Final

River Mile 10.9 Removal Action Final Design Report, Lower Passaic River Study Area

Prepared for

Cooperating Parties Group, Newark, New Jersey

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Acronyms and Abbreviations

µg	microgram
µm	micrometer
°F	degrees Fahrenheit
ADCP	acoustic Doppler current profiler
AOC	Administrative Settlement Agreement and Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society of Testing Materials
AUD	Acceptable Use Determination
bgs	below ground surface
BMP	best management practice
BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
COPC	chemical of potential concern
CPG	Cooperating Parties Group
CWA	Clean Water Act
CZMA	Federal Coastal Zone Management Act
DOC	dissolved organic carbon
EFH	essential fish habitat
EqP	equilibrium partitioning (method)
FR	*Federal Register*
ft	foot, feet
ft^3	cubic feet
FW2	fresh water type 2 per New Jersey Department of Environmental Protection
HMW	high molecular weight
hr	hour
HSP	Health and Safety Plan
IDW	investigation-derived waste
in.	inch, inches
JCMUA	Jersey City Municipal Utility Authority
kg	kilogram
L	liter
LAeq	equivalent continuous A-weighted sound pressure level
lb	pound
LDR	Land Disposal Restrictions
LMW	low molecular weight
LPR	Lower Passaic River
LPRSA	Lower Passaic River Study Area
LRC	Low Resolution Coring
mg	milligram
NCP	National Contingency Plan

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ng	nanogram
NGVD	National Geodetic Vertical Datum
NJAC	New Jersey Annotated Code
NJDEP	New Jersey Department of Environmental Protection
NJHPO	New Jersey Historic Preservation Office
NJPDES	New Jersey Pollutant Discharge Elimination System
NJSA	New Jersey Statues Annotated
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity units
NWP	Nation Wide Permit
OSR	Off-Site Rule
Pa	pascal
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
pg	picogram
PPE	personal protective equipment
ppm	parts per million
ppt	parts per trillion
PWCM	Physical Water Column Monitoring
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RDWP	removal design work plan
RI	remedial investigation
RM	river mile
sec	second
SOP	standard operating procedure
SVOC	semivolatile organic compounds
TBC	to be considered
TCDD	tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time-Critical Removal Action
TEQ	toxicity equivalency quotient
TOC	total organic carbon
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
UTS	Universal Treatment Standards
VOC	volatile organic compound
WQC	Water Quality Certification
yd^3	cubic yard

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SECTION 1

1 Introduction

This Final Design Report (Final) for River Mile (RM) 10.9 of the Lower Passaic River (LPR) has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action, Docket No. 02-2012-2015 (USEPA, 2012a), by the Cooperating Parties Group (CPG) (hereinafter referred to as the RM 10.9 AOC). The AOC became effective on June 18, 2012.

The Removal Action will be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a Time-Critical Removal Action (TCRA). This Final describes the Removal Action selected by the USEPA in the Action Memorandum/ Enforcement dated May 21, 2012 (USEPA, 2012b).

This Final is based on the AOC (USEPA, 2012a), the Action Memorandum/Enforcement (USEPA, 2012b), and the Removal Design Work Plan (RDWP) (CH2M HILL, 2012a). This Final revises and updates the Draft Final Design Report (CH2M HILL, 2013) based on USEPA comments received on March 29, 2013 and Final Design comments received May 23, 2013. The purpose of this Final Design Report is to describe the overall design for RM 10.9, including the various engineering design packages. In addition to the design packages attached to this Final Design Report are the following supporting appendixes:

A RM 10.9 Concentration Data and Figures for 2,3,7,8-TCDD, Mercury, and Total PCBs at Select Depth Intervals
B Geotechnical Data (boring Logs, bulk density, sieve analysis curves)
C Dredging and Material Transport Design Support Documents and Calculations
D Dredging Design Engineered Plan Drawings
E Technical Specifications
F Project Health and Safety Plan
G Community Health and Safety Plan
H RM 10.9 Removal Action Sediment-Washing Bench-Scale Testing Report
I Construction Quality Control Plan
J Draft LTMMP
K Project Schedule

1.1 Project Description

The RM 10.9 Study Area extends, bank to bank, between RM 10 and RM 12 of the Lower Passaic River Study Area (LPRSA) (**Figure 1-1**). The RM 10.9 Sediment Deposit Area, an area within the RM 10.9 Study Area, extends approximately 2,380 feet (ft), between RM 10.65 to RM 11.2. The RM 10.9 Removal Area (**Figure 1-2**) is an approximate 5.6-acre area located on the eastern side of the LPRSA within the RM 10.9 Sediment Deposit Area and extending to the northeast.[1]

The Removal Area is situated along an inside bend of the LPR upstream of the DeJessa Park Avenue Bridge and includes the mudflat and point bar in the eastern half of the river channel. It is bounded to the west by the navigation channel of the Passaic River and to the east by the Riverside Park complex, which is jointly owned and operated by Bergen County and the Township of Lyndhurst.

The extent of potentially exposed surface sediment shown in **Figure 1-2** was generated from the -2 ft elevation contour (NGVD29), which represents the mean low water for this reach of the LPR. The data source was the July 2011 bathymetry survey conducted as part of the RM 10.9 Characterization Program (CH2M HILL and AECOM, 2012). This elevation contour represents the extent to which the river bottom/sediment is exposed during low

1 The Removal Area is approximately 0.6 acres greater than that specified in the AOC due to the inclusion of a narrow area that extends approximately 700 ft to the northeast. This area was included after a further review of the delineation sampling conducted by the CPG at the direction of USEPA (RM 10.9 Quality Assurance Project Plan [QAPP] Addendum A, May 2012). As a result of the sampling, the CPG proposed including the additional 0.6 acres into the RM 10.9 Removal Area in its August 1, 2012, letter to USEPA.

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tide at mean low water. The Action Memorandum/Enforcement (USEPA, 2012b) requires the removal of the highest near-surface and shallow subsurface concentrations of the entire deposit, and defines the RM 10.9 Removal Area to include that area that is exposed at low tide. The eastern boundary and uppermost elevation of the Removal Area is defined by the mean high water mark (elevation 2.4 ft NGVD29).

Because of elevated concentrations of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury, and other chemicals of potential concern (COPCs) and the potential for receptors to be exposed to them, the CPG is required to perform all actions necessary to remove, treat, and/or properly dispose of approximately 20,000 cubic yards (yd^3) of sediment from the designated portion (i.e., the Removal Area) of the RM 10.9 Sediment Deposit Area. The Removal Action involves the following scope elements:

- Mechanically dredge the contaminated surface sediment (to a depth of 2 ft below existing grade) from the RM 10.9 Removal Area (Figure 1-2)
- Transport the dredged materials via barge to an existing permitted offsite facility for treatment via stabilization
- Treat barge supernatant at a permitted offsite facility prior to discharge
- Cap the newly exposed sediment surface
- Transport the stabilized sediment to a permitted out-of-state disposal facility

1.2 Removal Action Objectives

The Removal Action objectives for RM 10.9 include the following:

- Reduce the potential for exposure to receptors from sediment present in the RM 10.9 Removal Area.
- Prevent potentially significant migration of contamination from the RM 10.9 Removal Area.
- Remove approximately 20,000 yd^3 of surface sediment (top 2 ft) and stabilize it at an existing permitted facility (includes out-of-state landfill disposal).
- Evaluate the means and methods for sediment removal.
- Determine potential impacts of dredging contaminated sediment on surface waters and the means to minimize, or otherwise address, these impacts.
- Identify and minimize/address potential impacts to the environment and public health.
- Evaluate effectiveness of sediment capping methods on reducing bioavailability and migration of COPCs, including caps with carbon amendments in an active layer to mitigate the potential for contaminants to migrate upward through the sand cap.

