction Manager, ARCADIS U.S., Inc.



Robert Reed
Quality Assurance Manager, ARCADIS U.S., Inc.

Table

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Acronyms and Abbreviations

2008 AOC	Administrative Order on Consent Docket No. 02-2008-2020
Abscope	Abscope Environmental Inc.
Aragonite Incinerator	CHES Aragonite Hazardous Waste Incinerator Facility
ATON	aids to navigation
Brills Yard	Brills Yard Transload Facility
CB	construction bulletin
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CHASP	Community Health and Safety Plan
CHES	Clean Harbors Environmental Services, Inc.
COC	constituent of concern
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
cy	cubic yard(s)
DAR	Design Analysis Report
DDT	dichlorodiphenyltrichloroethane
EM	Environmental Media
EPIC	Environmental Protection and Improvement Company
FM	field modification
ft	foot/feet
GAC	granular activated carbon
Grassy Mountain	Grassy Mountain Subtitle C Landfill
Greenville Yard	Weeks' Greenville Yard in Jersey City, New Jersey
GWTS	groundwater treatment system
HASP	Health and Safety Plan
HAZ	Hazardous Characteristic Material
HDPE	high-density polyethylene
Lone Mountain	Lone Mountain Subtitle C Landfill Facility
LPRSA	Lower Passaic River Study Area
MMF	multimedia filtration
Nicholson	Nicholson Construction Company
NJDEP	New Jersey Department of Environmental Protection
NMFS	National Marine Fisheries Service
OU-1	Operable Unit 1
OSI	Ocean Surveys, Inc.

PAM	perimeter air monitoring
PCB	polychlorinated biphenyl
PLC	programmable logic controller
PPE	personal protective equipment
PSE&G	Public Service Electric and Gas Company
QAPP	Quality Assurance Project Plan
RAO	Removal Action Objective
RAWP	Removal Action Work Plan
RTK-DGPS	real-time kinetic digital global positioning system
S-W	Sherwin-Williams
Stuyvesant	Stuyvesant Environmental Contracting, Inc.
TCDD	tetrachlorodibenzo-p-dioxin
Tierra	Tierra Solutions, Inc.
TSS	total suspended solids
TTD	transport, treatment, and disposal
$\mu g/m^3$	micrograms per cubic meter
UPF	upland processing facility
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WC QAPP	Waste Characterization QAPP
Weeks	Weeks Marine, Inc.

1. Introduction

Presented herein is the Phase I Removal Action Final Construction Report (Final Construction Report) for sediment removal activities conducted within the Phase I Work Area, an approximately 2-acre region of the Lower Passaic River Study Area (LPRSA), in Newark, New Jersey. This Final Construction Report has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent Docket No. 02-2008-2020 (2008 AOC; U.S. Environmental Protection Agency [USEPA] 2008) by Tierra Solutions, Inc. (Tierra), and on behalf of Occidental Chemical Corporation; the successor to Diamond Shamrock Chemicals Company (formerly known as Diamond Alkali Company).

The purpose of this Final Construction Report is to document the work performed during the Phase I Removal Action, including Construction Quality Assurance (CQA) monitoring activities, and to describe the achievement of the established design objectives. This Final Construction Report is consistent with the requirements in the 2008 AOC (USEPA 2008).

1.1 Removal Action Design Documents and Construction Plans

The Phase I Removal Action was conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan as a Non-Time-Critical Removal Action in accordance with the USEPA-approved documents listed below[1]. Documentation of USEPA's approvals, which include emails and letters, are provided in Appendix A.

- Final *Enclosure Technical Design Drawings* and *Enclosure Specifications* (Tierra 2011d and 2011c, respectively): provides drawings and specifications for the enclosure. The enclosure drawings and specifications and interim versions of the

[1] Determining the location of the UPF represented one of the major project challenges. During the design process, a number of potential UPF sites were evaluated, and a UPF site was selected during the preliminary design in 2009. However, during the final design process in 2011, the first UPF site was no longer viable due to new concerns and issues of the property owner. To maintain the construction schedule, enclosure design, enclosure RAWP, and UPF design documents were submitted for USEPA approval in July and August 2011. The complete design package was submitted in September 2011 and reflected the final UPF location.

Community Health and Safety Plan (CHASP) and the Construction Quality Assurance Plan were approved by USEPA in a letter dated July 28, 2011, from Ms. Elizabeth Butler.

- *Removal Action Work Plan Part 1 – Sediment Excavation Enclosure Component* (RAWP Part 1; Tierra 2011e): provides the implementation plan for the enclosure design element of the Phase I Removal Action and was approved by the USEPA in a letter dated July 28, 2011, from Elizabeth Butler.

- *Upland Processing Facility (UPF) Civil Design Drawings* and *UPF Design Analysis Specifications* (Tierra 2011g and 2011h, respectively): provides drawings and specifications for the UPF and were approved by USEPA in an email dated August 17, 2011, from Elizabeth Butler.

- Final *Design Analysis Report* (DAR; Tierra 2011b): provides and summarizes design analysis memoranda for each component of the Phase I Removal Action design and was approved by USEPA in a letter dated September 29, 2011, from Elizabeth Butler.

- Final *Technical Design Drawings* and *Design Analysis Specifications* (Tierra 2011k and 2011j, respectively): provides the complete Design Drawings and Specifications for the Phase I Removal Action, including previously issued enclosure and UPF drawings and specifications, and were approved by USEPA in a letter dated September 29, 2011, from Elizabeth Butler.

- *Removal Action Work Plan Part 2 – Remaining Removal Action Components* (RAWP Part 2; Tierra 2011l): provides the construction and implementation plan for the UPF and related design elements (i.e., sediment removal; hydraulic pipeline; sediment processing; water treatment and discharge; off-site transport, treatment, and disposal [TTD]; and backfilling) of the Phase I Removal Action. The RAWP Part 2 was approved by USEPA in an email dated November 1, 2011, from Elizabeth Butler. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler.

- *Construction Quality Assurance Plan (CQAP)* and associated Addendum (Tierra 2011i and 2012b, respectively): provides quality assurance plans and requirements for construction. The CQAP and CQAP Addendum were approved by USEPA in emails from Elizabeth Butler dated January 19, 2012, and May 10, 2012, respectively. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler.

- *Removal Action Work Plan Quality Assurance Project Plan (RAWP QAPP)* and Modifications 001 and 002 (Tierra 2011o, 2012e, 2012f, respectively): provides quality assurance procedures for data collection during construction and was approved by USEPA in an email dated January 31, 2012, from Elizabeth Butler. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler.

- *Waste Characterization Quality Assurance Project Plan* (WC QAPP; Tierra 2011p): provides quality assurance procedures for data collection for waste characterization during construction and was approved by USEPA in an email dated April 2, 2012, from Elizabeth Butler. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler.

- *Substantive Requirements Compliance Action Plan* (SRCAP; Tierra 2012g): provides a description of Applicable or Relevant and Appropriate Requirements and how their associated substantive requirements would be met by the design, and was approved by USEPA in an email dated May 21, 2012, from Elizabeth Butler. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler. Permits and permit equivalencies are provided in Appendix B.

- *Final Community Health and Safety Plan* (CHASP; Tierra 2012d): provides the public with a summary of how the project is designed, emergency preparedness and response measures, how complaints will be handled, and was approved by USEPA in an email dated May 14, 2012, from Elizabeth Butler. Formal approval was documented by the USEPA in a letter dated June 29, 2012, from Elizabeth Butler.

- *Construction Health and Safety Plan* (*HASP)* and associated Addenda (Tierra 2011a, 2011f, 2011m, 2011n, 2012a, 2012c, respectively): provides the health and safety procedures and plans for construction activities and was provided to USEPA for information purposes only.

1.2 Removal Action Summary

Tierra completed the Phase I Removal Action in accordance with the 2008 AOC (USEPA 2008). The Phase I Removal Action included the removal and disposal of approximately 40,000 cubic yards (cy) of Passaic River sediment located within the Harrison Reach of the LPRSA at approximately River Mile 3.4. Sediments were transported and disposed of off site as either Environmental Media (EM; waste that does not demonstrate hazardous characteristics and can be directly disposed of at a Subtitle C landfill) or Hazardous Characteristic Material (HAZ; waste that requires treatment [e.g., incineration prior to disposal]). The classification of waste was based on in-situ characterization developed during pre-design studies. Construction was completed between July 2011 and January 2013. An estimate of total construction costs is provided in Appendix C, as required by the 2008 AOC (USEPA 2008). The USEPA approved the completion of Phase I Removal Action as documented in a letter dated March 13, 2013, from Elizabeth Butler (Appendix A).

The Phase I Work Area is situated adjacent to Operable Unit 1 (OU-1) of the Diamond Alkali Superfund Site, located at 80 and 120 Lister Avenue, Newark, New Jersey. The LPRSA is 17 miles long and extends from the Dundee Dam near Garfield, New Jersey, to Newark Bay. Figure 1-1 illustrates the extent of the LPRSA (including the surrounding estuary), while Figure 1-2 delineates the extent of the Phase I Work Area. The UPF is located on the former Fairmount Chemical Site (owned by Morris Fairmount Associates, LLC) located at 117 Blanchard Street in Newark, New Jersey, approximately 1,400 feet (ft) downstream of the Phase I Work Area as shown on Figure 1-3. The Phase I Removal Action conceptual process flow diagram is illustrated on Figure 1-4.

1.3 Removal Action Objectives

The main objective of the work was to remove sediments containing some of the highest concentrations of 2,3,7,8-tetrachloro-dibenzo-*p*-dioxin (2,3,7,8-TCDD) found in the LPRSA along with other constituents of concern. The specific removal action objectives (RAOs) for the Phase I Work were included in the Action Memorandum (USEPA 2009) and consist of the following:

- *RAO #1*: Remove a portion of the most concentrated inventory of dioxin (2,3,7,8-TCDD) and other hazardous substances to minimize the possibility of migration of contaminants due to extreme weather events.

- *RAO #2*: Prevent, to the maximum extent practicable, the migration of resuspended sediment during removal operations through appropriate engineering controls, monitoring, and other activities.

- *RAO #3*: Prevent, to the maximum extent practicable, the potential for spillage or leakage of sediment and contaminants during transport to the disposal facility.

- *RAO #4*: Restore habitat. (Restoration of the Phase I Work Area will be coordinated with future removal activities within the LPRSA.)

1.4 Construction Team

The successful completion of the Phase I Removal Action described in both parts of the Phase I RAWP (Tierra 2011e, 2011l) depended on the interaction of many qualified parties. ARCADIS served as the prime contractor for the project, and engaged other subcontractors as necessary to complete the work. The roles, responsibilities, and qualifications of the key subcontractors are described below in alphabetical order.

- Abscope Environmental Inc. (Abscope), of Canastota, New York for UPF civil and site preparation construction activities

- Clean Harbors Environmental Services, Inc. (CHES), of Newark, New Jersey, for TTD and water treatment services

- DPK of Middlesex, New Jersey, for professional land surveying services

- Nicholson Construction Company (Nicholson) (as subcontractor to Weeks Marine, Inc.) of Cuddy, Pennsylvania, for tieback installation, loading, and post-tensioning

- Ocean Surveys, Inc. (OSI) of Old Saybrook, Connecticut, for bathymetric surveying services

- Stuyvesant Environmental Contracting, Inc. (Stuyvesant), of Princeton, New Jersey, for sediment screening/processing and hydraulic pipeline operation

- Weeks Marine, Inc. (Weeks), of Cranford, New Jersey, for sheet pile enclosure construction, sediment removal, backfilling, and hydraulic pipeline construction.

1.4.1 Project Communication

Project communication included kick-off meetings, regular project meetings, and work site meetings. The first Phase I Removal Action construction kick-off meeting was held on June 21, 2011, prior to mobilization. The kick-off meetings included Regulatory Oversight Agencies, subcontractors, and ARCADIS staff, including the Site Field Manager, Project Manager, Engineer of Record and/or design lead, and the Lead CQA Field Coordinator.

Subsequent construction kick-off meetings were held prior to the start of a new work activity as follows:

- June 21 and July 7, 2011 – Enclosure construction kick-off meetings
- July 7, 2011 – First responders meeting including local fire department, state police, and local police
- July 27, 2011 – UPF construction kick-off meeting
- September 22, 2011 – Water treatment and sediment processing systems construction kick-off meeting
- June 12, 2012 – Teardown, decontamination, and demobilization kick-off meeting.

During construction, daily and weekly project meetings were held to maintain clear and open channels of communications. A weekly progress meeting was held to discuss construction activities and CQA activities. At a minimum, the weekly progress meeting was attended by Regulatory Oversight Agencies and ARCADIS staff, including the Site Field Manager, Project Health and Safety Manager, and the Lead CQA Field Coordinator. Meeting minutes for the weekly progress meetings were distributed to meeting attendees.

Daily work meetings were held at the beginning of each work day and were scheduled at the beginning/end of each shift to allow for the transition and exchange of information. The purpose of the daily work meeting was to discuss construction activities, CQA activities, and health and safety.

Daily and weekly construction reports were prepared to document the construction observations for the day/week and are included as Appendices D and E, respectively.

Daily CQA reports were prepared to document the CQA activities for each day and are included as Appendix F.

2. Achievement of Design Objectives

The Phase I Removal Action design objectives were provided in the USEPA-approved DAR (Tierra 2011b) and Technical Design Drawings and Design Analysis Specifications (Tierra 2011k and 2011j, respectively). The project was implemented in general accordance with these design documents and achieved the design objectives. In addition, the Phase I Removal Action met the substantive requirements established in the permits and permit equivalencies.

Changes to the design during construction were documented as field modifications (FMs) for the Phase I Removal Action project. FMs are described where applicable in Section 3, and the FM forms are included in Appendix G. There were a total of 12 FMs (FM-01 to FM-06, and FM-08 to FM-013; the designation FM-07 was not used). The process for implementing FMs included the following:

- ARCADIS or subcontractors identified a potential change to the design during construction.
- The ARCADIS design lead developed the proposed approach for the change and drafted the FM form, including working with technical or field staff and subcontractors to prepare backup documentation.
- The Engineer of Record reviewed the FMs and (following any revisions) signed the FM.
- The FMs were submitted to the subcontractor. Following incorporation of any additional revisions, the FMs were finalized and distributed to the project team.

In addition, construction bulletins (CBs) were prepared to clarify the existing design. CBs were prepared and reviewed by appropriate technical staff and the Engineer of Record prior to distribution. The CBs are also included in Appendix G.

3. Summary of Work Performed

The Phase I Removal Action construction activities are described below according to each major project component. Daily activities were documented in the daily construction reports provided in Appendix D. Record drawings are provided in Appendix H. Waste manifests for the removed material are provided in Appendix I. Contractor and vendor submittals are provided in Appendix J. Analytical data are provided in Appendix K. A summary of the key construction quantities is provided in Table 3-1.

3.1 Mobilization

The Phase I Removal Action construction mobilization began following the June 21 and July 7, 2011 kick-off meetings and continued through August 2011. Mobilization was conducted in a phased manner to accommodate numerous factors, including UPF landowner negotiations, construction sequencing requirements, in-water work windows[2], and seasonal factors (e.g., winter weather's impact to productivity). The activities associated with mobilization to the OU-1 and UPF sites are described below.

A utility clearance was performed prior to the start of any construction activities. Signage and flagging were installed to identify low clearance areas near overhead utilities. The perimeter of the OU-1 and UPF sites was secured, and access to each site was limited to a single entrance. The OU-1 and UPF sites were monitored by security during off-shift hours and were patrolled daily. Temporary facilities were established to support construction activities at the UPF and OU-1, including office trailers, sanitary facilities, parking areas, and signage. A temporary, one-way access road at the OU-1 site was constructed in accordance with the design to provide access adjacent to the OU-1 floodwall for equipment and personnel. The June, July, and August 2011 daily and weekly construction reports include details and photographs of the mobilization activities (Appendices D and E, respectively).

[2] To minimize impacts to migrating anadramous fish, National Marine Fisheries Service (NMFS) recommended that in-water work should not occur between March 1 and June 30, but indicated that work within the enclosure could occur between March 1 and June 30, provided that the enclosure was installed and removed outside of this timeframe (see SRCAP, Tierra 2012g).

Prior to beginning enclosure construction activities, ARCADIS structural and geotechnical engineers performed a pre-construction survey of the OU-1 Floodwall, Sherwin-Williams (S-W) bulkhead, and the Singer Realty (Singer) bulkheads the OU-1 site between July 25 and July 27, 2011. Pre-construction survey observations and photographs were documented in a field report which is included in Appendix F.

3.2 Upland Processing Facility

The construction activities associated with the UPF were conducted from August to October 2011 and February to March 2012 and are described below. The daily and weekly construction reports from these time periods include details and photographs of the UPF construction activities (Appendices D and E, respectively).

3.2.1 Site Preparation

Site preparation at the UPF included installation of a construction support area, a pipeline support area, temporary soil erosion and sedimentation control measures, and a concrete washout area. In addition, a small portion of an interior fence line was removed, and the existing access gate in the perimeter fence was widened.

The UPF had existing environmental impacts, prior to the Phase I Removal Action, including soils primarily contaminated with hexavalent chromium, as well as dioxins and volatile organic compounds (VOCs). Historical investigations indicated VOCs were detected in existing UPF soils above New Jersey Department of Environmental Protection (NJDEP) impact to groundwater remediation standards, and hexavalent chromium was detected above 240 mg/kg within the excavation footprint. The Morris Companies conducted additional soil investigations for these constituents in July 2011 to refine the approach for soils management, and the results were included in the Soil Management Plan – UPF Soils (ARCADIS 2011). During site preparation, and due to the existing UPF contamination, the excavated UPF soil materials were segregated based on concentrations of hexavalent chromium and VOCs in accordance with the Soil Management Plan – UPF Soils (ARCADIS 2011). A geotextile demarcation layer was placed on the existing ground surface prior to stockpiling clean fill or excavated materials.

3.2.2 Utility Connection

Generators supplied electricity for office trailers, security lighting, and the stormwater pump station during the site preparation and UPF construction phases of the project.

Utility power from Public Service Electric and Gas Company (PSE&G) was connected to these systems just prior to the commencement of dredging. Separate generators were installed to supply power to the sediment processing equipment and to water treatment equipment as these systems required power beyond what could be provided by PSE&G on a temporary basis. Power supplies were run in conduits along the ground surface.

3.2.3 Construction of Sediment Processing and Water Treatment Areas

Following completion of excavation and grading, the sediment processing and water treatment areas were developed at the UPF site. Development of these areas included construction of a stormwater system, structural foundations, and pavement, as well as installation of sediment processing and water treatment equipment. Settlement monitoring was performed after completion of the foundations. After the sediment processing and water treatment areas were prepared, the sediment processing and water treatment systems were installed, as described in Sections 3.6.1 and 3.8.1, respectively.

3.2.4 Installation of Surrogate Sampling Locations

Because the existing environmental impacts at the UPF, included soils contaminated with dioxins and VOCs, which were constituents of concern (COCs) for the Phase I Removal Action, it was important to differentiate between what was already at the UPF site and what may have resulted from the sediment processing operations. Surrogate sample locations were installed to provide data to demonstrate the effectiveness of the concrete and asphalt pads and careful operations in preventing the sediment processing and water treatment operations from impacting the UPF soils.

In accordance with the CQAP (Tierra 2011i, 2012b), 15 surrogate sample locations (consisting of clean sand) were installed prior to construction of the asphalt and concrete surfaces. The surrogate sample locations allowed post-construction verification that the asphalt and concrete surfaces at the UPF effectively isolated the sediment processing operations from the UPF site soils. Each surrogate sample location was approximately 1 ft by 1 ft horizontal and 0.5 ft deep, lined with polyethylene sheeting, and then filled with imported fill material. The imported (i.e., clean sand) was sampled and analyzed for organic and inorganic compounds prior to shipping the material to the site. The soil windows were covered with geotextile fabric and then overlain with either aggregate base and asphalt or a concrete pad, depending on the location. Each soil window was designed to represent a specific surface area of the UPF and the Phase I Removal Action activities that were occurring within that surface area. During demobilization from the UPF, surrogate sample locations were sampled and the samples were analyzed as described in Section 3.10.2.

3.2.5 UPF Field Modifications

Several FMs were made to the UPF design during construction as summarized below. The FMs are listed by number, which is not chronological because numerous activities were conducted simultaneously.

- FM-002: The 6-inch protective layer within the stockpile areas for materials not requiring off-site disposal was changed from sand to dense-grade aggregate.

- FM-003: Excavated soils requiring off-site disposal (as described in Section 3.7.4) were placed directly on 16-ounce geotextile material (omitting the 6-inch protective layer). The protective layer was included in the design as a part of the liner system as a precaution in case the stockpile material stored contained debris and other sharp materials. During construction it was determined that excavated material would not damage the geotextile (i.e., materials to be disposed of off-site contained minimal debris and posed little risk to geotextile materials), and therefore, the protective layer was unnecessary and would have generated additional waste material at the end of the project.

- FM-004: The Type-B catch basin lid specified was modified to use a 0.5-inch solid plate with anti-skid tape on the lid instead of a 0.625-inch checker plate, because the material specified was not readily available.

- FM-005: Catch basin CB-2 was relocated to the north because the location specified in the design was beneath the conveyor pivot point. CB-2 was relocated without any changes to grading.

3.3 Enclosure

Prior to sediment removal activities, the sediment excavation enclosure (hereinafter referred to as the enclosure) was constructed from August 2011 through February 2012. The enclosure consisted of Riverside Enclosure Walls (three sides), a Sherwin-Williams (S-W) Enclosure Wall (constructed in front of an existing structure), scour protection, ancillary structures, and new permanent grouted tieback anchors for the existing OU-1 Floodwall. The following sections summarize construction activities associated with the enclosure. The daily and weekly construction reports from August 2011 to February 2012 include details and photographs of the enclosure construction activities (Appendices D and E, respectively).

3.3.1 OU-1 Tieback Installation

Prior to construction of the enclosure sheet pile walls, permanent tiebacks were installed to maintain the stability of the existing OU-1 Floodwall during dredging. From October to November 2011, 36 tieback anchors were installed as follows:

- Coring of existing OU-1 floodwall to accommodate tiebacks
- Installation and grouting of cable-strand tieback anchors
- Separation of core cuttings from drilling fluids and temporary storage of cuttings for disposal
- Pre-treatment of drilling fluids for solids removal. Treatment of remaining drilling fluids with on-site mobile water treatment system, followed by treatment in the existing OU-1 groundwater treatment system (GWTS). The treated water was stored and then reused or batch discharged.
- Wale installation.

After tieback installation was complete, the anchor head assembly was installed and the tiebacks strands were cut, greased, and encapsulated in a grease cap for short-term corrosion protection. After grout testing indicated achievement of sufficient compressive strength, the tieback anchors were performance tested (i.e., incremental load applied and removed up to the test load) or proof-tested [i.e., loaded to 200 kips (1,000 pounds)]. The first three anchors (i.e., tiebacks T-3, T-5, and T-7) installed were performance tested. All other anchors were proof-tested. After successful testing, the tieback anchors were locked off against the installed wale at its lock-off load (approximately 90 kips) and the anchor head was greased and capped. Once installation was complete, the tieback equipment was decontaminated and demobilized off site.

Load cells were placed on 10 of the tiebacks to measure and monitor the performance of the tiebacks during sediment removal and backfill. During dredging/backfilling activities, Nicholson was mobilized back to the site after load cell monitoring results for T-37 indicated a sudden drop in load from lock-off. Nicholson performed a lift-off test to confirm the load in the tieback, and re-locked the tieback at approximately 90 kips. Details of the re-stressing are provided in CB-1 (Appendix G).

After backfilling the Phase I Work Area, Nicholson performed tieback punch list activities, including removing load cells, re-greasing, and replacement of the anchor head assembly gaskets for longer-term corrosion protection. Upon completion, tieback anchors were left locked off at their working loads. The tieback anchors remain as a permanent part of the OU-1 Floodwall. Final construction details for the OU-1 Floodwall tiebacks are provided in the OU-1 Floodwall Record Drawings (Appendix H).

3.3.1.1 Tieback Drilling Fluids and Cuttings Management

Soil cuttings generated through tieback installation were separated, stabilized, and disposed of off site as described in Section 3.7.4. The water decanted from the separation processes was pre-treated by a mobile system to reduce drilling fluids solids content prior to being treated in the OU-1 GWTS. The water source for tieback drilling initially consisted of potable water. The tieback drilling fluid treated by the OU-1 GWTS was reused for drilling until all of the tiebacks were installed. At the end of tieback installation, all treated process water was analyzed in accordance with the OU-1 New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water (DSW) Permit Equivalent (these analytical results are not included in this report and are included in separate reports for OU-1 that were previously submitted to USEPA) prior to discharge to the Passaic River.

3.3.1.2 Field Modifications to Tiebacks

Three FMs were made to the tiebacks during construction. Based on the existing conditions of the OU-1 Floodwall encountered during construction, the tieback wale design was modified as described below (and as detailed in FM-001 and FM-011, Appendix G).

- FM-001 included three changes:
  - Wedge anchors were placed to existing AS 500-12 flat sheeting where cutting of bolts and sheeting (at existing master piles) caused existing sheets to pull away from the OU-1 Floodwall.
  - Steel shims were placed at master pile locations below pre-fabricated steel shoes for wale connections to account for the arcuate shape of the tremie

between the existing master piles being more significant than anticipated, as well as any added effects contributed by the AS 500-12 flat sheeting, which would have impeded tieback wale installation.

  - The elevation of the proposed tiebacks was adjusted due to field surveyed locations of existing tie rods/master piles that otherwise interfered with tieback locations (i.e., elevations were adjusted).

- FM-011: Tiebacks T-1 and T-38 were not installed due to obstructions encountered during drilling. A structural evaluation determined that these tiebacks could be omitted from the permanent construction without significant structural impact to the function of the OU-1 Floodwall.

- FM-008: The tieback fluids treatment tie-in and pre-treated water storage were adjusted to optimize performance of the GWTS. Pre-treated tieback water was pumped into the GWTS prior to the GWTS oil-water separator and was then pumped to tank T-1 by operators on a batch basis.

In accordance with the Drawings and Specifications (Tierra 2011k and 2011j), contingency length was added to six tiebacks (T-2, T-6, T-14, T-22, T-29, and T-37) based on drilling conditions and the results of the tieback testing. Each of these six tiebacks included approximately 10 ft of additional length within the soil anchor zone to provide additional load capacity.

3.3.2 Scour Protection

To reduce resuspension of sediment during enclosure installation, scour protection material was placed adjacent to the Phase I Work Area in late September and early October 2011. Prior to enclosure wall construction, approximately 6-inches of sand were placed on the river side of the proposed enclosure alignment using a barge-mounted crane. After the enclosure was installed in late January and early February 2012, the remaining scour protection components, which consisted of geotextile and articulated concrete mattresses located immediately around the perimeter of the enclosure. The geotextile was attached to the armor mattresses prior to placement using tie wires, and they were installed together as one unit. The armor mattresses and geotextile were positioned over the river bottom using a barge-mounted crane and spreader bar. Gaps between the sheet pile enclosure and the articulated concrete mattresses were filled with sand bags lowered from a work barge and placed in a continuous, side-by-side fashion.

3.3.3 Sheet Pile Enclosure Wall Installation

The enclosure was a temporary wall installation consisting of a combination wall, comprised of equally spaced H-piles (62.5-ft-long king piles) providing primary lateral support for the wall and interlocking Z-shaped 35-ft-long sheet piles forming a continuous enclosure. The Riverside Enclosure Wall included a main wall to the North, adjacent to the navigation channel, and two return walls tying into the existing OU-1 Floodwall and S-W Wall. These three sections of the Riverside Enclosure Wall comprised the North, East, and West walls of the enclosure, respectively. The south enclosure wall in front of the existing S-W sheet pile bulkhead was the same combination wall type and size as the Riverside Enclosure Wall. The interlocks of the temporary Riverside Enclosure Wall were sealed as per the design specifications to minimize water leakage and loss of sediment through the wall to the maximum extent practicable.

Between October 2011 and January 2012, the enclosure piling was installed from the river using a barge-mounted crane and a vibratory hammer. The enclosure was installed using a pre-fabricated 60-ft-long, 11.7-ft-wide steel frame template structure. The template was sized to accommodate nine king piles per setup and consisted of the steel frame attached to support piling driven into the subsurface.

During installation of the enclosure, a barge-mounted crane lifted each king pile from an adjacent deck barge and aligned the pile in the template. The king pile was driven to the design tip elevation using a vibratory hammer. The process was repeated for each of the nine king piles within the template. Once all nine king piles were successfully installed to the design elevation, the template was removed, and the intermediate sheet piling was installed using the vibratory hammer. Intermediate sheet piling was installed within approximately 2 hours of contact with the water to prevent early swelling and potential stripping of joint sealant from the interlocks. Vibration monitoring was performed during pile driving per the specifications in the CQAP (Tierra 2011i; 2012b), and the results are included in Appendix F.