The implementation of the RM 10.9 Removal Action is currently anticipated to begin in May 2013, with dredging to begin in July 2013; the cap construction is scheduled to be complete in fall 2013.

1.3 Engineering Design Packages

The RM 10.9 Removal Action is divided into the four engineering design packages (which have been combined into two subcontracts) listed below and illustrated in **Figure 1-3**:

- Dredging and barge transport (Subcontract #1)
- Stabilization (Subcontract #1)
- Capping (Subcontract #1)
- Overland transportation and offsite (out-of-state) disposal (Subcontract #2)

The engineering design is being conducted in four phases: the Basis of Design Report (BODR) (30 percent; submitted August 2012), the Pre-Final Design Report (90 percent; submitted November 2012), the Draft Final

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Design Report (May 6, 2013), and the Final Design Report (100 percent; this report). Each design phase undergoes an internal review as well as a review by the CPG prior to being submitted to the USEPA for its review and acceptance.

1.3.1 Dredging and Barge Transportation

The dredging design package is performance-based and consists of designs for the following activities:

- Dredging
- Transporting the dredged material by barge to the stabilization facility's off-loading site outside the RM 10.9 Removal Area
- Monitoring water and air quality during construction

1.3.2 Stabilization

The stabilization design package is performance based and includes activities from the time the dredged-material barge is received at the off-loading site until the stabilized dredged material is loaded into intermodal containers for overland truck and rail transport to the final, out-of-state disposal facility. These activities will consist of the following:

- Pumping and temporarily storing excess water from barges (as required)
- Off-loading dredged material from the barges
- Preparing (screening, mixing) sediment for stabilization
- Treating the sediment with Portland cement to stabilize the sediment
- Temporarily storing the treated sediment at the stabilization facility
- Loading the treated material onto trucks and rail cars for transport to the final, out-of-state disposal facility

1.3.3 Capping

The capping design package is a detailed design for selecting material and sizing and placing the cap. The approach described in this document consists of the following:

- Chemical containment modeling
- Cap placement plan and typical cap sections (active layer, sand layer, geotextile barrier, and armor stone)
- Cap erosion control design
- Cap material delivery and staging
- Cap placement criteria
- Water quality monitoring

1.3.4 Overland Transportation and Final Disposal

The transportation and disposal design package is performance-based and includes activities from the time the stabilized material is loaded into intermodal containers at the stabilization facility until it is received and unloaded at the designated out-of-state disposal facility.

This design package also includes appropriate offsite transportation, treatment, and disposal of excess water removed from the material barges.

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SECTION 2

2 Applicable or Relevant and Appropriate Requirements

Conditions at the LPRSA RM 10.9 Removal Area meet the criteria for a TCRA under CERCLA, as set forth in Section 300.415(b)(2) of the NCP, 40 CFR Part 300. The Removal Action specifies removal of a predetermined depth of sediment (top 2 ft) and in-place capping of the remaining sediment. The removal action objectives are to mitigate potential threats to the public health, welfare, and the environment posed by the presence of the elevated levels of contaminants in the surface sediments in the RM 10.9 Removal Area and to minimize the availability of the contaminants. The Removal Action will be implemented by removing sediment and transporting it via barge to an offsite commercial stabilization facility with the final disposal at an out-of-state RCRA Subtitle C landfill.

In accordance with CERCLA section 121(e)(1), no federal, state, or local permits are required for the portion of any removal or response action conducted entirely onsite, where such removal action is selected and carried out in compliance with Section 121. However, pursuant to 40 CFR Section 300.415(j), the Removal Action shall, to the extent practicable considering the exigencies of the situation, attain Applicable or Relevant and Appropriate Requirements (ARARs) under federal environmental or state environmental or facility siting laws. The design aspects that address substantive requirements or the intent of the permitting regulations are described in this section.

Definitions of the ARARs and the "to be considered" (TBC) criteria set forth in the NCP are identified below:

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site," address problems or situations sufficiently similar (relevant) to those encountered at a CERCLA site that their use is well suited (appropriate) to the particular site.
- TBC criteria are non-promulgated, non-enforceable advisories, criteria, or guidance to be considered for a particular release that may be useful for developing a CERCLA response action or for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include those in the NJDEP (1997) dredging technical manual and related best management practices (BMPs).

Another factor in determining which requirements must be addressed is whether the requirement is substantive or administrative. "Onsite" CERCLA response actions must comply with the substantive requirements but not with the administrative requirements of environmental laws and regulations as specified in the NCP, 40 Code of Federal Regulations (CFR) 300.5, "Definitions of ARARs," and as discussed in 55 *Federal Register* (FR) 8756 (March 8, 1990). Substantive requirements are those pertaining directly to actions or conditions in the environment. Administrative requirements are mechanisms that facilitate the implementation of the substantive requirements of an environmental law or regulation. In general, administrative requirements prescribe methods and procedures (e.g., fees, permits, inspections, or periodic reports) by which substantive requirements are made effective for the purposes of a particular environmental or public health program.

ARARs are grouped into three types: chemical specific, location specific, and action specific, and are presented in **Tables 2-1, 2-2, and 2-3**, respectively.

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2.1 Chemical-Specific ARARs

Chemical-specific ARARs include laws and requirements that establish health- or risk-based numerical values or methodologies for environmental contaminant concentrations or discharge. Because there are no federal or state promulgated standards for contaminant levels in sediments, and because the Removal Action specifies removal of a certain depth of sediment, there are no chemical-specific ARARs for the sediments. However, the removal action objectives include reducing the bioavailability of the contaminants; therefore the New Jersey surface water quality standards and discharge criteria are relevant and appropriate for surface water. **Table 2-1** presents the chemical-specific ARARs for surface water, which are summarized here.

The LPR at RM 10.9 is categorized as an FW2-NT (fresh water, non-trout)/SE2 (saline estuary) water body; this designation extends from Dundee Lake downstream to the confluence with Second River. The designated uses of FW2 water bodies per New Jersey Administrative Code (NJAC) 7:9B-1.12 include the following:

1. Maintenance, migration, and propagation of the natural and established biota
2. Primary contact recreation
3. Industrial and agricultural water supply
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection
5. Any other reasonable uses

In all SE2 waters the designated uses are:

1. Maintenance, migration, and propagation of the natural and established biota
2. Migration of diadromous fish
3. Maintenance of wildlife
4. Secondary contact recreation
5. Any other reasonable uses

The relevant water quality criteria for the onsite Removal Action for the contaminants of concern are referenced in **Table 2-4**. General technical policies and numerical limits have been established under NJAC 7:9B. The NJDEP has the authority to set nutrient limits and require best available technologies. Mixing zones are allowed; rules on mixing zone distances are set forth, as well as methods to determine in-stream concentrations within mixing zones.