3.3.3.1 Ancillary Structures Installation

The ancillary structures associated with the enclosure design were installed at various points prior to, during, and following enclosure wall installation. Prior to enclosure installation, a single support pile was driven for the bulkhead along the Singer Realty bulkhead. Due to constructability issues, no fender was installed, but a wood shim was fabricated and installed between the support pile and existing bulkhead.

The enclosure wale and wale supports, weir gate, and walkway were installed concurrently with the enclosure using deck barges for material staging and a crane-mounted barge to lift the components into place. The weir gate and walkway were installed after enclosure installation had sufficiently progressed to properly place equipment. The steel walkway from the weir gate to the OU-1 site was installed as designed. Additional walkway was installed using wood decking and steel pipe and cable for railings for the remainder of the perimeter of the enclosure. Following enclosure sheet pile installation, steel dolphins were installed outside of the enclosure through pre-fabricated voids located in the armor mattresses (these voids were provided to facilitate the driving of the steel dolphins), and fenders were placed on the dolphins. Pipe monopiles were installed, offset from the outer perimeter of the enclosure, to reduce the risk of vessel collisions with the enclosure. Inclinometers were installed and optical survey points were established on the OU-1 Floodwall and enclosure walls by placing fixed benchmarks for repeatability in measurements (e.g., survey bolts and other markers). Baseline survey data were recorded, and inclinometer and optical survey monitoring occurred throughout sediment removal and backfilling. The survey data and monitoring results are provided in Appendix F. Enclosure construction was concluded with the completion of ancillary structures in February 2012.

Weeks temporarily sealed the tide valves covering the outfalls (one on each side of the OU-1 Floodwall) within the enclosure area. Weeks rerouted the stormwater flow from OU-1 by installing stormwater diversion pipes to discharge onto the armor mattresses outside of the enclosure. The tide valves were replaced on the end of the rerouted stormwater pipes.

A bird deterrent system was installed along the shoreline side of the enclosure to prevent birds from using the Phase I Work Area as foraging ground (as described in Section 4.4).

3.3.3.2 Field Modifications to Sheet Pile Enclosure Wall and Ancillary Structures

Four field modifications were made during construction of the sheet pile enclosure wall and ancillary structures. The field modifications are summarized below and detailed in FM-006, FM-010, FM-012, and FM-013 (Appendix G).

- The design elevation of the weir gate was lowered approximately 1 ft to allow water at high tide to enter the completed enclosure during the winter, prior to mobilizing pumps to the site. Lowering the weir gate by 1 ft resulted in several changes to the weir gate design, primarily as it relates to the fit of the pre-fabricated gate into the opening of the combination wall, and is detailed in FM-006 (Appendix G).

- Field survey of the proposed S-W Enclosure Wall (i.e., the south enclosure wall) alignment determined that the existing S-W sheet pile wall would interfere with the proposed enclosure alignment and would require adjustment. This was due to inaccuracy in the existing survey information for the existing S-W Enclosure Wall alignment. To accomplish the revised positioning, King Pile P-38 was removed from the west enclosure wall, and King Pile P-1 was adjusted approximately 9 inches north into the Passaic River as documented in FM-010 (Appendix G).

- The S-W wale braces were not installed along the existing S-W Enclosure Wall as indicated in the design due to field constructability issues. Rather, wood shims and blocking were placed along the S-W Enclosure Wall between the enclosure and existing bulkhead to create a continuous connection (i.e., eliminate any gap) and to support the existing S-W wall, if needed during dredging. The modifications are as detailed in FM-012 (Appendix G). Once S-W Enclosure Wall piling was installed, the remaining connection to the OU-1 Floodwall (at the S-W Enclosure Wall) was performed. Field measurements for closure connections were made for selected corners or junctions and fabricated according to these field measurements. These piles were installed during the overall enclosure construction period, but could not be measured for the field-fit until the adjacent piles had been installed. The final modifications to the enclosure connections based on field measurements are provided in the as-built drawings (Appendix H).

- As enclosure construction progressed to the southeast corner, the last king pile in the enclosure alignment (P-170) was approximately one foot closer to the existing OU-1 Floodwall master pile than designed due to small variations in the enclosure alignment. Consequently, the originally designed pipe/spring closure piece (Detail 3, Drawing S-6; Tierra 2011k) would not fit as designed. Therefore, a modified connection using AZ-14 sheet piling as a form and controlled density fill was used to make this corner water-tight between the enclosure and the OU-1 Floodwall. Complete details for this modification are included in FM-013 (Appendix G).

3.3.4 Aids to Navigation Installation

A U.S. Coast Guard Notice to Mariners was issued to notify mariners of the Phase I Removal Action activities. Buoys, delineators, markings, and other aids to navigation (ATON) were installed outside the Phase I Work Area. Following placement of the scour protection, the float collars and buoys were placed to alert mariners to the Phase I Work Area. Following the construction of the enclosure walls and ancillary structures, remaining ATON were placed on these features (e.g., 2-mile solar lights).

3.4 Sediment Removal

The construction activities associated with sediment removal operations are described in the sections below. The daily and weekly construction reports from March to June 2012 include details and photographs of the sediment removal operations (Appendices D and E, respectively).

3.4.1 Pre-Removal Activities

Barges, other removal equipment, and the sediment screening barge were mobilized from Weeks' waterfront property, located at Greenville Yard on Colony Road, Jersey City, NJ, 07305 (Greenville Yard) and barged to the Phase I Work Area just prior to the completion of the combination wall for the enclosure. Five barges were used for sediment removal and processing: the sediment removal barge, two sediment holding barges, the debris staging barge, and the sediment screening barge. The barges were moved into the enclosure prior to completion of all of the enclosure walls. During system testing and final dredging preparations in early March 2012, the remaining equipment and materials were lifted into the enclosure and positioned on the barges using a crane.

The real-time kinetic digital global positioning system (RTK-DGPS) and the necessary sensors that enabled horizontal and vertical positioning of the dredge bucket were installed and calibrated prior to mobilization to the Phase I Work Area. On February 27, 2012, Weeks demonstrated the RTK-DGPS system at the Greenville Yard, overseen by ARCADIS, to verify that the dredge bucket met the required positioning tolerance of plus or minus 2 inches vertically and plus or minus 3 inches horizontally.

A multi-beam bathymetric survey was conducted on August 17, 2011, by OSI, prior to construction of the sheet pile enclosure. The purpose of this survey was to confirm that the bathymetric surface had not changed significantly since the bathymetry survey that was conducted in 2009, which was used as the basis of the dredging design. The 2009 bathymetry is shown on Figure 3-1.

3.4.2 Mechanical Removal Operation

Removal operations commenced at the Phase I Work Area on March 9, 2012. Removal operations were performed 12 hours per day, 6 days per week. The average production rate was approximately 500 cy per day, resulting in a removal duration of approximately 14 weeks. Sediment was removed by a Caterpillar 385 CL excavator equipped with a 5-cy level-cut clamshell bucket mounted on a deck barge using spuds for anchoring.

3.4.2.1 Dredge Positioning

Vertical bucket control was monitored during sediment removal operations using a combination of methods. The accuracy of the RTK-DGPS system was verified daily for normal removal operations. When Weeks was removing sediment within 1 ft of a border between an EM and HAZ dredge unit, the RTK-DGPS system was verified three times every day, once before work was started and again every 4 hours. This verification consisted of placing the clamshell bucket on a point of known elevation, such as the water surface, to confirm that the RTK-DGPS system and HYPACK™ graphical interface software were accurately calibrated. The performance of the RTK-DGPS was verified weekly and documented in the CQA Reports (Appendix F).

To independently confirm the accuracy of the dredge positioning software, depth soundings were collected on March 23, 2012, at 64 locations within the enclosure to assess the accuracy of the dredging software. The sounding data were found to be within plus or minus 0.2 vertical ft of Weeks' dredging profiles developed by the HYPACK™ dredge guidance software.

3.4.2.2 Debris Handing and Offloading to the OU-1 Site

Debris was generated in two separate processes during dredging. Larger oversized debris was individually lifted out of the dredge prism using the dredge bucket and set on the designated debris staging barge. Debris larger than approximately 0.5 inches that was not removed using the dredge bucket was removed by the grizzly and trommel screens preceding the hydraulic pipeline slurry step, and a conveyor transferred it to the debris barge. Debris also included materials that did not pass through the grizzly screen and needed to be removed from the top of the screen.

White phosphorus was also encountered in multiple dredge units along the OU-1 Floodwall. White phosphorous material self-combusted on several occasions within the debris and material barges, resulting in temporary work shutdowns and immediate mitigation measures to address the fire and inhalation hazards. The white phosphorus self-combustion varied from small areas of smoldering material to open flames. Pre-design investigations included screening for white phosphorus with no positive indications of the presence of white phosphorus. However, historical observations of white phosphorus at OU-1 suggested it may be present within the Phase I Work Area. Based on this knowledge, staff responded quickly and safely managed the response during construction. During the debris washing operations, materials observed to contain white phosphorus were separated and temporarily stored in steel drums filled with water for subsequent off-site disposal.

In addition, three gas cylinders were recovered from the sediment during dredging that required special handling and storage prior to off-site disposal, as described in Section 3.7.2.

3.4.2.3 Field Modifications to Sediment Removal and Debris Handling Operations

There were no formal field modifications to sediment removal operations. However, several modifications were made as summarized below.

- The initial sediment removal design called for six transitions between EM to HAZ material during the dredging sequence, due to the layering of the different types of material. After dredging began, and the contractor had a better understanding of how the material would behave during removal operations, two of these transitions were eliminated by consolidating the removal of multiple layers of HAZ material. The revised dredge sequence was approved by USEPA (USEPA e-mail, April 10, 2012, Appendix A). This resulted in less time lost during the transitions between EM and HAZ materials.

- The design specified that interim bathymetric surveys would be conducted within 1 ft of the interface between dredge units of different classifications (i.e., between a dredge unit designated as EM and a dredge unit designated as HAZ). Once the work began, the project team, in conjunction with USEPA, determined that interim bathymetric surveys would be problematic to conduct and may not provide useful data due to the presence of several pieces of floating and steel equipment that considerably limited space within the enclosure and the potential for signal interference. An alternate method to interim bathymetric surveys was selected, which consisted of collecting manual soundings every 10 ft along transects with 25-ft spacing using a plate and rod. This method was completed by ARCADIS, independent from a similar sounding method that was being conducted by Weeks, using the barge as a point of reference. These survey-quality data points were compared directly to the design elevations to confirm the dredging was achieving the design elevations within the allowable tolerance. These data points were also compared to the HYPACK™ dredge guidance software used by Weeks to confirm that the software was correctly indicating the elevation of the dredge bucket. Finally, Weeks also employed an overdredge alarm, which provided a visual output to the dredger when the target dredge elevation was exceeded. These three lines of evidence were considered sufficient, such that interim bathymetric surveys were not needed to confirm dredge elevations at EM/HAZ transitions. The alternative method for bathymetry surveys was approved by USEPA (USEPA e-mail, May 22, 2012, Appendix A).

- A large concentration of oversized debris was encountered while dredging a HAZ dredge unit along the OU-1 Floodwall. The concentration and size of this debris consistently clogged the trommel screen, and the quantity and size of the debris caused additional complications for TTD size restrictions associated with the incinerator. A debris washing operation, comprised primarily of mechanical equipment, static screens, and high-pressure water, was established at the UPF site to separate sediments from the oversized debris. Debris washed during this operation was disposed of at a Subtitle C landfill, as described in Section 3.7.

3.5 Hydraulic Pipeline Construction

The hydraulic pipeline was used to convey the removed material from the Phase I Work Area to the UPF. The activities associated with construction of the hydraulic pipeline are described in the sections below.

3.5.1 Pipeline Assembly and Installation

High-density polyethylene (HDPE) pipe for the nominal 6-inch-diameter inner (carrier) and the nominal 12-inch-diameter outer (containment) pipeline was delivered to the UPF. Barges, workboats, and cranes used by Weeks for installing the pipeline were mobilized from the Greenville Yard to the project site via the river.

Construction of the hydraulic pipeline began on February 13, 2012, and took approximately 2 weeks to complete. The HDPE pipe was welded using a butt welder and assembled at the UPF site. Pipe welds were water-tested for leaks prior to being deployed. Installation of the pipeline began with installation of the UPF pontoon to transition the floating pipeline section in the river to the UPF and continued upriver (east to west) until the pipe reached the enclosure. Anchor piles were installed approximately every 250 ft along the floating section of the pipeline. A protective layer of sand was placed around the anchor pile locations prior to installation of each anchor pile to reduce potential scour. After the pipeline was installed, Weeks performed a leak test by pumping river water through the pipeline and inspecting the length of the pipeline, including welded pipeline connections, flexible joints, and vacuum breakers. The daily and weekly construction reports from February 2012 include details and photographs of the pipeline installation (Appendices D and E, respectively).

3.5.1.1 Field Modifications to Pipeline Installation

One field modification was made during assembly of the hydraulic pipeline as summarized below and detailed in FM-009 (Appendix G). As an alternative to a flexible connection and as documented in FM-009, the piping route was adjusted to provide sufficient slack in the pipeline for tidal fluctuations where the pipeline transitioned from floating to fixed connections.

3.5.2 Pipeline Removal

After pipeline operations were completed, the pipeline was decontaminated by flushing it with river water for a minimum of 1 hour. The decontamination water was directed through the processing equipment and subsequently through the water treatment system. After pipeline flushing was complete, the pipeline was disconnected at the enclosure, and the pipe was pulled towards the UPF with a workboat, where the pipe was cut into smaller sections, hauled onto the landside of the UPF, and cut again. With the exception of the scour protection material, all components of the pipeline, including but not limited to pipe, anchors, anchor cables, pumps, pontoons, and pipe fittings, were removed from the river. Removed equipment and materials were decontaminated prior to off-site transport. The smaller lengths of pipe were stored at the UPF temporarily until they were transported off site for potential reuse by subcontractor.