Effluent limitations for Removal Action activities are set at the remediation effluent standards listed in **Appendix B** of NJAC 7:14A-12 for any pollutant or pollutant parameter that either results from any removal action or is present onsite at a concentration greater than the applicable surface water quality standards, unless it has been demonstrated to NJDEP's satisfaction that the pollutant, upon discharge, will not cause, have the reasonable potential to cause, or contribute to an excursion above any applicable surface water quality standards. The effluent limitations for contaminants in the RM 10.9 Removal Area are referenced in **Table 2-5**.

The Removal Action will be performed in such a way as to meet the applicable surface water quality standards and effluent limitations to the extent practicable at the end of a mixing zone defined at designated upstream and downstream monitoring points.

2.2 Action-Specific ARARs

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. They generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to managing hazardous substances or pollutants. These requirements are triggered by the remedial activities selected. The action-specific requirements usually are restrictions on the conduct of certain activities or the operation of certain technologies at a particular site.

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Table 2-2 presents the action-specific ARARs for the RM 10.9 Removal Action. The most important ARARs and their substantive requirements are discussed below.

The principal action-specific ARARs for the RM 10.9 Removal Action include the federal Clean Water Act (CWA), Section, 401 Water Quality Certification (WQC); the Rivers and Harbors Act, Section 10; and the associated New Jersey Land Use and Water Resources implementing regulations.

The CWA Section 401 WQC is implemented by NJDEP through the Waterfront Development Act (New Jersey Statues Annotated [NJSA] 12:5-3). The Waterfront Development Act is implemented through Coastal Zone Management regulations (NJAC 7:7E) and Coastal Permitting Rules (NJAC 7:7). See **Table 2-6** for substantive requirements of the Coastal Zone Management regulations. The design includes preventive measures to minimize resuspension of sediment and water quality monitoring during dredging so that the proposed activity will not violate water quality standards. Post-removal restoration activities will be addressed in the construction documents. Monitoring will be conducted to confirm the effectiveness of the cap.

The dredging or placement of fill or structures and other activities that may adversely affect aquatic ecosystems within navigable waters of the United States are regulated under Section10 of the Rivers and Harbors Act. Similar activities in any waters of the United States are addressed by CWA Section 404, for which the U.S. Army Corps of Engineers has jurisdiction. USACE Nationwide Permit 38, Cleanup of Hazardous and Toxic Waste (March 2012), is considered to be the applicable general permit, and its substantive requirements will be followed. The applicable substantive requirements include the following:

- Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high-water mark or high-tide line, must be permanently stabilized at the earliest practicable date. To the extent practicable, work should be performed within waters of the United States during periods of low flow or no flow.
- No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area.

Dredged material that is subject to the requirements of a permit that has been issued under Section 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. Similarly, dredged material in New Jersey is exempt from being a solid waste when it is regulated under certain statutes, such as the New Jersey Water Pollution Control Act, Waterfront Development Law, Clean Water Act, and Federal Coastal Zone Management Act (CZMA). Contaminated environmental media (e.g., sediment) are not hazardous waste but can become subject to regulation under the Resource Conservation and Recovery Act (RCRA) if they “contain” hazardous waste. USEPA generally considers contaminated environmental media to contain hazardous waste when: (1) they exhibit a characteristic of hazardous waste or (2) they are contaminated with concentrations of hazardous constituents from listed hazardous waste that are above health-based levels. Offsite sediment-processing and disposal facilities must comply with all administrative and substantive aspects of the regulations, including facility-specific permit requirements, which may impose constraints prior to accepting the sediment.

2.3 Location-Specific ARARs

Location-specific ARARs are requirements that relate to the geographic position of the site. State and federal laws and regulations that apply to the protection of wetlands, construction in floodplains, and protection of endangered species in streams or rivers are examples of location-specific ARARs.

Table 2-3 presents the location-specific ARARs for the RM 10.9 Removal Action. The principal location-specific ARAR is CZMA, administered by National Oceanic and Atmospheric Administration (NOAA), and the associated implementing NJDEP laws and regulations that apply to dredging and placement of a sediment cap. The New Jersey Waterfront Development Law (NJSA 12:5-3) is implemented through the CZMA and the Coastal Permitting Program Rules; substantive requirements have been described in Section 2.2.

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TABLE 2-1
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Act/Authority		Citation	Brief Description	Applicability and Anticipated Requirements
New Jersey Water Pollution Control Act, New Jersey Water Quality Planning Act	Surface Water Quality Standards	N.J.A.C. 7:9B Surface Water Quality Standards	Establishes standards for the protection and enhancement of surface water resources.	Relevant and appropriate. Used by the State in setting NJDPES discharge limits and Waterfront Development Law requirements. The RM 10.9 Removal Area is classified as FW2-NT/SE2, which has corresponding surface water quality standards for constituents such as turbidity, dissolved oxygen, and various toxic substances. The anticipated requirement is to use BMPs during dredging and to comply with applicable surface water quality standards at designated upstream and downstream monitoring locations. Also, the removal action objective of the post-dredge cap is to isolate the remaining sediment contaminants from the environment, including their migration into the surface water.
New Jersey Pollutant Discharge Elimination System (NJPDES)	Surface Water Discharge Criteria	N.J.A.C. 7:14A	Establishes discharge standards to protect water quality.	Relevant and appropriate. Refer to Waterfront Development Law.

TABLE 2-2
Action-Specific Applicable or Relevant and Appropriate Requirements
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Act/Authority		Citation	Brief Description	Applicability and Anticipated Requirements
Clean Water Act 33 U.S.C. 1251				
	Section 401 Water Quality Certification		Under Section 10 of the Rivers and Harbors Act and Section 404 of the CWA, federally authorized projects are required to obtain Water Quality Certification pursuant to Section 401 of the CWA. A Water Quality Certification (WQC) would specify the requirements to be implemented so that the proposed activity will comply with applicable water quality standards; namely, turbidity, TSS, 2,3,7,8 TCDD, total PCBs, and mercury. Activities requiring a Water Quality Certification include those where a federal permit is required, for example: Discharge of dredged material dewatering effluent Placement of fill in waters of the United States; Temporary discharges of decant waters from dredge material disposal sites or from barges and vessels.	Applicable. New Jersey has delegated authority. Section 401 of the CWA is implemented through compliance with the New Jersey Waterfront Development Law (NJSA 12:5-3; NJAC 7:7 and 7:7E), Coastal Zone Management Rules (NJAC 7:7E-1 et seq.), and Coastal Permit Program Rules (NJAC 7:7). Refer to those sections below for anticipated substantive requirements, which are proposed to include implementation of BMPs and monitoring to meet water quality criteria during barge and dredge movement, anchoring, and operations.
	Section 404 Dredge and Fill Requirements		Regulates activities in waters of the U.S. including discharge of dredged materials, placement of fill materials, and reconstruction of mudflats.	Applicable. Substantive portions are proposed to include implementation of BMPs and monitoring to meet water quality criteria during barge and dredge movement, anchoring, and operations. USACE considers Magnuson-Stevens Fishery Conservation and Management Act as well as Section 401 Water Quality Certification requirements. Refer also to Section 10 of the Rivers and Harbors Act.
	Pollution Prevention Regulations for Vessels	33 CFR Subchapter O	All vessels are required to have spill plans and emergency spill equipment	All fueling of boats will be at established marinas. Any fuel transfer over water necessary to run equipment on the barge will comply with U.S. Coast Guard regulatory requirements.
Section 10 Rivers and Harbors Act of 1899/ Section 404 Clean Water Act				

	33 CFR 320-330	Administered by USACE. Regulates activities such as dredging, and other construction in navigable waters of the U.S.	Applicable. Substantive requirements are found in the General Permit and Regional Conditions. Nationwide Permit (NWP) #38 Cleanup of Hazardous and Toxic Waste March 2012 is anticipated to be the applicable General Permit and its substantive requirements will be followed. There are no substantive Regional General Conditions associated with NWP #38; however, a Pre-Construction Notification is required as part of NWP #38 and Regional General Condition #1; therefore, consultation will occur, although a permit is not required. NWP 38 substantive requirements include: Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Work should be performed within waters of the United States during periods of low-flow or no-flow. No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area.
Toxic Substances Control Act (TSCA)			
	40 CFR Part 761 Subpart D Storage and Disposal	Regulates PCBs and other toxic substances from manufacture to disposal.	Applicable. Environmental media containing PCBs may be considered bulk PCB remediation waste. TSCA provides provisions for management of bulk PCB remediation waste at concentrations <50 ppm. Because the remedy requires removal of surface sediment to a certain depth (2 ft), and because the maximum PCB concentration detected in the surface sediment is less than 50 ppm, no substantive requirements are triggered.
Federal Resource Conservation and Recovery Act			
Non Hazardous Solid Waste Program (Subtitle D)	40 CFR 239-258	Establishes requirements for generators, transporters, and facilities that manage non-hazardous solid waste.	Relevant and appropriate. NJ has delegated authority; refer to the N.J.A.C. 7:26 Solid Waste. Depending on contaminant concentrations, disposal of contaminated sediment may occur at an upland area and may need to be managed as a solid waste (e.g., treat to get rid of free liquids), prior to upland disposal. All administrative and substantive requirements of regulations will be followed for offsite activities.

	Hazardous Waste Management Program (Subtitle C)	40 CFR 262-265	Establishes requirements (e.g., USEPA ID numbers and manifests) for generators, transporters, and facilities that manage hazardous waste.	Relevant and appropriate. Dredged material that is subject to the requirements of a permit that has been issued under Section 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. NJ has delegated authority; refer to the N.J.A.C. 7:26G Hazardous Waste. All administrative and substantive requirements of regulations will be followed for offsite activities. If contaminated sediment exhibits characteristics of hazardous waste (e.g., fail TCLP), they must be managed as a hazardous waste (e.g., treat to stabilize the contaminants and get rid of free liquids) prior to upland disposal.
	Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes which are restricted from land disposal. All listed and characteristic hazardous waste or soil or debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by LDRs.	Relevant and appropriate. Dredged material that is subject to the requirements of a permit that has been issued under Section 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. However, contaminated sediment may fail hazardous waste characteristics (e.g., TCLP) and may be managed and disposed of at an upland landfill. All administrative and substantive requirements of regulations will be followed for offsite activities. If contaminated sediment are disposed of at an offsite upland location, they may need to be managed in a manner similar to a hazardous waste (e.g., treat to stabilize the contaminants and get rid of free liquids) prior to upland disposal.
State of New Jersey Statutes and Rules—Waste Management and Site Remediation				
	New Jersey Solid Waste Management Act	N.J.A.C. 7:26 Solid Waste & N.J.A.C. 7:26G Hazardous Waste	Establishes requirements for generators, transporters, and facilities that manage nonhazardous solid waste and hazardous waste	Substantive requirements for solid waste generators are applicable to onsite actions. All substantive and administrative requirements will be followed for offsite actions. Substantive requirements for hazardous waste generators may be relevant and appropriate.
		N.J.A.C. 7:26E Technical Requirements for Site Remediation	Establishes minimum regulatory requirements for investigation and remediation of contaminated sites in New Jersey, including surface water, sediment, and ecological evaluations.	Not an ARAR for this removal action, as no additional delineation testing of sediment is required, and NJDEP was consulted on and agrees with the RM 10.9 Removal Action authorized by the Action Memorandum/Enforcement. The design will state that bathymetric measurements to confirm the depth of sediment removed and the depth of the cap will occur during implementation.
	NJDEP Standards for Soil Erosion and Sediment Control Act	N.J.A.C. 2:90	The Hudson-Essex and Passaic Soil Conservation District governs all soil disturbances greater than 5,000 ft^2.	Not applicable because the land disturbance at the contractor's upland construction support area will be less than 5,000 ft^2. Fill will be barged onto the site, and dredged sediment will be transported offsite via barge while wet.

	NJDEP Technical Manual "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters", October 1997		Not promulgated; technical manual prepared pursuant to N.J.S.A. 13:1D-111 to 1D-113 to provide guidance.	To the extent practicable, the removal action will incorporate BMPs, sampling methodologies and analytical procedures. Practices will include use of an environmental clamshell bucket with sensors to ensure complete closure of the bucket before lifting the bucket; controlled descent and lifting; prohibiting barge overflow. To reduce the creation and dispersal of suspended sediments when finer-grained sediments are dredged, deliberate placement of dredged material in the barge to prevent spillage of material overboard; use of watertight barges or scows with solid hull or sealed hull construction; no rinsing or hosing of gunwales of the dredge scows during dredging except to the extent necessary to ensure the safety of workers maneuvering on the dredge scow.
Federal Clean Air Act Section 112				
	National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for 8 contaminants including benzene and vinyl chloride. Identifies 25 additional contaminants as having serious health effects but does not provide emission standards for these contaminants.	The sediment is being removed and transported in the wet. Therefore, emission of air pollutants in concentrations that would trigger these regulations or adversely affect the surrounding population is not anticipated to occur. However, data will be collected during the removal action, as described in the Community Health and Safety Plan, to document no adverse effect. Refer to N.J.A.C. 7:27 below
New Jersey Air Toxics Program				
	Standards for Hazardous Air Pollutants	N.J.A.C. 7:27 Air Pollution Control	Rule that governs the emitting of, and such activities that result in, the introduction of contaminants into the ambient atmosphere. Controls and prohibits air pollution, particle emissions, and toxic VOC emissions	Relevant and appropriate. The sediment is being removed and transported in the wet. Therefore, emission of air pollutants in concentrations that would trigger these regulations or adversely affect the surrounding population is not anticipated to occur. Cap placement has the potential for a small amount of particulate emissions; the design includes implementation of BMPs to control these emissions. However, data will be collected during the removal action, as described in the Community Health and Safety Plan, to document no adverse effect.
Noise Control N.J.S.A. 13:1G-1 et seq.				