3.6 Pipeline Transport and Sediment Processing

Sediment handling and processing was conducted at the Phase I Work Area and UPF. After debris removal and screening at the Phase I Work Area, the sediment slurry was pumped to the UPF through the pipeline. The key components of sediment processing were:

- Debris was removed and the remaining material was slurried at the Phase I Work Area using the following equipment, located on a sediment processing barge within the enclosure:
  - Hopper with grizzly to remove large debris
  - Trommel screen to remove coarse debris
  - Slurry tank and pipeline feed pump
  - Control unit
- Sediment slurry was pumped through a hydraulic pipeline from the Phase I Work Area to the UPF.
- Sediment slurry was de-sanded, thickened, and dewatered at the UPF using the following equipment:
  - Shaker screen to remove coarse solids (+0.125 inch and -0.5 inch)
  - Hydrocyclone unit to separate and dewater the sand fraction (+0.003 inch and -0.125 inch)
  - Tanks to store slurry, thickened sludge, process water, and for contingency
  - Polymer addition system to add polymer to the slurry to improve dewatering
  - Gravity thickener to thicken the de-sanded slurry
  - Membrane filter presses to dewater gravity-thickened fine sediment
  - Conveyor system to load transport containers

The construction activities for sediment handling and processing, including pipeline transport, are described in the following sections. The daily and weekly construction reports from March to June 2012 include details and photographs of the pipeline transport and sediment processing operations (Appendices D and E, respectively).

3.6.1 Assembly and Installation of Sediment Processing Equipment

Sediment screening equipment to be used at the Phase I Work Area were pre-assembled at the Greenville Yard and transported by barge to the Phase I Work Area. Equipment and materials were lifted using a crane over the enclosure wall and placed onto the processing barge inside the enclosure. The remaining sediment processing components were transported by truck to the UPF for assembly and installation. Necessary support structures, piping, electrical wiring, and programmable logic controller (PLC) software were installed and connected, and a control room was installed at the UPF and at the Phase I Work Area.

3.6.2 Sediment Processing Startup

All electrical and mechanical parts were tested and checked. A leak test was performed to check the systems for leaks and performance. The test was completed using potable water in the fall of 2011 and using river water in March 2012. Following testing and inspection of equipment, startup of the sediment processing system was coordinated with sediment removal and water treatment. Sediment processing startup consisted of processing dredged material at a reduced rate and slowly increasing to the full production rate. Processing startup was coordinated with startup of the water treatment system and began on March 12, 2012 (see Section 3.8).

3.6.3 Pipeline Transport Operations

The HDPE dual containment pipeline described in Section 3.5 was used to transport sediment slurry from the Phase I Work Area to the UPF. The pipeline velocity, density, and pressure were continuously monitored using the in-house PLC-controlled monitoring system “Dredge-View” developed by Stuyvesant. The data generated by the Dredge View program are provided in the CQA Reports in Appendix F. The pipeline was observed visually from the water daily. After daily processing operation, the pipeline was flushed with river water. The pipeline was operated without issue (e.g., no leaks, no damage, etc.)

3.6.4 Sediment Handling and Processing Operations

Sediment handling and processing operations were conducted concurrently over the 14 weeks of sediment removal from March 12 to June 12, 2012. Mechanical dewatering at the UPF was conducted 24 hours per day, 6 days per week. The sediment screening operations at the UPF and at the Phase I Work Area generally operated 16 hours per day. Sediment processing equipment was regularly inspected, monitored, and maintained by Stuyvesant. The procedure for transitioning operations between EM and HAZ material was followed in accordance with the design. Production was slower during processing of HAZ material and material with significant debris, but higher production during processing of EM and low amounts of debris material resulted in an overall average production rate of approximately 500 cy/day.

The filter cake percent solids were measured daily and the results are included in the daily CQA reports (Appendix F). The membrane plate and frame filter presses met or exceeded the design target of 57.5 percent solids and achieved, on average, a total solids content of approximately 67 percent.

3.6.4.1 Field Modifications to Sediment Handling and Processing Operations

There were no formal field modifications to sediment handling and processing operations. However, the handling of coarse solids required a post-startup supplemental process. Periodically, coarse solids separated by the shaker screen and the dewatering screen consisted of organic material (e.g., leaves) that contained free liquid. These wet organic coarse solids required additional handling to address the free liquid and make it suitable for TTD. The coarse solids were further dewatered by placing them into roll-off boxes, which allowed free liquid to drain prior to placing the coarse solids into the water-tight intermodal containers. The liquids drained from the roll-off boxes were captured in the stormwater management system and subsequently treated. The drained coarse solids were mixed with a super absorbent polymer to capture any remaining free liquids.

3.6.5 Sediment Processing Demobilization

The sediment processing equipment at the Phase I Work Area and at the UPF was decontaminated following completion of sediment processing activities. The equipment was then disassembled as necessary and was transported offsite by subcontractors for potential reuse.

3.7 Off-Site Transport, Treatment, and Disposal

This section describes the TTD of wastes generated from the UPF and OU-1 sites. The TTD-related equipment included:

- Environmental Protection and Improvement Company (EPIC) Intermodal containers for off-site transport
- Scaffolding to facilitate sealing and tarping of EPIC containers
- Sorbent materials to absorb free liquids from debris and coarse solids during handling and transport.

The construction activities associated with off-site TTD are described in the sections below. Table 3-1 includes a summary of TTD quantities.

3.7.1 Container Filling and Closure

EPIC containers at the UPF were filled with dewatered coarse solids and filter cake directly from the sediment processing system using conveyor belts outfitted with a weighing mechanism, except as noted in Section 3.6.4.1. EPIC containers were filled to a target net weight of approximately 22.5 tons (not to exceed a maximum of 25 tons). Debris was periodically offloaded from the debris barge inside the enclosure into EPIC containers located at OU-1. CHES transported EPIC containers of debris from OU-1 to the UPF for staging.

Sorbent products (ZapZorb Coarse, Calcimet, and/or cement) were used to absorb free liquids that drained from the coarse solids and debris. The material was placed in the EPIC containers prior to filling the containers. The quantity of additional sorbent required was evaluated and modified as needed to reduce the potential for free liquids in the container.

Prior to tarping the EPIC containers, CHES visually inspected the container contents to verify that the contents matched the waste profile description and the waste manifest (e.g., debris, filter cake, or coarse solids). Then the 6-mil polyethylene liner was sealed and the soft tarp cover (18-ounce rip-stop vinyl) was secured.

3.7.2 Handling of Special Debris

There were no formal field modifications to the TTD operations. However, debris was encountered that required special handling. As described in Section 3.4.2.2, white phosphorus was encountered in multiple HAZ material dredge cells along the OU-1 Floodwall. Material containing white phosphorous was segregated and stockpiled for separate handling and disposal. Abscope worked with ARCADIS personnel to segregate and wash the large debris for disposal with other HAZ debris. Once the large debris had been removed, the remaining material containing white phosphorous was placed into drums, covered with water to prevent further reaction, and transported off site for disposal. A total of two drums with phosphorous-containing material were incinerated at the CHES Aragonite Hazardous Waste Incinerator Facility (Aragonite Incinerator).

Additionally, three gas cylinders were uncovered during dredging. These were carefully handled and placed in water-filled containers pending final handling. One container was found to be empty, with one cylinder containing ammonia, and the other cylinder containing acetylene. The cylinder containing ammonia was dealt with using hydrolysis, and the resulting material and container were properly disposed of off site. The cylinder containing acetylene was vented in a controlled manner, and the empty container was properly disposed of off site.

3.7.3 Transport, Treatment, and Disposal

Filled EPIC containers were transported for off-site disposal as follows:

- Wastes were hauled off site by CHES to the Brills Yard Transload Facility (Brills Yard, located at 319 Avenue P, Newark, New Jersey) approximately 2 miles from the UPF via the truck routes established in the design.
- Containers were weighed at the trade-certified truck scale, located at the Brills Yard. CHES oversaw container weighing. The weight recorded established the invoicing tonnage for transport and disposal of the container. A total of 1,508 EPIC containers were transported off site. Table 3-1 includes the quantities of each type of waste.
- Containers were loaded onto ABC flatcars that accommodated six containers each, secured by standard interlock mechanisms.
- EM material was transported by rail to one of two Subtitle C Landfills:
  - The CHES-owned Avard Transfer Facility in Oklahoma, where the EPIC containers were transferred from the railcars onto tractor-driven chassis and transported less than 30 miles from the Avard Transfer Facility to the CHES Lone Mountain Subtitle C Landfill Facility (Lone Mountain) where the container contents were landfilled.
  - The CHES-owned Clive Transfer Facility in Utah, where the EPIC containers were transferred from the railcars onto tractor-driven chassis and transported from Clive to the nearby CHES Grassy Mountain Subtitle C Landfill (Grassy Mountain) where the container contents were landfilled.
- HAZ material was sent by rail to the Clive Transfer Facility in Utah. HAZ material was transferred from railcars onto truck-driven chassis and transported approximately 10 miles from Clive to the Aragonite Incinerator. The container

contents were processed through the incinerator, and the ash was disposed of at Grassy Mountain.

- Large HAZ debris material was sent by rail to the Clive Transfer Facility in Utah. This material was transferred from railcars onto truck-driven chassis and transported from Clive to Grassy Mountain, where the container contents were encapsulated and landfilled.

Transportation of waste was conducted without incidents or accidents.

3.7.4 Management of Non-Sediment Waste Streams

A variety of non-sediment waste streams were generated throughout the implementation of the Phase I Removal Action including the following.

- Non-contact (i.e., not contacted by Phase I Work Area sediment) construction- and demolition-related materials (e.g., cut pipe scrap and excess concrete) were stored in on-site roll-off boxes and disposed of at a local municipal waste facility.

- Municipal waste (i.e., general trash) was collected for disposal by the local municipal waste facility.

- Other operations-related wastes, such as personal protective equipment (PPE) that contacted process material, were mixed in with EM waste and included in the EM waste quantities. Drums of final operations and decontamination waste were also disposed of as EM waste.

- Granular activated carbon (GAC) from the water treatment system (approximately 240 tons) was disposed of as HAZ material.

- Drill cuttings (approximately 108 tons) resulting from tieback installation during site preparation activities were disposed of off site at Lone Mountain based on waste characterization data.

- Soils excavated during UPF construction were managed in accordance with the Soil Management Plan – UPF Soils (ARCADIS 2011). Excavated soils were reused on site when possible.

- Approximately 202 tons of excavated soils that were not reused on site due to elevated VOC concentrations (i.e., concentrations that exceeded NJDEP impact to groundwater remediation standards) were disposed of off site based on in-situ data. The material did not exceed Resource Conservation and Recovery Act regulatory levels, and was classified as non-hazardous waste and disposed of at Lone Mountain.
- Approximately 503 tons of excavated soils with hexavalent chromium concentrations greater than the site-specific soil remediation standard of 240 milligrams per kilogram were disposed of off site at Lone Mountain, based on in-situ data.

3.7.5 Waste Tracking

CHES performed waste tracking, including tracking the locations of EPIC containers, waste manifest status, and certificates of disposal. The waste-type designation of each day's production activities was verified daily between CHES and the Site Field Manager. CHES provided a weekly summary of the net weight of each type of material removed from the site and its TTD status. Waste manifests were prepared by ARCADIS on behalf of the generator (Tierra) and transferred into the custody of the truck driver prior to departure from the UPF or OU-1. Copies of the waste manifests signed by the receiving facility were returned to Tierra acknowledging completion of the transfer of the waste material from the generator to the disposal facility. Certificates of disposal were issued upon disposal of the waste and provided to Tierra not more than 30 days after disposal had been completed. Waste manifests for the transport and disposal of the removed material are provided in Appendix I. Railcar tracking summaries were provided to ARCADIS and Tierra by CHES in their weekly construction reports which are included in the CQA Reports (Appendix F).

3.8 Water Treatment

The temporary water treatment system treated process water from the sediment processing system to meet the project discharge requirements prior to discharge to the Passaic River. Treated effluent was discharged directly to the Passaic River, reused at the UPF, or discharged back to the enclosure.

The water treatment equipment included:

- Equalization, backwash solids, and treated water holding tanks
- Clarifier

- Multimedia filter (MMF) vessels
- Bag filter vessels
- Liquid-phase GAC vessels
- Ancillary equipment: solids and surge tanks, transfer pumps, air compressor system, pump buildings, instrumentation, flow meters, PLC, and associated piping and appurtenances

The construction activities associated with the water treatment operations are described in the sections below.

3.8.1 Water Treatment System Installation

Equipment and materials were obtained from several vendors and transported by truck to the UPF. Vendor-supplied units were connected to the system piping. System instrumentation and electrical connections, including grounding of equipment, were made to allow operation of each system component. Equipment was placed on the prepared asphalt foundation or concrete pads and secured into place. Process piping was properly secured and supported to prevent damage to the piping, valves, and instrumentation. Instrumentation and alarm conditions were tested to validate correct operation of the instrument and PLC. An 8-inch HDPE outfall pipe was constructed to convey effluent from the water treatment system to the Passaic River discharge outfall.

There were no formal field modifications to the water treatment system installation. However, the hydraulic pipeline was modified to allow use of the pipeline for transfer of treated water from the UPF to the enclosure. These modifications consisted of addition of a valve and tee to each end of the hydraulic pipeline to connect pumps to pump treated water from the water treatment system back to the enclosure. This modification and the subsequent discharge of treated water back to the enclosure were approved by USEPA (USEPA e-mail, March 5, 2012, Appendix A).

3.8.2 Water Treatment Operation

Operation of the water treatment system was divided into the four separate phases described below. The daily and weekly construction reports from March to June 2012 include details and photographs of the water treatment and discharge operations (Appendices D and E, respectively). There were no formal field modifications to the water treatment system operation. However, treated water was discharged to the enclosure during startup and processing of HAZ material as approved by USEPA and described below (USEPA e-mail, March 5, 2012, Appendix A).

3.8.2.1 Mechanical Startup

Mechanical startup of the water treatment system was conducted during one week in December 2011 prior to winterization, and again in February 2012 prior to initial batch-mode startup. Mechanical startup confirmed that the equipment and controls were working properly as a whole before performing the initial system startup.

Leak testing, pneumatic testing, and hydrostatic pressure testing of the water treatment system were carried out in accordance with the specifications. The leak and hydrostatic pressure testing test were completed using potable water in the fall of 2011 and using river water in March 2012. Test water was discharged from the system via the outfall. No compliance testing was required to discharge excess test (river or potable) water.

In February 2012, the polymer was delivered and connected to the clarifier, the MMF vessels were filled with filter media, and the GAC vessels were filled with new GAC. A mechanical startup was performed again with the vessels full, and included a verification of polymer addition rates to the clarifier. To maximize the performance of the polymer and extend the life of the GAC, a coagulant (ferric chloride) was added to the water treatment process in accordance with the design specifications which provided for use of a coagulant if needed.