	NJAC 7:29	Regulates noise levels for certain types of activities and facilities such as commercial, industrial, community service, and public service facilities. Also provides authority to municipalities to establish noise ordinances.	Relevant and appropriate. While the dredging project does not fit the definition of any type of regulated activity, the regulation is relevant and appropriate. Emergency environmental cleanups are exempted; however, this Removal Action is time critical but not an emergency. The allowable levels at a residential property line from 7 am-10pm are 65 dBA continuous, 80 dBA impulsive, and octave band sound pressure levels as stated in the regulation. For residential 10pm- 7 am, 50 dBA continuous and 80 dBA impulsive with octave levels. At industrial, commercial, community service, and public service property lines, the maximum allowable continuous and impulsive levels are the same as daytime residential, with specific octave range levels. Noise monitoring that will be conducted is described in the Community Health and Safety Plan.

TABLE 2-3
Potential Location-Specific Applicable or Relevant and Appropriate Requirements
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Act/Authority	Citation	Brief Description	Applicability and Anticipated Requirements
Fish & Wildlife Coordination Act 16 U.S.C. 661			
	40 CFR 2 6:302(g)	Requires consultation with the U.S. Fish and Wildlife Service when a Federal department or agency proposes or authorizes any modification of any stream or other water body, and requires adequate consideration to protection of fish and wildlife resources and their habitats. Wildlife and wildlife resources include: birds, fish, mammals, and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent.	Applicable. The Passaic River is a migratory pathway, nursery, and forage area for anadromous fish, however, given the relatively large size of the lower Passaic River and the depth and area of the existing channel, the project activities should not affect the ability of migratory species to migrate and/or spawn within the river and utilize their preferred habitats. However, U.S. Fish and Wildlife Service will be consulted to determine if conservation measures are appropriate for this reach of the river bed.
Endangered Species Act, Section 7 16 U.S.C. 1531			
		Restricts activities where endangered species may be present, to protect endangered species.	The NJDEP Division of Fish and Wildlife Service was consulted and determined that no threatened and endangered species or habitats are likely to be present in this reach of the river bed.
National Historic Preservation Act 16 U.S.C. 470			
		Requires federal agencies to take into account the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or is eligible for inclusion in the National Register of Historic Places.	The New Jersey Historic Preservation Office (NJHPO) was consulted and determine that there will be no adverse impacts to historic or cultural resources, therefore, the project complies with this regulation.
Federal Coastal Zone Management Act 16 U.S.C §§ 1456 (Section 307)			
	15 CFR 930.30 Federal Consistency Determination	Administered by National Oceanic and Atmospheric Administration (NOAA) and provides for management of the nation's coastal resources, to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone."	Applicable to dredging. Refer to attached Table 2-6 listing substantive requirements of the New Jersey Waterfront Development Law and New Jersey Coastal Zone Management (N.J.A.C. 7:7E).
Magnuson-Stevens Fishery Conservation and Management Act, as amended and authorized by the Sustainable Fisheries Act			

		Establishes 10 national standards for fishery conservation and management requires that other federal agencies consult with National Marine Fisheries Service (NMFS) on actions that may adversely affect essential fish habitats, which are defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."	Applicable. It is believed that the entire Lower Passaic River has been designated as essential fish habitat EFH for various fish species. It is expected that the Removal Action activities will result in a short-term impact to EFH, but will provide a long-term benefit to EFH, federally managed species, and all of the aquatic resources of the Passaic River. The NMFS was consulted by NJDEP DFWS. A fish window prohibiting dredging from March 1 through June 30 has been imposed. Dredging and capping operations will occur outside of the designated fish windows in order to meet these requirements.
Flood Hazard Area Control Act N.J.S.A. 58: 16A-50 et. seq.			
	N.J.A.C. 7:13	Delineates flood hazard areas and regulates construction and development within these areas, to minimize potential damage to property, minimize degradation of water quality, protect wildlife and fisheries, and protect and enhance the public's health and welfare.	Applicable. The Removal Action will occur within a flood hazard area. Refer to New Jersey Waterfront Development Law for substantive measures.
New Jersey Waterfront Development Law (NJSA 12:5-3)			
		Regulates any waterfront development, including sediment removal and fill, at or below mean high water and up to 500 ft from mean high water in the coastal zone and tidal waters of the state. Implemented through Coastal Zone Management (NJAC 7:7E) and Coastal Permit Program Rules (NJAC 7:7)	Applicable to sediment removal, capping, and including the mudflat. Refer to Coastal Zone Management and Coastal Permit Program Rules for substantive requirements.
	Coastal Zone Management N.J.A.C. 7:7E	Provides standards for use and development of resources in NJ's coastal zone including those performed in accordance with the Waterfront Development Law. Standards for reviewing Federal Consistency Determinations under the Federal Coastal Zone Management Act and Water Quality Certificates in coastal areas under Section 401 of the Federal Clean Water Act.	Applicable. The Coastal Zone Management rules are considered in developing requirements for the Water Quality Certification Substantive requirements and BMPs include measures to minimize scouring and resuspension of sediment during dredging and placement of cap materials, slope management, and monitoring upstream and downstream.
	Coastal Permit Program N.J.A.C. 7:7	Establishes substantive rules regarding the use and development of coastal resources.	Applicable. The Coastal Permit Program rules are considered in developing requirements for the Water Quality Certification. Substantive requirements and BMPs include measures to minimize scouring and re-suspension of sediment during dredging and placement of cap materials, slope management, and monitoring upstream and downstream
Tidelands Act (Riparian Lands Leases, Grants and Conveyances [NJSA 12:3-1 et seq.])			

	Requires a tidelands lease, grant, or conveyance for the use of state-owned riparian lands, including sediment removal. The State of New Jersey owns riparian lands flowed by the mean high tide of a natural waterway, except for those lands in which it has already conveyed its interest in the form of a riparian grant.	Applicable to the sediment removal and backfill. Substantive requirements include that development plans must be prepared by a professional engineer, and must depict the limits of the tidelands instrument. The project complies with these requirements.