3.8.2.2 Initial Batch-Mode Startup

Initial batch-mode startup of the water treatment system began on March 12, 2012 and took approximately one week. Compliance samples were collected after treating representative water from sediment processing for a minimum of two full hours. Approximately 405,000 gallons of slurry were processed through the gravity thickener before the overflow was considered “representative” (equivalent to approximately 1.5 times the gravity thickener volume of 270,000 gallons). In accordance with discussions with USEPA, treated water was discharged to the enclosure during batch-mode operation until sampling indicated that project discharge requirements were met (USEPA e-mail, March 5, 2012, Appendix A). On March 16, 2012, analytical results for the initial startup treated water samples were received, confirming that the discharge limits were met, and continuous operation began. Water treatment analytical data are provided in Appendix K.

3.8.2.3 Continuous Steady-State Operation

The water treatment system operated continuously and generally on the same schedule as sediment processing and dewatering. Due to the configuration of the GAC vessels, new standby GAC vessels were not available at all times. As a result, when the exhausted GAC needed to be replaced, the operations were slowed down to accommodate the change-out. The water treatment system flow rate was generally 850 gallons per minute. A total of approximately 480,000 pounds of GAC was used for the project. The used GAC was disposed of as described in Section 3.7.4.

3.8.2.4 Initial Batch-Mode Waste-Type Transition

Dredging activities were halted when transitioning between EM and HAZ dredge units, the hydraulic pipeline was cleared, and the tanks within the sediment processing and water treatments systems were drawn down. Once the systems were cleared, dredging and processing resumed, with the water treatment system operating in batch-mode. Treated water was discharged to the enclosure during batch-mode operation until sampling indicated that project discharge requirements were met.

There were three transitions from EM to HAZ material. On April 20, 2012, the first transition began, and the water treatment system began treating the process water from the HAZ material. Compliance samples of the effluent were collected on April 21, 2012. The system continued operation in batch mode while waiting for the effluent sample results (expedited turnaround) from the water treatment system. On April 26, 2012, the laboratory analytical results were received, confirming compliance with the discharge limits, and the water treatment plant returned to continuous steady-state operation with discharge to the river. About halfway through processing of the second HAZ material period, the construction team proactively decided to recycle treated water into the enclosure due to some concerns with the water quality. During the final HAZ material period treated water was recycled into the enclosure. Water treatment analytical data are provided in Appendix K.

3.9 Backfilling

Backfill was placed from the bottom of the Phase I Removal Action depth up to the pre-Phase I Removal Action elevation. Backfilling began in June 2012 and was completed on September 10, 2012. The backfill material, placement, and monitoring are described in more detail below. The daily and weekly construction reports from June to

September 2012 include details and photographs of the backfilling operations (Appendices D and E, respectively).

3.9.1 Material Supply and Delivery

Weeks arranged for backfill material to be delivered directly from the backfill supplier to the Phase I Work Area on barges. Prior to delivery of imported material, the Contractor demonstrated that the imported material physical and chemical characteristics complied with the specifications (Tierra 2011j) in accordance with the CQAP (Tierra 2011i and 2012b). The backfill material was supplied by Tilcon New York, Inc., and barged from their Clinton Point Quarry. Backfill analytical data are provided in Appendix K.

3.9.2 Placement Operation

The barges and excavator associated with the sediment removal activities remained inside the enclosure through the completion of backfill activities. Equipment used for both sediment removal and backfilling was rinsed with water prior to backfill activities. Backfill material was placed using a clamshell bucket by a crane on a barge located outside the enclosure and the same Caterpillar 385 CL excavator (as needed) used for sediment removal from inside the enclosure.

The design included removal and off-site reuse or disposal of the armor mattresses located outside of the enclosure. However, during construction, USEPA approved placement of the armor mattresses within the removal area prior to placing backfill. Following placement of the armor mattresses along the inside perimeter of the enclosure/Phase I Work Area, the initial lift of backfill was placed. Placement of the armor mattresses did not necessarily reduce the volume of backfill material required, but did assist in reducing resuspension and mud waving as the first backfill lift was placed.

Following placement of the armor mattresses, backfill was placed to the original grade consistent with the design. The estimated backfill volume is based on material bill of lading slips and is greater than the in-situ sediment removal volume. The reasons for this difference include the following: some backfill mixed with the underlying sediments, loose fill volumes are greater than in situ volume due to lower density, the backfill supply barge was not fully emptied (e.g., residual volumes may have been double counted), and the final post-backfill surface is not identical to the pre-dredge surface.

Interim bathymetry surveys were not performed during backfill placement for the same reasons that were described in Section 3.4.2.3. Weeks used their own survey and RTK-DGPS equipment to confirm placement thicknesses. Backfill progress was monitored by hand sounding using a calibrated depth probe. A manual sounding survey, similar to the soundings collected during dredging operations, was conducted upon completion of backfill placement to verify that the required elevations had been met. After removal of the enclosure in November 2012, a multi-beam bathymetric survey was conducted to verify the manual soundings and as final confirmation of the backfill elevations. Due to scheduling and safety constraints, the final bathymetry survey was conducted following Hurricane Sandy and not within 5-days of the enclosure removal (Tierra 2012i). Figure 3-2 shows the post-backfill bathymetry within the Phase I Work Area. The manual soundings data are included in Appendix F.

3.10 Demobilization

Decontamination of equipment and demobilization from the UPF and the Phase I Work area began following completion of sediment processing in June 2012 and backfilling in September 2012, respectively. Following decontamination of the sediment processing system, demobilization was temporarily suspended for three months at the request of the USEPA and Tierra while other potential operations for the sediment processing system were investigated. Demobilization was resumed in October 2012 and was completed in January 2013. Decontamination and Demobilization activities are described in more detail below.

3.10.1 Decontamination

Reusable equipment and materials were decontaminated prior to off-site transport per the RAWP Part 1 (Tierra 2011e). Equipment was dry-brushed to remove gross contamination. High-pressure wash water (contained and collected) was used to clean and decontaminate equipment and material from the project. As the sediment processing and water treatment systems were disassembled, the components were cleaned and decontaminated. Much of this equipment required multiple washings before it was determined to be decontaminated.

3.10.2 UPF Demobilization

Demobilization at the UPF consisted of removing all equipment installed at the UPF. This included office trailers, sediment processing and water treatment equipment, stormwater pumping stations, and generators and electrical conduits. Reusable equipment and materials were decontaminated prior to removal from the site. The UPF was restored in accordance with the restoration agreement established between Tierra and the property owner. The concrete was removed at the completion of the project; however, the asphalt was left in-place. Stormwater catch basins and piping were cleaned and remain in place. Holes were punctured in the bottom of the catch basins to allow them to drain and not hold surface water.

Samples were collected from the surrogate sampling locations at the UPF between August and December 2012. Sampling was conducted at each surrogate sample location following removal of existing equipment and asphalt and concrete pads and immediately after uncovering each soil window to avoid potential cross-contamination from other sources. Sampling was conducted as described in Standard Operating Procedure No. 9 (SOP-9) of the RAWP QAPP (ARCADIS 2011c) using a stainless steel sampling spoon; soil was homogenized in a stainless steel bowl. Soil window PRR1SOLPC-12 was unable to be located and, therefore, was not sampled. A detailed description of the activities related to soil window sampling and results is provided in the Surrogate Sampling Memorandum (ARCADIS 2013). The analytical results for the surrogate samples are provided in Appendix K. Post-operations surrogate sampling data confirm that the sediment processing and water treatment paving and site operations were successful in preventing impacts to the subsurface from UPF operations.

The UPF post-construction survey information was requested by and provided to the UPF property owner in accordance with the restoration agreement. The USEPA approved of modifying the UPF Post-Construction Closeout requirements in the CQAP to allow use of the combination of visual (photo-documentation) and as-built surveys via e-mail correspondence (Butler, March 14, 2013; Appendix A).

3.10.3 Phase I Work Area Demobilization

After completion of the sediment removal and backfilling, the sheet pile enclosure was removed and demobilized from the Phase I Work Area. Each item was removed, decontaminated, and transported off site.

A barge-mounted crane was used to remove armor mattresses and geotextile. The mattresses were placed in the Phase I Removal Area beneath the backfill material, as described in Section 3.9. Ancillary structures attached to the enclosure walls were removed prior to enclosure pile removal. The enclosure wale located on the interior perimeter was removed in sections along the enclosure wall and staged on deck barges. Once a sufficient portion of wale had been removed to facilitate enclosure removal equipment, Weeks began to remove the enclosure piling. The walkway and weir gate along the east wall of the enclosure were also removed prior to east wall removal. Tiebacks and the double-wale along the existing OU-1 Floodwall remained in place. The water-level management piping and power were disconnected, and pumps were lifted out of place using a barge-mounted crane after the enclosure had been partially opened to the Passaic River. Walkway, wale, and weir components were cut manually from the enclosure walls, by personnel staged from work boats adjacent to the enclosure, in a manner to avoid damage to remaining piling and maximize reusability. Barge-mounted cranes lifted materials out of the enclosure and staged it on barges for transport to the Greenville Yard.

Enclosure king and sheet piles were removed using a barge-mounted crane and vibratory hammer. The enclosure piling was extracted expeditiously to minimize scour. Therefore, prior removal of the king piles, the shorter intermediate sheet piles were removed over a section of wall because they were smaller and easier to remove. Once sheet piles had been removed over a section of wall, the king piles were removed. Piles were decontaminated as they were removed per RAWP Part 1 (Tierra 2011e) and staged on barges for transport to the Weeks' Greenville Yard for demobilization via crane.

3.11 Final Inspection

A final inspection was conducted of the OU-1 Site and the UPF to document the completion of the Phase I Removal Action. A representative from Tierra, the CQA Officer, the Site Field Manager, and the Regulatory Oversight Agency attended the inspections. The inspections consisted of a walkthrough to evaluate the completeness of construction efforts and its consistency with the drawings, specifications, and the CQAP (Tierra 2011i, 2012b). The OU-1 site final inspection was conducted on November 28, 2012. The UPF final inspection was conducted on January 22, 2013. Following the inspections, the USEPA approved the completion of Phase I Removal Action as documented in a letter dated March 13, 2013 from Elizabeth Butler (Appendix A).

4. CQA Monitoring Activities/Documentation

CQA observations and inspections confirmed that the proper equipment and materials were used during the project, and that these components were installed in accordance with the USEPA-approved design, as modified by FMs. CQA activities were also conducted to confirm compliance with permits and permit equivalencies (Appendix B).The design team also reviewed contractor and vendor submittals during construction to confirm compliance with the USEPA-approved design. Submittals are provided in Appendix J. Generally, operation-related CQA activities are summarized in Section 3, and compliance-related CQA activities are included in this section.

Daily and weekly construction reports were prepared to document the construction observations for the day/week, including material quantities used in the construction, sediment removal/filling/earthwork quantities, equipment used, and general tabulation of the Contractor's use of personnel and equipment. These reports are included as Appendices D and E.

Daily CQA reports were prepared to document the CQA activities for each day, including any deficiencies and corrective actions, and are included as Appendix F. The CQA reports include chemistry data and an evaluation of the chemistry data. During construction and during the removal action, due to time restrictions, verified data were used for CQA activities and included in the CQA reports. The data were subsequently validated. The validated data may be slightly different than the verified data. Qualifiers were added to data during validation, as appropriate, including qualifiers that change a result from a detected value to a non-detect result. Although the validated data may be slightly different than the verified data used during construction, the conclusions made during construction on the verified data are still valid with the validated data. The data validation reports and analytical laboratory reports are provided in Appendix K. A Data Quality Usability Assessment Report is provided in Appendix L.

A public website was created to provide the community information on the site with updated news items, weekly status reports, site photos, and a project timeline. The website includes the Community Health and Safety Plan, Community Hotline and Investigation/Response Process contact information, and near real-time monitoring information about air monitoring, water quality monitoring, and quality of life issues. Links to the project documents are also provided on the website.

4.1 Enclosure Monitoring Activities

Enclosure construction monitoring included pre-construction structural and geotechnical survey of waterfront structures, surveying of the enclosure, vibration monitoring, and tieback load testing , As described in Sections 3.1 and 3.3, the construction monitoring was performed per the CQAP (Tierra 2011i; 2012b), and the results are included in Appendix F.

During sediment removal operations, enclosure monitoring activities included visual inspections, inclinometer monitoring, optical surveying, tieback load cell monitoring, and water level monitoring. Tide gages were installed to monitor the river elevation outside of and within the enclosure, to provide a record of river levels, and to provide information for implementation of the water-level management plan. Four tide gauges were installed by OSI and surveyed by DPK. The enclosure monitoring results were reviewed by the design team and are included in Appendix F.

4.2 Weather Monitoring

A weather station was installed at the UPF to collect real-time measurements during pre-construction monitoring and sediment processing activities. The weather station measured wind speed, wind direction, amount of precipitation, barometric pressure, and temperature. Weather data are included in the CQA Reports (Appendix F).

4.3 Underwater Sound Monitoring

The NMFS requested that underwater sound monitoring data be collected in the river during sediment removal. These data were collected for informational purposes only and were not used for compliance purposes. Underwater sound monitoring was conducted prior to construction activities, during enclosure installation, and during sediment removal. Two days of monitoring were performed prior to enclosure installation to collect ambient data. During enclosure installation, monitoring was conducted during two separate events (for a total of four days). During sediment removal operations, monitoring was conducted during two separate events (for a total of four days): one two-day event at the start of sediment removal operations, and one two-day event midway through sediment removal operations. Monitoring at the start of sediment removal recorded acoustic data during sediment removal near the pre-dredge sediment surface (i.e., within the top 6 ft). Monitoring midway through sediment removal recorded acoustic data during sediment removal approximately 10 to 12 ft below the pre-dredge sediment surface. Underwater sound monitoring was conducted by OSI. The methodology and results are summarized in the Underwater Sound Report (Tierra 2012h).

4.4 Bird Deterrence

The U.S. Fish and Wildlife Service expressed concern that the Phase I Work Area may present an attractive area for foraging birds within the enclosure. A bird deterrence system was implemented to reduce the likelihood of birds utilizing the Phase I Work Area. A Red Hat Eagle Eye bird deterrent system, targeted for gulls, was installed along the shoreline side of the enclosure to prevent birds from using the Phase I Work Area as foraging grounds. Each Eagle Eye unit consisted of a mirrored, rotating pyramid that acted as a visual deterrent by reflecting sunlight into birds' eyes, significantly limiting their vision and causing them to fly to another destination. Five units were placed equidistant along the OU-1 Floodwall; each unit providing up to 150 ft coverage. Inspection for bird presence (alive, moribund, or dead) on enclosure walls or equipment, or within the enclosure, was conducted daily. Observations are included in Appendix F.