TABLE 2-4
RM 10.9 Onsite Removal Area Surface Water Quality Standards
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Regulation	Requirement and Standards
Statements of Policy	
7:9B-1.5(a)3,4	3. Therefore, point and nonpoint sources of pollutants shall be regulated to attain compliance with the Surface Water Quality Standards human health criteria outside of regulatory mixing zones. 4. Toxic substances in waters of the State shall not be at levels that are toxic to humans or the aquatic biota, or that bioaccumulate in the aquatic biota so as to render them unfit for human consumption.
7:9B-1.5(a)9	The Department uses the Integrated Water Quality Monitoring and Assessment Methods developed pursuant to N.J.A.C. 7:15-6.2 to evaluate water quality data and identify waters where water quality does not meet the Surface Water Quality Standards at N.J.A.C. 7:9B as required by Section 303(d) and 305(b) of the Federal Clean Water Act.
7:9B-1.5(c)1,2i,2ii,2iii	1. The natural water quality shall be used in place of the promulgated water quality criteria of N.J.A.C. 7:9B-1.14 for all water quality characteristics that do not meet the promulgated water quality criteria as a result of natural causes. 2. Water quality criteria are expected to be maintained during periods when nontidal or small tidal stream flows are at or greater than the MA7CD10 flow, except as provided below: i. For acute aquatic life protection criteria, the design flow shall be the MA1CD10 flow; ii. For chronic aquatic life protection criteria for ammonia, the design flow shall be the MA30CD10 flow; and iii. For human health criteria for carcinogens listed at N.J.A.C. 7:9B-1.14(f)7, the design flow shall be the flow which is exceeded 75 percent of the time for the appropriate "period of record" as determined by the United States Geological Survey.
7:9B-1.5(e)7	7. The Department may require characterization monitoring in NJPDES permits for mercury and PCBs using the USEPA approved method 1631 for mercury (Guidelines Establishing Test Procedures for the Analysis of Pollutants; Measurement of Mercury in Water; Revisions to EPA Method 1631, 40 C.F.R. 136, Fed. Reg. 67:65876, October 29, 2002) incorporated herein by reference, as amended and supplemented, available at http://www.epa.gov/waterscience/methods/1631.html, as supplemented and amended and 1668A for PCBs (Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS. EPA-821-R-00-002, December 1999) incorporated herein by reference, as amended and supplemented, available at http://www.epa.gov/Region8/water/wastewater/biohome/biosolidsdown/methods/1668a5.pdf.
7:9B-1.5(h)	(h) A permittee may request that a regulatory mixing zone be established by the Department for applicable criteria except as otherwise provided in this section.
7:9B-1.5(h)1ii	ii. Water quality criteria may be exceeded within the regulatory mixing zone; however, surface water quality criteria must be met at the edge of the regulatory mixing zone;
7:9B-1.5(h)1v	v. Regulatory mixing zones shall be established to assure that significant mortality does not occur to free swimming or drifting organisms;
7:9B-1.5(h)1v(2)	(2) In cases of extended regulatory mixing zones resulting from multiple, conjoined individual regulatory mixing zones, site-specific studies to demonstrate no significant mortality shall be required, taking into account factors including, time of travel, concentration, and the toxicity of the parameters in question;

7:9B-1.5(h)1viii	viii. Regulatory mixing zones, including those for shore hugging plumes, shall not extend into recreational areas, potable surface water intakes (1,500 feet upstream and 500 feet downstream or to the farthest point of backwatering due to the intake, whichever is more protective), shellfish harvesting areas, threatened or endangered species habitat, and other important biological or natural resource areas;
7:9B-1.5(h)1ix	ix. The regulatory mixing zone shall not inhibit or impede the passage of aquatic biota;
7:9B-1.5(h)2ii,2ii(1),2ii(2)	ii. For discharges to tidal water bodies: (1) Regulatory mixing zones for chronic and human health criteria are limited to one fourth of the distance between the discharge port closest to the shoreline and the shoreline during average tidal conditions, or 100 meters, whichever is greater; and (2) Regulatory mixing zones for acute criteria are limited by the distances calculated in accordance with the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991, incorporated herein by reference. In no case shall a regulatory mixing zone for acute criteria extend more than 100 meters from the discharge point or include more than five percent of the total surface area of a water body based on critical ambient tidal conditions during low slack, astronomical spring tide for the applicable exposure period.
7:9B-1.5(h)3	3. A regulatory mixing zone study shall be conducted in accordance with a work plan preapproved by the Department. General protocols for conducting mixing zone studies are described in the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991. In addition, the following principles apply:
7:9B-1.5(h)4,4i,4ii	4. Instream pollutant concentrations at the boundary of the regulatory mixing zone shall be determined as follows: i. The instream concentrations shall be determined using either a general mass balance equation or a mathematical model, if available; or the information generated during the course of a study as described at (h)2 above. ii. If the regulatory mixing zone is based upon the guidance and procedures in the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991, the Technical Support Document will also be used to determine instream concentrations at the boundary of the regulatory mixing zone.
Surface Water Quality Criteria	
7:9B-1.14(c)	(c) Unless site-specific criteria are established at (g) below, State-wide criteria apply for FW2, SE, and SC waters as listed in accordance with (d) through (f) below.
General Surface Water Quality Criteria for FW2, SE and SC Waters: (Expressed as Maximum Concentrations Unless Otherwise Noted) Criteria	
7:9B-1.14(d)3,3i	3. Floating, colloidal, color and settleable solids; petroleum hydrocarbons and other oils and grease i. None noticeable in the water or deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota. None which would render the waters unsuitable for the designated uses.
7:9B-1.14(d)7,7iii	7. Solids, Suspended (mg/L) (Non-filterable residue) iii. None of which would render the water unsuitable for the designated uses.
7:9B-1.14(d)8,8iii	8. Solids, Total Dissolved (mg/L) (Filterable Residue) iii. None which would render the water unsuitable for the designated uses.

7:9B-1.14(d)12,12i,12iii,12iv,12v	12. Toxic Substances (general) i. None, either alone or in combination with other substances, in such concentrations as to affect humans or be detrimental to the natural aquatic biota, produce undesirable aquatic life, or which would render the waters unsuitable for the designated uses. iii. Toxic substances shall not be present in concentrations that cause acute or chronic toxicity to aquatic biota, or bioaccumulate within an organism to concentrations that exert a toxic effect on that organism or render it unfit for consumption. iv. The concentrations of nonpersistent toxic substances in the State's waters shall not exceed one-twentieth (0.05) of the acute definitive LC50 or EC50 value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18. v. The concentration of persistent toxic substances in the State's waters shall not exceed one-hundredth (0.01) of the acute definitive LC50 or EC50 value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18.
7:9B-1.14(d)13,13i	13. Turbidity (Nephelometric Turbidity Unit-NTU) i. Maximum 30-day average of 15 NTU, a maximum of 50 NTU at any time.
7:9B-1.14(f) 7 Surface Water Quality Criteria for Toxic Substances (µg/L), Freshwater (FW2) and Saline Water (SE & SC) Criteria, Aquatic and Human Health	

TABLE 2-5
RM 10.9 Removal Area Effluent Standards Applicable to Direct Discharges to Surface Water and Indirect Discharges to Domestic Treatment Works
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Regulation	Effluent Standard
7:14A-12 Appendix B	Effluent Standards for Site Remediation Projects, SE Waters, Monthly Average (µg/L)
7:14a-12 Appendix B	Effluent Standards for Site Remediation Projects, SE Waters, Daily Maximum (µg/L)