4.5 Quality of Life Considerations

Potential short-term quality of life impacts, including noise, navigation, traffic, light, and sustainability, were evaluated during design, and many of these potential impacts were eliminated or reduced in the design. Remaining potential quality of life impacts were monitored and mitigated during construction. Air and odor monitoring are discussed in Section 4.7.

4.6 Water Treatment Monitoring

4.6.1 Operation Monitoring

During operation, CHES monitored the operation of the water treatment system and prepared a daily water treatment system operation report, which was included in each CQA Report (Appendix F). Monitoring results of the water treatment system are summarized below, and the analytical data are provided in Appendix K.

Flow meters continuously monitored the water from sediment processing and the effluent discharge to the river. The effluent flow meter monitored the total amount of treated water discharged to the Passaic River each day, in accordance with the project discharge requirements. A water treatment system operator recorded the total amount of treated water discharged daily.

As shown in Table 3-1, the total flow of treated effluent discharged to the river via the treatment system outfall was approximately 40.6 million gallons. During startup, the first HAZ transition, third HAZ transition, decontamination, and demobilization, treated water was discharged to the enclosure.

4.6.2 Startup Monitoring

Startup monitoring was performed to verify consistency of actual effluent parameters with the values predicted during design and to confirm that effluent quality met the project discharge effluent limits. The startup operations and monitoring were conducted while the plant was operating in batch mode. Treated water was discharged back to the enclosure pending analytical results.

After the water treatment system achieved steady-state conditions, as described in Section 3.8.2.3, three samples of influent and three samples of effluent water were collected. The influent samples were collected from the sample port after the equalization tanks. The effluent samples were collected from the sample port on the effluent line from the lag GAC vessel. Effluent samples were analyzed for the suite of parameters with the project discharge limits. Influent samples were analyzed for total suspended solids (TSS) only. The RAWP QAPP (Tierra 2011o) provides details on this sampling and analysis requirements. Effluent sample analytical results were compared to project discharge effluent limits. The influent TSS sample analytical results were used to evaluate system operations.

After the effluent sample results confirmed that the treated water met the project discharge effluent limits, the plant operations shifted to continuous operation and treated water was discharged to the river. During continuous operation and discharge, compliance sampling was performed, in accordance with the project discharge requirements. In addition to compliance monitoring, other performance monitoring (described in Section 4.6.3) was conducted to confirm that the system continued to meet design and performance criteria.

As during startup, the first time that sediment processing transitioned from EM to HAZ material, the treatment system was operated in batch mode. No discharge occurred during batch mode operations until sampling indicated that the discharge limits were met.

4.6.3 Performance Monitoring

Performance monitoring was conducted to evaluate solids removal and chemical removal through the system. Solids removal monitoring included turbidity into and out of the clarifier, collecting TSS samples at stages in the treatment system as needed, and measuring the pressure drop across each GAC vessel daily to monitor for solids breakthrough and confirm that vessels were not preferentially loaded.

To monitor for breakthrough of the GAC, chemical monitoring of the lead GAC vessels was conducted twice weekly chemical during processing of EM material and more frequently (generally daily) during processing of HAZ material. One sample was collected from the influent to the GAC vessels and one sample from the effluent of one lead GAC vessel. The samples were analyzed for three indicator compounds: 2-butanone, chlorobenzene, and chemical oxygen demand. After nine performance monitoring events, chemical oxygen demand was eliminated from the performance sampling because the results were poorly correlated with the chemical concentrations. This sampling modification was detailed in RAWP QAPP Mod 002 (Tierra 2012f) and approved by USEPA via e-mail correspondence (Butler, May 31, 2012; Appendix A).

4.6.4 Compliance Monitoring

Compliance monitoring was performed to verify that the effluent quality met the discharge effluent limits. Compliance sampling was performed for the duration of treated water discharge, through decontamination and demobilization. Compliance monitoring samples were collected from the influent to the water treatment system, after the equalization tanks, and from the effluent prior to discharge to the Passaic River. The samples were collected during the day, when the primary influent source was water from sediment processing.

4.6.4.1 Total Suspended Solids Monitoring

TSS samples were collected daily from the effluent when treated water was discharged to the river. In addition, turbidity was monitored continuously using a flow-through cell on the discharge line. During the first two weeks of operations, the correlation between TSS and turbidity was evaluated; however, the correlation was not strong enough to convert turbidity readings into TSS. Daily TSS samples were collected for the remainder of the treated water discharge.

4.6.4.2 Weekly Chemical Monitoring

An effluent sample was analyzed weekly for Aroclor polychlorinated biphenyls (PCBs), dioxins, metals, VOCs, semivolatile organic compounds, pesticides, herbicides, total organic carbon, and pH. The effluent analytical results were compared to the project discharge effluent limits. In addition, an influent and an effluent sample were collected and analyzed weekly for 11 chemicals without project discharge limits. After the first four weeks, the influent sample was reduced to bi-weekly based on satisfactory performance of the water treatment system (Appendix K). This modification was approved by USEPA via e-mail correspondence (Butler, May 3, 2012; Appendix A).

4.6.4.3 Monthly Toxicity Monitoring

Once a month, an effluent sample was analyzed for acute whole effluent toxicity testing. The analytical results were reported to the NJDEP for information purposes only.

4.6.5 Water Treatment Corrective Actions

Corrective action was undertaken if an effluent sample exceeded the discharge requirements. Certain effluent compliance samples collected between May and June 2012 contained a few analytes exceeding the discharge criteria. The corrective action for the samples was to complete a change-out of the GAC vessels. The CQA reports (Appendix F) include tables with the sampling results indicating which analytes exceeded the discharge criteria.

On June 6, 2012, an effluent sample was collected that exceeded some of the discharge criteria. While waiting for the analytical results and in accordance with previous discussions with USEPA, a proactive field decision was made based on visual observations of the variability in turbidity to suspend water discharge directly to the river on June 12, 2012, and to discharge treated water back to the enclosure until completion of sediment processing (USEPA e-mail, March 5, 2012, Appendix A).

Following the completion of the sediment processing activities, the water treatment system was shut down, and a smaller-capacity temporary water treatment system was brought on site (with new GAC) to treat the decontamination water.

4.7 Air Monitoring

Air monitoring included three components, described in greater detail below: background air monitoring, perimeter air monitoring, and worker safety air monitoring. Background and perimeter air monitoring was conducted following the guidelines presented in the Perimeter Air Monitoring (PAM) Program for the Passaic River Phase I Removal Action, dated February 14, 2012 (USEPA 2012). On-site weather monitoring data were collected continuously during perimeter air monitoring activities. The air monitoring results are summarized in the CQA reports (Appendix F), and air monitoring analytical data are provided in Appendix K.

4.7.1 Background Air Monitoring

Background air monitoring was conducted at OU-1 and the UPF four days prior to the initiation of sediment removal. Background monitoring occurred over two, 24-hour periods (March 5 and 6, 2012, and March 7 and 8, 2012) to determine ambient air concentrations. Ten monitoring locations were identified to be sampled. These ten monitoring locations included four non-residential locations along the perimeter of OU-1 (adjacent to the Phase I Work Area), four non-residential locations along the perimeter of the UPF, and two residential locations as shown on Figure 4-1. One of these background monitoring locations (AIR-03) was sampled during the background monitoring period only. AIR-03 was located on the northern edge of the sheet pile enclosure wall.

During pre-construction (background) air monitoring, air samples were collected for indicator compounds only. The following primary COCs were analyzed during the background sampling period, and as described in PAM plan, these compounds served as indicators for other contaminants that might have been present at the site:

- Dioxins/furans (expressed as 2,3,7,8-TCDD toxicity equivalent quotient)
- Total Aroclor PCBs
- Chlorobenzene
- Dichlorodiphenyltrichloroethane (DDT)

4.7.2 Perimeter Air Monitoring During Construction

PAM was conducted at nine locations (three at OU-1, four at the UPF, and two residential locations) to monitor potential impacts to off-site receptors. Air monitoring was conducted at two residential locations (Location 9 and 10); however, Location 10 was replaced by Location 11 beginning on March 15, 2012, at the Location 10 property owner's request.

Samples were collected at each of the monitoring locations for laboratory analysis of the primary COCs. These 24-hour air samples were collected daily during sediment removal and processing (Monday through Saturday) and shipped to the laboratory for an expedited turnaround time of 48 to 72 hours, depending on the analyses required.

As sediment removal and processing activities continued, USEPA-approved modifications were made to the PAM plan during EM dredging. Beginning on April 2, 2012, PAM at the nine locations for all COCs was performed once a week or when winds were forecasted to originate from the north or northeast (USEPA e-mail, March 29, 2012, Appendix A). It was later agreed that winds originating from the northwest and east would be acceptable to meet this requirement (USEPA e-mail, April 19, 2012, Appendix A). On May 15, 2012, USEPA approved the discontinuation of perimeter air sampling for DDT and PCBs at the seven non-residential locations for the remainder of the project (USEPA email, May 15, 2012, Appendix A). However, sampling for DDT and PCBs was continued at the two residential locations at a reduced sampling frequency. Dioxins continued to be monitored daily at the residential off-site locations.

The analytical results of PAM were compared with the health-based values established by the Pre-Construction Permit Equivalency (NJDEP 2012) and in the PAM plan (USEPA 2012). Laboratory analytical results were evaluated daily. A summary of prevailing weather conditions was included in this daily evaluation.

The only air exceedance was a detection of chlorobenzene at a concentration of 810 micrograms per cubic meter [$\mu g/m^3$]) on May 1, 2012, at location AIR-05, south of the UPF perimeter, which was greater than the USEPA concern level for chlorobenzene of 800 $\mu g/m^3$. The nearest residential sample location is AIR-09, located approximately 800 ft west-southwest of location AIR-05. Chlorobenzene was simultaneously detected at 47 $\mu g/m^3$ at this location. In general, wind originated primarily from the northeast, northwest, and west on May 1, 2012, with several hours from the southeast during the morning of May 1, 2012. On May 1, 2012, HAZ material was being dredged and processed. As a result of real-time worker safety air monitoring, workers in affected areas upgraded to Level C PPE. On May 2, 2012, chlorobenzene concentrations returned to well below the concern level. On May 3, 2012, dredging switched from HAZ to EM. USEPA concern and/or alert levels were not exceeded during any other day of monitoring.

PAM analytical results were included in daily air monitoring reports as the verified/validated data became available. Weekly summary reports were submitted to USEPA and NJDEP at the end of each work week. Any new actions and/or corrective actions implemented to reduce exposure were also documented in the daily/weekly air monitoring reports.

4.7.3 Worker Safety Air Monitoring

Worker safety air monitoring was conducted to evaluate potential impacts to workers involved in construction activities and to implement provisional controls, as needed, to reduce the potential impacts. During sediment removal and processing activities, worker air safety monitoring was performed continuously and focused on VOCs and hydrogen sulfide. Worker safety air monitoring during sediment removal and processing activities consisted of selected workers wearing monitoring equipment and deploying monitoring equipment in the work areas, providing breathing zone data and work area data. Worker safety monitoring was also performed during non-sediment removal and processing activities at a reduced frequency (compared to during sediment removal and processing activities) and was focused on typical construction inhalation hazards (e.g., dust). Worker safety air monitoring results were evaluated daily in comparison to the alert and action levels specified in the HASP (Tierra 2011a, 2011f, 2011m, 2011n, 2012a, 2012c), and PPE was used in accordance with the HASP. All monitoring equipment was maintained and calibrated in accordance with manufacturer's recommendations.

4.7.4 Odor Monitoring

On-site odors were monitored based on workers' complaints of excessive odor. Off-site odor conditions were monitored based on community complaints.

5. Certification

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

By: ____________________________ Date: March 19, 2013

Matthew Bowman
Construction Manager, ARCADIS U.S., Inc.

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Table

Table 3-1
Summary of Construction Quantities

Removal Action Component	Quantity	Unit
UPLAND PROCESSING FACILITY (UPF) SITE PREPARATION		
UPF Soil Disposed Offsite	688	Tons
Imported Fill (Aggregate)	7,100	Tons
ENCLOSURE		
Scour Protection Sand Footprint	100,065	SF
Concrete Mattresses	110	EA
Sheet Piles	171	EA
King Pile	170	EA
Tiebacks	36	EA
REMOVAL		
In-place Dredged Material Volume[1]	41,434	CY
Water Pumped into Enclosure from Fish Screen	42,939,000	Gals
PROCESSING[2]		
Average % Solids in Filter Cake	67	%
Total Filter Cake Weight	29,960	Tons
Total Coarse Solids Weight	3,986	Tons
Total Debris Weight (Debris removed from Phase I Work Area)	599	Tons
TRANSPORT, TREATMENT, AND DISPOSAL[2]		
Total Number of Containers Shipped Off Site	1,508	EA
Total Sediment Waste (Filter Cake, Coarse Solids, Debris, Drill Cuttings, GAC, Decontamination Waste)[2]	34,545	Tons
HAZ Material Treated at Aragonite Incinerator and Disposed of at Grassy Mountain[2]	8,311	Tons
HAZ Debris Material Disposed at Grassy Mountain	91	Tons
Total EM Material Disposed of Off Site	26,144	Tons
EM Material Disposed of at Lone Mountain[2]	22,837	Tons
EM Material Disposed of at Grassy Mountain	3,307	Tons
WATER TREATMENT		
Treated Water[3]	56,724,038	Gals
Water Treatment Discharge to River	40,591,437	Gals
Water Treatment Discharge to Enclosure	7,442,595	Gals
BACKFILL		
Backfill Placed[4]	47,849	CY