TABLE 2-6
RM 10.9 Coastal Zone Management Applicable or Relevant and Appropriate Substantive Requirements
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Regulation	Substantive Requirement Discussion
7:7E-3.6 Submerged Vegetation Habitat	Water areas documented as previously supporting rooted and submerged vascular plants are considered to be submerged vegetation special areas. The project area is a mudflat with no submerged aquatic vegetation. In 2010, Windward Environmental LLC performed a habitat identification survey and fish community survey with tissue collection for the LPRSA Remedial Investigation (RI). Reports were issued in June and July 2011, respectively. Based on this information, it is anticipated that there would be little plant biomass in the RM 10.9 mudflat. Therefore, the Removal Action complies with this policy.
7:7E-3.12 Submerged Infrastructure Routes	There may be submerged private or public utility features within the project area. -Intrusive activities to the river bottom will not start until the Removal Action contractor has notified the New Jersey One Call System and has complied with New Jersey's Underground Facility Protection Act. The contractor will be responsible for the safety, maintenance, protection, and final restoration to the same usefulness, durability, and safety as what existed prior to construction. This applies to not only submerged infrastructure but also all surface and subsurface utilities, facilities, streets, structures, waterways, and other properties at or near the site. Utilities identified will be placed on all plans detailing excavation and stabilization activities to assure the utilities' protection and compliance with the Act to the extent possible. As a result, the Removal Action complies with this policy.
7:7E-3.15 Intertidal and Subtidal Shallows	Project disturbances may occur within any intertidal and subtidal areas. The goal of the Removal Action is to remove contaminated sediment and cap remaining sediment to reduce exposure to human and ecological receptors. Therefore, the proposed project is in compliance with this rule.
7:7E-3.25 Flood Hazard Areas	Even though the project is located within the Flood Hazard Area, no impact on the flood hazard area is anticipated. The proposed project removes contaminated surface sediment from the Lower Passaic River, approximately up to the mean high water line, and does not require permanent structures that may obstruct tidal and high-water flows. Temporary changes to drainage patterns occurring during construction will mimic preconstruction conditions, and diversions will be sized to carry frequent storm events. Following sediment removal, the areas will be backfilled with a cap which will provide no net fill. The project will not permanently alter any drainage patterns. Refer to the Flood Hazard Area Control Rules (N.J.A.C. 7:13) and the associated substantive permit requirements. This project complies with Section 7:7E-3.25, since no permanent development will occur within the Flood Hazard Area creating an obstruction that could increase flood elevations.
7:7E-3.26 Riparian Zones	The New Jersey Flood Hazard Area Control Rules 7:13-4.1(a) 4 state that a riparian zone exists along every regulated water. The Riparian Zone includes the land and vegetation within each regulated water, as well as the land and vegetation within a certain distance of each regulated water. As defined in N.J.A.C. P:13-4.1, the Riparian Zone is 50 feet landward from the top of the stream bank. No project-related support facilities will be constructed on property adjacent to the Removal Area. The river bottom will be restored with a protective cap. The cap's top elevation will be no higher than the existing sediment surface, allowing flow in and out of areas similar to preconstruction conditions. The removal of any vegetation from the mudflat or shoreline trees will be limited to the workspace and areas will be allowed to revegetate naturally following the removal action.
7:7E-3.36 Historic and Archaeological Resources	The New Jersey and National Registers of Historic Places, and the NJDEP Landscape Project mapping, which contains the boundaries of Critical Environmental and Historic Sites of the New Jersey State Development and Redevelopment Plan, have been reviewed. Additionally, NJDEP coordinated a consultation with the New Jersey Historic Preservation Office (NJHPO) which confirmed that the project complies with state and federal policies regarding historic and archaeological resources. No impact to cultural resources is anticipated.

7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats	There was a consultation with NJDEP New Jersey Natural Heritage Program and the National Marine Fisheries Service (NMFS) to confirm that the project complies with all state and federal policies and conditions regarding endangered or threatened wildlife. The NMFS has been contacted to confirm compliance with the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Fishery Conservation and Management Act.
7:7E-3.39 Critical Wildlife Habitats	There was a consultation with NJDEP to confirm that the project complies with all state and federal policies and conditions regarding critical wildlife habitats.
7:7E-3.41 Special Hazard Areas	Special hazard areas include areas with a known actual or potential hazard to public health, safety, and welfare, or to public or private property, such as where hazardous substances, as defined at N.J.S.A. 58:10-23.11b-k, are used or disposed of, including adjacent areas and areas of hazardous material contamination. Typically, approvals from NJDEP's Division of Solid and Hazardous Waste are obtained before beginning hazardous substance investigations or cleanup activities at contaminated sites. The LPR site is a listed CERCLA site and therefore is known to contain potentially hazardous materials. The purpose of this project is to remove contaminated sediment contained within the RM 10.9 site. Investigations have been conducted to indicate contamination levels and to provide data for designing Removal Action procedures. The USEPA's May 2012 Action Memorandum was agreed to by the NJDEP and therefore the project is in compliance with this rule. Contaminated sediment will be handling using BMPs to reduce health and safety hazards to the extent practical.
7:7E-3.47 Geodetic Control Reference Marks	The LPRSA RI/FS has established control that meets the stated regulation and those controls will be utilized for all surveys conducted.
7:7E-3.50 Lands and Waters Subject to Public Trust Rights	Lands and waters subject to public trust rights are tidal waterways and their shores, including both lands now or formerly below the MHW line, and shores above the MHW line. The Removal Action will provide beneficial effects to this portion of the Lower Passaic River, by reducing the potential for exposure to both human and ecological receptors from contaminated sediment present in the RM 10.9 Removal Area, and preventing potential migration of contamination from the RM 10.9 Removal Area. The access to the waterway is not being altered. Therefore, the project is in compliance with this rule. (See the section discussing Subchapter 8, Public Trust Rights (7:7E-8.11) for detailed information regarding public trust rights and how the project is in compliance with this policy.)
Subchapter 4. General Water Areas	
	General Water Areas are all water areas located below either the spring high water line or the normal water level of non-tidal water that are subject to the Coastal Zone Management rules and to Special Area rules. There are 22 General Water Areas identified in the regulations and the following sections summarize potential ARARs.
7:7E-4.7 New Dredging.	New dredging is the removal of sediment that does not meet the definition of maintenance dredging at N.J.A.C. 7:7E-4.6. Maintenance dredging is the removal of accumulated sediment from previously authorized and legally dredged navigation and access channels, marinas, lagoons, canals, or boat moorings for the purpose of maintaining a previously authorized water depth and width for safe navigation. Maintenance dredging would not apply to this project because the purpose of this dredging is not for maintaining a previously authorized water depth and width for safe navigation. The dredging of sediment associated with the Removal Action is strictly for removing contaminated sediment from the waterway. As required with any "new dredging" , environmental impacts will be minimized to the maximum extent feasible; the dredge area is reduced to the minimum extent practical; dredging is anticipated to have no adverse impacts on groundwater resources; and no dredging will occur within 10 feet of any wetlands. There are no wetlands in the project area, and dredging shall be accomplished consistent with conditions as appropriate to the dredging method to minimize the loss of contaminated material to the extent possible, and to prevent potential adverse environmental impacts to the surrounding area. Dredging will be performed carefully using a clamshell bucket, and implementing BMPs, as described in Section 4. Because the sediment and soil excavation methods will limit downstream turbidity, limit the resuspension of contaminants, reduce the bioavailability of contaminants, and improve the health of the water body, the Removal Action is in compliance with this policy.