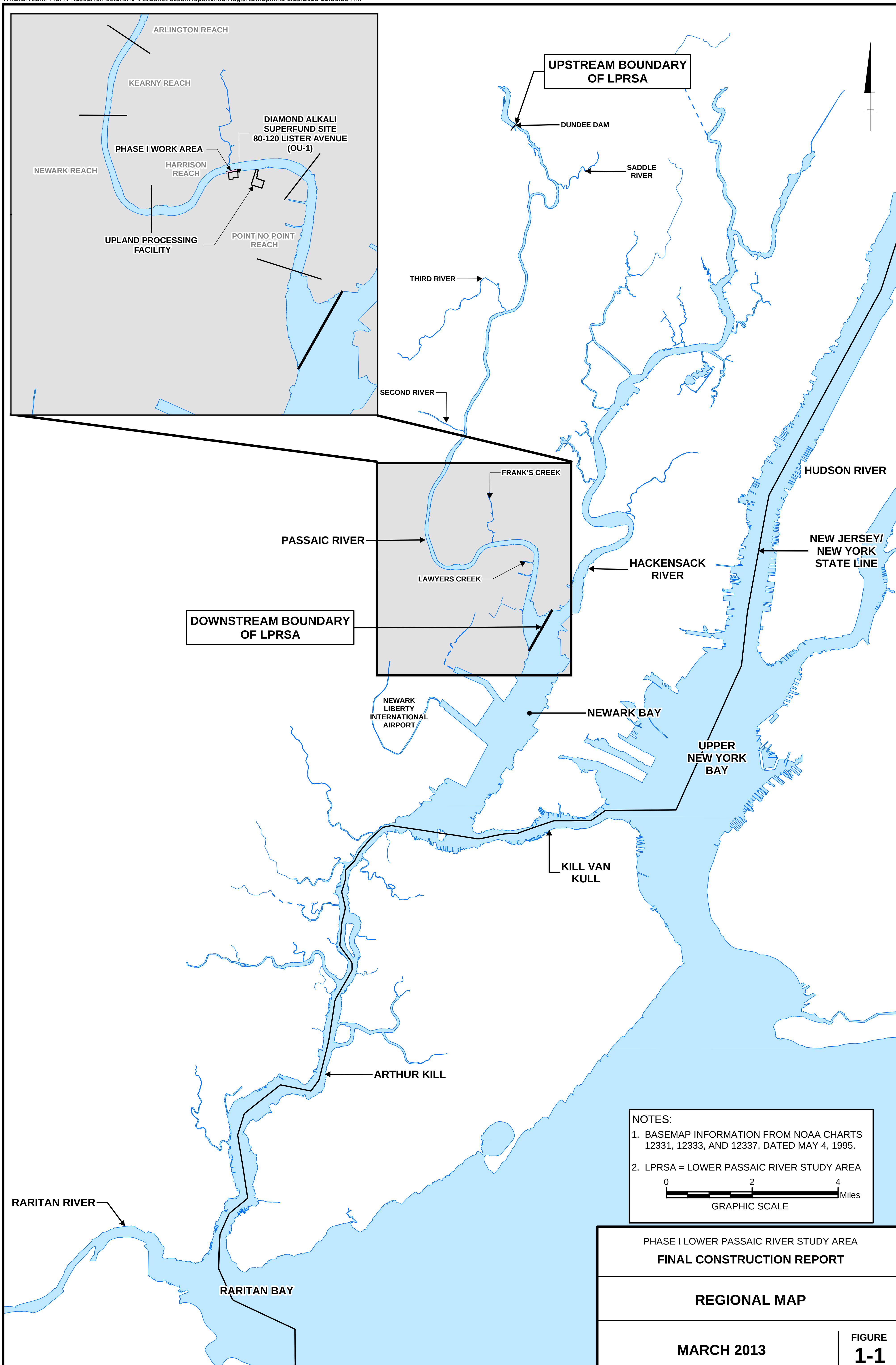
Acronyms and Abbreviations

% = percent
Aragonite Incinerator = CHES Aragonite Hazardous Waste Incinerator Facility
CY = cubic yards
EA = Each
EM = Environmental Media
GAC = granular activated carbon
Gals = gallons
Grassy Mountain = Grassy Mountain Subtitle C Landfill
HAZ = Hazardous Characteristic Material
Lone Mountain = Lone Mountain Subtitle C Landfill Facility
NA = not applicable
RTK-DGPS real-time kinetic digital global positioning system
SF = square feet
Stuyvesant = Stuyvesant Environmental Contracting, Inc.

Footnotes:

1. In-place dredged material was calculated by RTK-DGPS system and verified by soundings. This includes debris.
2. The filter cake consisted of dewatered fine sediment from the presses. The coarse solids consisted of dewatered coarse sediment that was processed at the UPF. Sediment waste quantity includes filter cake, coarse solids, and debris, as well as tieback drill cuttings and used GAC, which were combined with sediment for disposal. EM disposed of at Grassy Mountain includes approximately 108 tons of tieback drill cuttings. HAZ disposed at Aragonite includes 240 tons of GAC.
3. Reported volumes for water treatment do not balance because water was constantly recycled back to Stuyvesant from clean water holding tanks. There was no flow meter on this line to determine how much water Stuyvesant re-circulated back into the process for washing, polymer mixing, etc.
4. Actual backfill quantity based on Tilcon New York, Inc. material bill of lading slips.

Figures



PHASE I LOWER PASSAIC RIVER STUDY AREA

FINAL CONSTRUCTION REPORT

REGIONAL MAP

MARCH 2013

FIGURE **1-1**

LEGEND:

PROPERTY BOUNDARY
FENCE
NAVIGATION CHANNEL (USACE)
PHASE I REMOVAL AREA (REVISED 07/01/2010)
TIDELANDS CLAIM LINE

0 50' 100'
GRAPHIC SCALE

PHASE I LOWER PASSAIC RIVER STUDY AREA

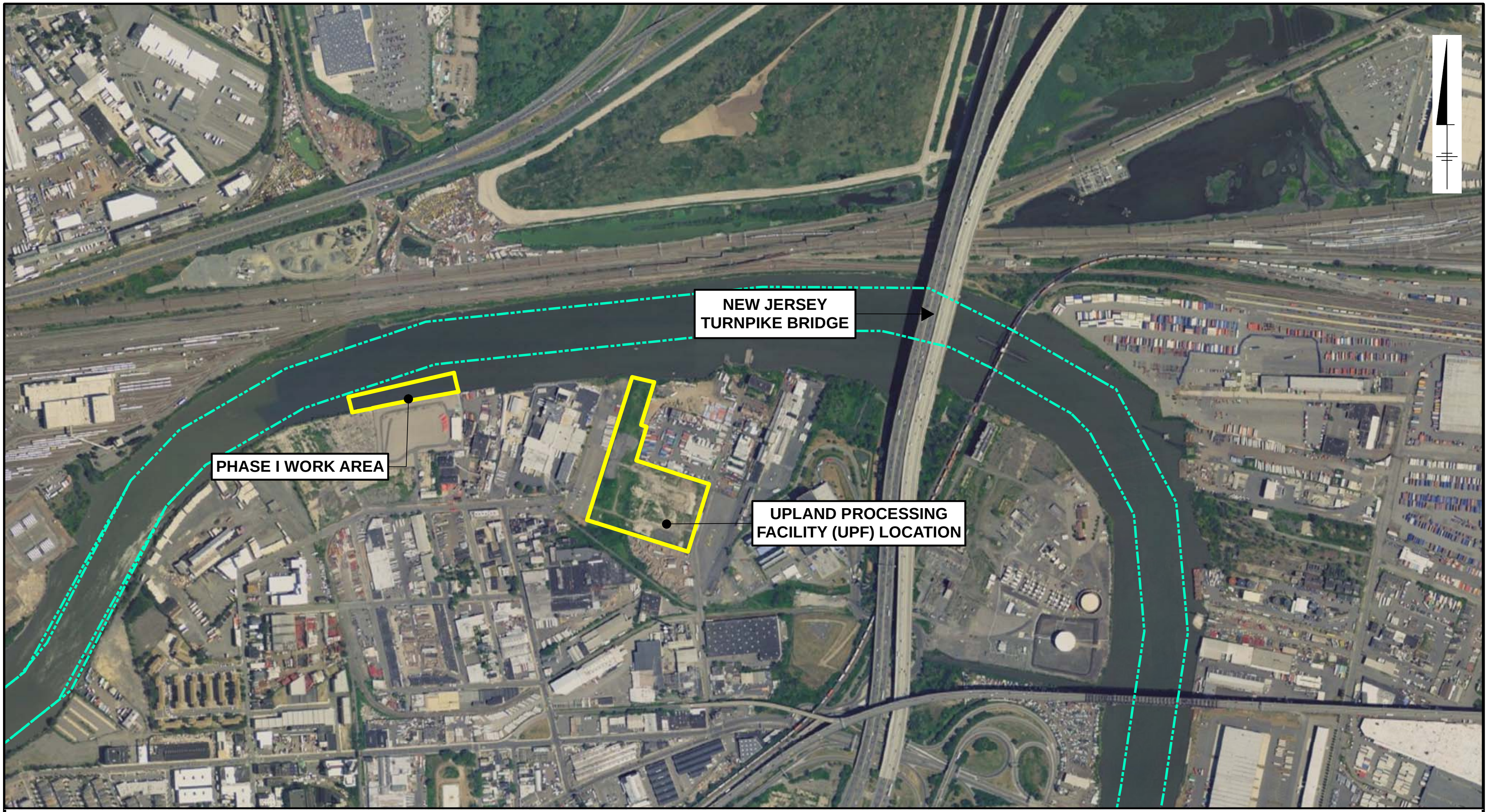
FINAL CONSTRUCTION REPORT

PHASE I WORK AREA

MARCH 2013

FIGURE
1-2

CITY: SYRACUSE DIV/GROUP: 141/ENV DB: G. STEINBERGER K. SINSABAUGH LD:(Opt) PIC: R.ROMAGNOLI PM: R.ROMAGNOLI TM: R.ROMAGNOLI LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0009956\0002\70008\DWG\FCR\09966G01.dwg LAYOUT: 1-2 SAVED: 3/18/2013 4:14 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/18/2013 4:15 PM BY: DECLERCQ, BRIAN
XREFS: IMAGES: PROJECTNAME: ----
09966X03
09966X00
09966XL1



LEGEND:

WORK AREA

FEDERAL NAVIGATION CHANNEL

NOTE:

1. 2010 NAIP IMAGERY PROVIDED BY ESRI'S MAPPING SERVICE.

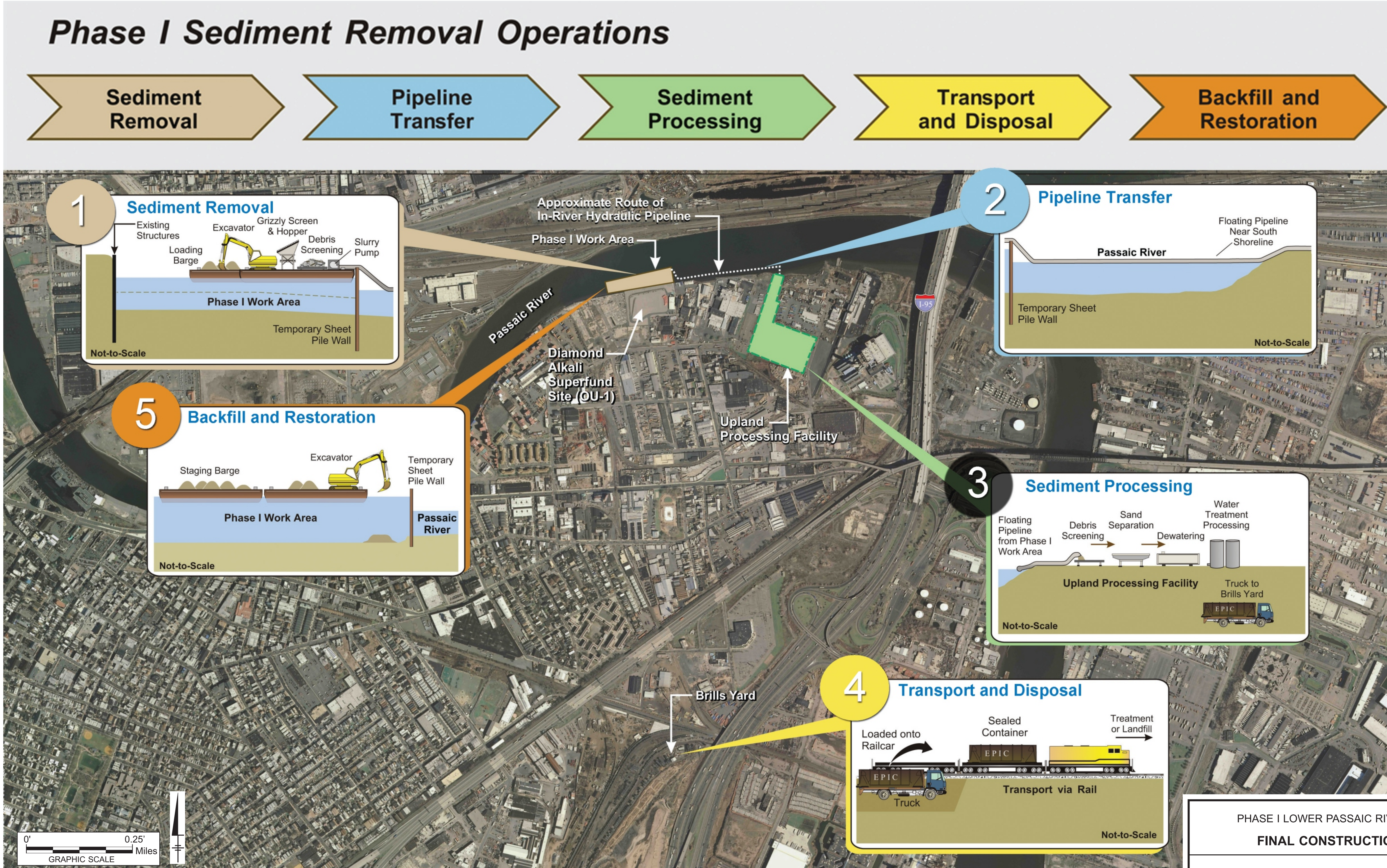
PHASE I LOWER PASSAIC RIVER STUDY AREA

FINAL CONSTRUCTION REPORT

UPF LOCATION

MARCH 2013

FIGURE 1-3



PHASE I LOWER PASSAIC RIVER STUDY AREA

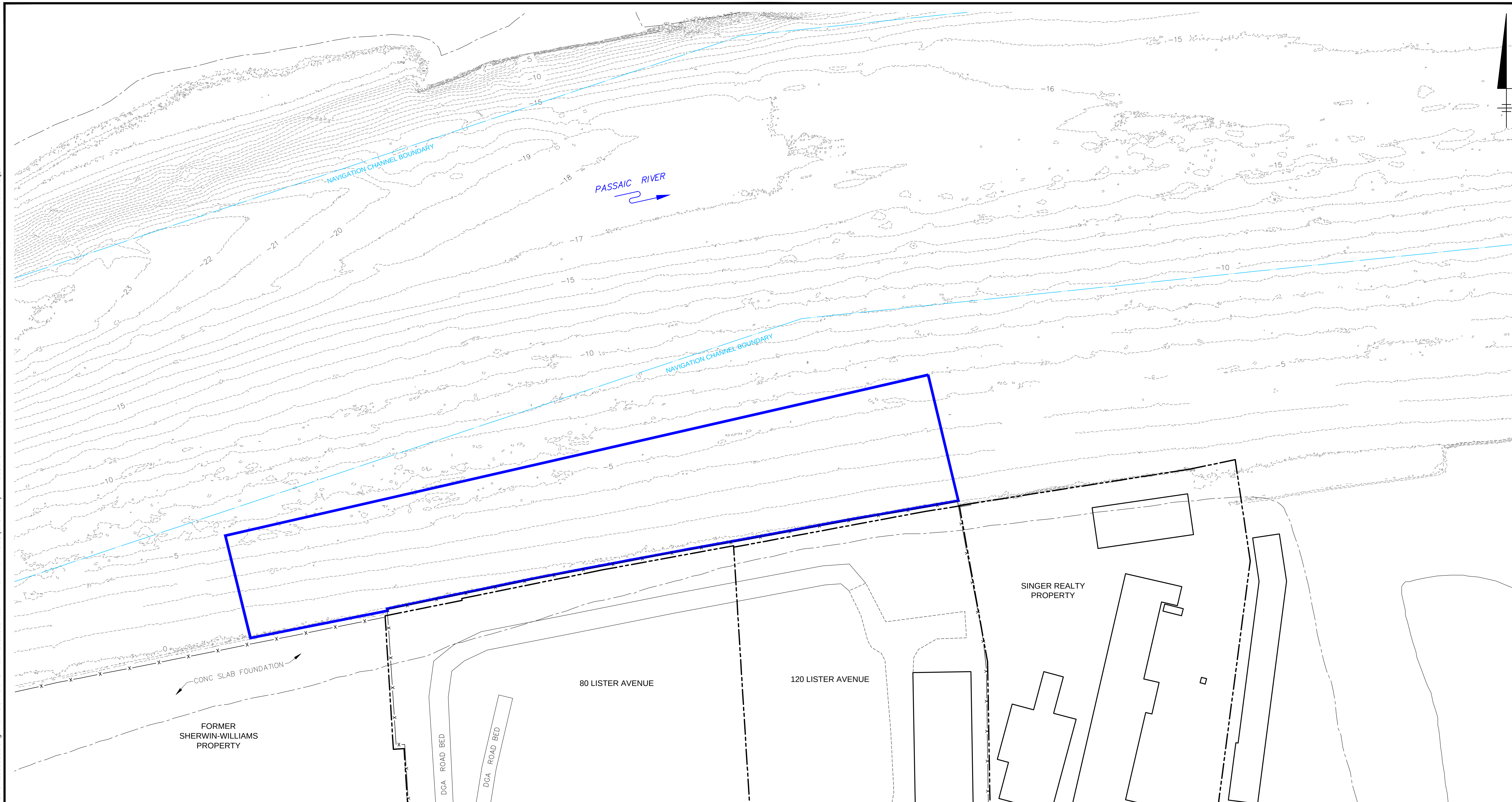
FINAL CONSTRUCTION REPORT

PHASE I REMOVAL ACTION CONCEPTUAL PROCESS FLOW DIAGRAM

MARCH 2013

FIGURE **1-4**

01/31/2013 SYRACUSE, NY-ENV/CAD-DJHOWES
B0009966/0002/70008/CDR/09966g01.CDR



LEGEND:

- PROPERTY BOUNDARY
- PRE–DREDGE BATHYMETRY
- FENCE
- NAVIGATION CHANNEL (USACE)
- PHASE I REMOVAL AREA (REVISED 07/01/2010)
- TIDELANDS CLAIM LINE

NOTES:

1. UPLAND TOPOGRAPHY AND EXISTING FEATURES WERE TAKEN FROM SHEET NO. 9 OF THE FINAL SITE CONDITIONS PLAN SUBMITTED BY FRENCH AND PARRELLO ASSOCIATES ON 6/17/2004.
2. NAVIGATION CHANNEL PROVIDED BY THE UNITED STATES ARMY CORPS OF ENGINEERS DATED 3/16/2005.
3. PIERHEAD AND BULKHEAD LINE AND TIDELANDS CLAIM LINE WERE PROVIDED BY DPK CONSULTING, L.L.C. DATED 10/1/2009.
4. BATHYMETRY DATA FROM OCEAN SURVEYS, INC. DATED 6/30/2009 REVISED 9/15/2009. GAPS IN BATHYMETRY DATA DUE TO SHALLOW WATER DEPTH AREAS WHERE FULL MULTIBEAM COVERAGE WAS NOT ATTAINABLE.
5. SINGER REALTY PROPERTY IS NOW OWNED BY FLASH CARRIER, LLC.

0 50' 100'
GRAPHIC SCALE

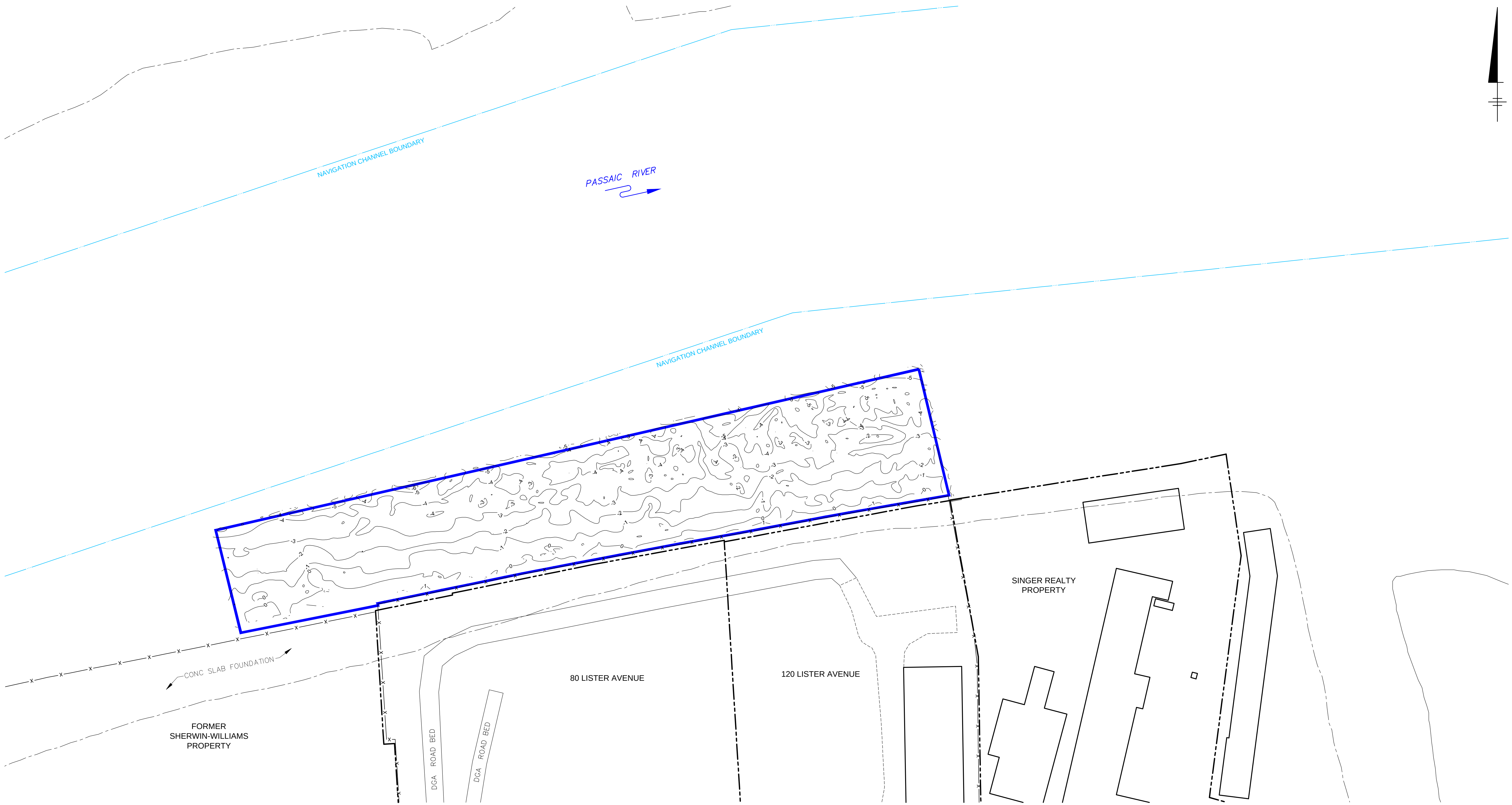
PHASE I LOWER PASSAIC RIVER STUDY AREA

FINAL CONSTRUCTION REPORT

PRE-DREDGE BATHYMETRY

MARCH 2013

FIGURE **3-1**



LEGEND:

- PROPERTY BOUNDARY
- POST–BACKFILL BATHYMETRY
- FENCE
- NAVIGATION CHANNEL (USACE)
- PHASE I REMOVAL AREA (REVISED 07/01/2010)
- TIDELANDS CLAIM LINE

NOTES:

1. UPLAND TOPOGRAPHY AND EXISTING FEATURES WERE TAKEN FROM SHEET NO. 9 OF THE FINAL SITE CONDITIONS PLAN SUBMITTED BY FRENCH AND PARRELLO ASSOCIATES ON 6/17/2004.
2. NAVIGATION CHANNEL PROVIDED BY THE UNITED STATES ARMY CORPS OF ENGINEERS DATED 3/16/2005.
3. PIERHEAD AND BULKHEAD LINE AND TIDELANDS CLAIM LINE WERE PROVIDED BY DPK CONSULTING, L.L.C. DATED 10/1/2009.
4. MULTIBEAM BATHYMETRY SURVEY PERFORMED BY OCEAN SURVEYS, INC. FROM NOVEMBER 5–7, 2012.
5. SINGER REALTY PROPERTY IS NOW OWNED BY FLASH CARRIER, LLC.

0 50' 100'
GRAPHIC SCALE

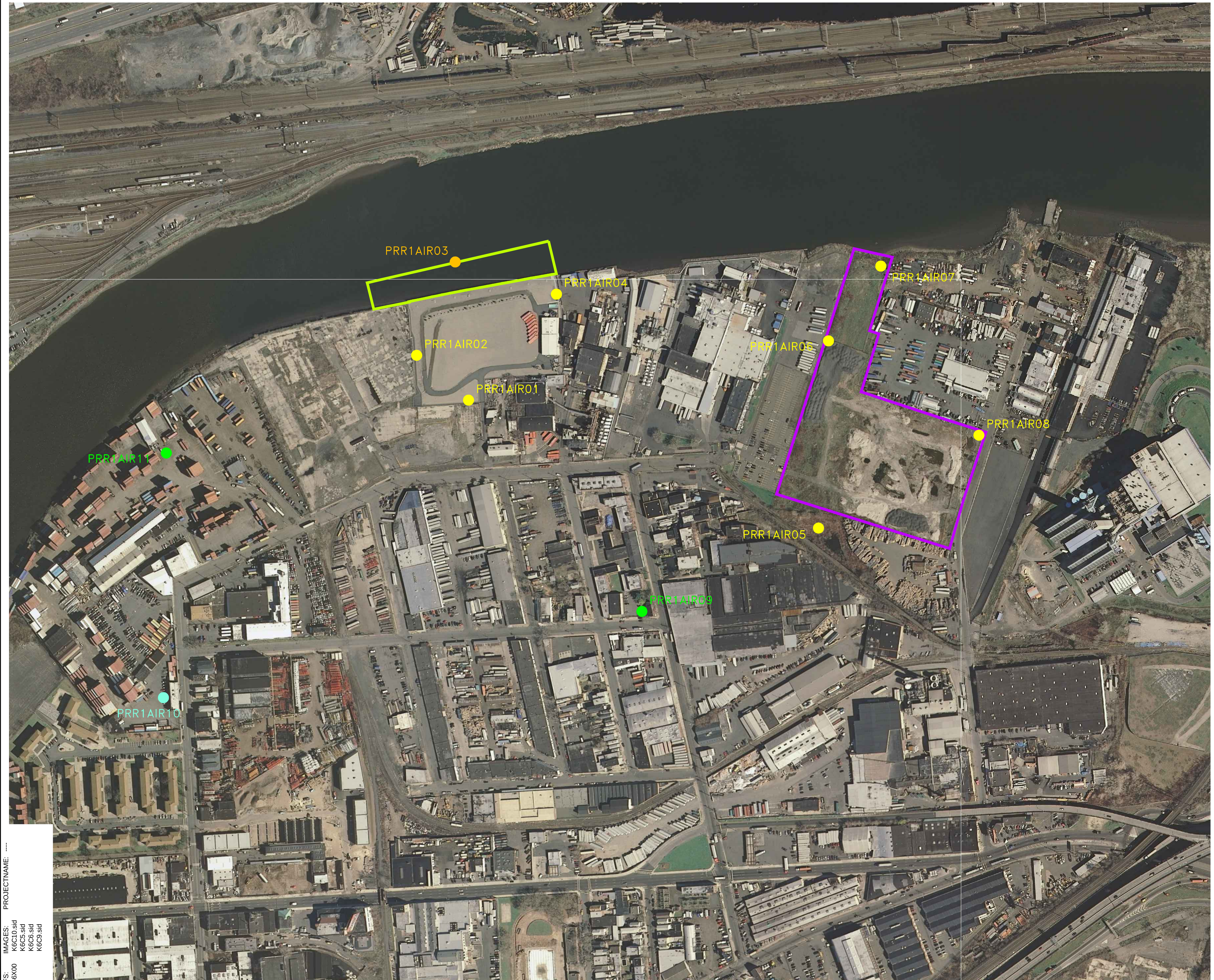
PHASE I LOWER PASSAIC RIVER STUDY AREA

FINAL CONSTRUCTION REPORT

POST-BACKFILL BATHYMETRY

MARCH 2013

FIGURE **3-2**



LEGEND:

- NONRESIDENTIAL MONITOR (yellow)
- RESIDENTIAL MONITOR (green)
- FORMER RESIDENTIAL MONITOR (light blue)
- BACKGROUND MONITOR (orange)
- APPROXIMATE LEASED PREMISES (purple line)
- PHASE 1 WORK AREA (light green line)

NOTES:

1. 2007 IMAGERY DOWNLOADED FROM THE NEW JERSEY GEOGRAPHIC INFORMATION NETWORK WEBSITE AT: http://njgin.state.nj.us
2. RESIDENTIAL MONITORS ARE LOCATED AT 99 CHAPEL STREET (WESTERN LOCATION) AND 122 ALBERT AVENUE (EASTERN LOCATION).

0 200' 400'
GRAPHIC SCALE

PHASE I LOWER PASSAIC RIVER STUDY AREA

FINAL CONSTRUCTION REPORT

AIR MONITORING STATION LOCATIONS

MARCH 2013

FIGURE **4-1**

Appendices

All appendices are provided on DVD