7:7E-4.10 Filling	By definition, "filling" is the deposition of material including, but not limited to, sand, soil, earth, and dredged material, into water areas for the purpose of raising river bottom elevations to create land areas. This policy is not applicable to the project because the purpose of placing material on the site is not for raising the original river bottom elevations or to create additional land, but to install an engineered cap that will isolate the underlying contaminated sediment. Although the technical definition is not applicable, a cap designed to reduce the bioavailability of contaminants will be placed within the stream channel as part of restoration. The project is in compliance with this rule because the purpose of the fill is not for raising water bottom elevations or for creating new land areas.
Subchapter 6. General Location Policies	
7:7E-6.2 Basic Location Rule	The project is in an area that is environmentally degraded due to a variety of environmental impacts. The Removal Area is not considered an exceptional wildlife habitat. The Removal Areas is located with the LPRSA which part of the Diamond Alkali Superfund Site which is a known contaminated site. This project will improve public health and safety related to the site because contaminated sediment will be removed and replaced with new, clean sediment. Therefore this project complies with this subchapter.
7:7E-6.3 Secondary Impacts	Secondary impacts are the effects of additional development likely to be constructed as a result of the approval of a particular proposal. Secondary impacts can also include traffic increases, increased recreational demand, and any other offsite impacts generated by onsite activities that affect the site and surrounding region. The Removal Action for this site is not likely to stimulate secondary development because of its location within the water body areas. Rather, the objective is to reduce exposure to human and ecological receptors to contaminated sediment.
Subchapter 8. Resource Rules	
7:7E-8.4 Water Quality	The Lower Passaic River is categorized as an SE3 water body. The designated uses of SE3 water bodies per NJAC 7:9B-1.12 are: 1. Secondary contact recreation; 2. Maintenance and migration of fish populations; 3. Migration of diadromous fish; 4. Maintenance of wildlife; and 5. Any other reasonable uses. Because the removal action objectives include reducing the bioavailability of the contaminants, the New Jersey surface water quality standards may be considered as chemical-specific ARARs. The project is in compliance with this subchapter because any potential impacts to surface water will be minimized by the BMPs and sediment control techniques, The overall Removal Action project is designed to improve long-term water quality in the area.
7:7E-8.11 Public Trust Rights	Public trust rights to tidal waterways and their shores established by the Public Trust Doctrine include public access, which is the ability of the public to pass physically and visually to, from, and along lands and waters subject to public trust rights, as defined at N.J.A.C. 7:7E-3.50, as well as to use these lands and waters for recreational activities. Public trust rights also include the right to perpendicular and linear access. Public access ways and public access areas provide a means for the public to pass along and use lands and waters subject to public trust rights. Because this is a CERCLA action, formal public access will not be provided and the work area in the water will be delineated. The nature of the project will be the removal of contaminated sediment to reduce exposure to human and ecological receptors. No structural development is proposed.

SECTION 3

3 Relevant Site Conditions

3.1 Area Description

The LPRSA encompasses the 17.4 miles of the Passaic River below the Dundee Dam, its tributaries below the head of tide, and the surrounding watershed that hydrologically drains below the Dundee Dam (**Figure 1-1**). Adjacent land use is predominantly industrial in the lower RMs (near Newark Bay) and starts to become more commercial, residential, and recreational near RM 4. Land use is increasingly residential and recreational above RM 8. The LPRSA has been industrialized and urbanized for more than two centuries; it has served as the receiving environment for industrial and municipal waste discharges since the nineteenth century. However, the river is now being used increasingly for recreational activities, such as boating and fishing, as parks and boat ramps are actively being restored or newly established. Natural habitat areas along the shoreline, including wetland and mudflat habitats, are limited to small patches or isolated areas.

The RM 10.9 Study Area extends, bank to bank, between RM 10 and RM 12 of the LPRSA (**Figure 1-1**). The RM 10.9 Sediment Deposit Area (**Figure 1-2**) extends approximately 2,380 ft from RM 10.65 to RM 11.1, along an inside bend of the LPR upstream of the DeJessa Park Avenue Bridge; and downstream of the Lyndhurst-Delaware Rail Bridge (RM 11.4); it is adjacent to Riverside County Park in Bergen County, across from a mixed residential and industrial area, and immediately downstream of the confluence of Third River and the LPR.

The RM 10.9 Removal Area is a 5.6-acre area, within the RM 10.9 Sediment Deposit Area, which is bounded on the west by the eastern limits of the federally authorized channel and bounded on the east by approximately the mean high water elevation (**Figure 1-2**). The Removal Action will take place within the RM 10.9 Removal Area.

3.2 Geology

The project site is within the physiographic province known as the Piedmont, which covers the central portion of New Jersey and is approximately one-fifth of the state. It is underlain by folded and faulted sedimentary rocks of Triassic and Jurassic age and igneous rocks of Jurassic age. The Piedmont is described as a “low rolling plain” (Dalton, 2003). The depth to this bedrock surface is approximately 50 ft near the Removal Area and rises sharply to near ground surface just west of Highway 21.

Within the northern part of the Piedmont province, the bedrock is overlain by surficial deposits made up of artificial fill, alluvial and estuarine sediments of postglacial age, and glacial sediment (Stanford, 2001). The terminus of Wisconsin glaciation is approximately 30 miles south of the site. Glacial lakes and streams within the region produced sediment, including stratified sand, gravel, silt, and clay. The till was deposited by the retreat of the glacial ice and can be up to 250 ft thick north of the site, these glacial lake sediments can be up to 50 ft thick and at elevations greater than the site. The glacial lake sediments below the site are usually less than 30 ft thick. Beneath these glacial sediments there may also be a till that is poorly sorted, non-stratified sediment directly deposited by the glacial ice. This till is described as reddish brown to light reddish brown silty sand to sandy clayey silt containing some to many sub-rounded and sub-angular pebbles and cobbles and a few sub-rounded boulders (Stanford, 2001). This till may be 10 to 20 ft thick at the site.

The post-glaciated sediments of the region include anthropogenic fill and sediment in salt marshes, in freshwater swamps, and in river flood plains and channels deposited after the glacial retreat (Stanford, 2001). Post-glaciated sediment at the site includes the Lower Passaic Terrace Deposits that make up the surface sediment east of Riverside Park. This deposit contains fine-to-coarse sand, some silt and pebble gravel; and can be light-reddish brown, light gray, or very pale brown in color. It is moderately to well-sorted, stratified, and can be as much as 40 ft thick (Stanford, 2001). This thickness is on the order of 20 ft east of Riverside Park. The Riverside Park and the RM 10.9 Removal Area are composed of alluvium deposits that contain sand, silt, pebble-to-cobble gravel, and minor clay that can be a dark brown, gray, and or reddish-brown in color and contains variable amounts of organic matter. These deposits can be up to 25 ft thick. The RM 10.9 Characterization Program identified

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sediment that on average was composed of approximately 2 percent gravel, 30 percent sand, and 68 percent silt and clay.

3.3 Groundwater

Groundwater in the region can occur in three different geologic formations: underlying bedrock and glaciated and non-glaciated fluvial deposits. Flow within unconsolidated sediments always migrates from areas of high hydraulic head to areas of low hydraulic head or from areas of recharge to areas of discharge. These deposits are the glacial lake Delawanna Deposits (Stanford, 2001), which can vary in amounts of silt, clay, fine sand, and sandy silt till. Silt and clay lake-bottom deposits have the lowest permeability, with estimated hydraulic conductivities of 3.5×10^{-9} to 3.5×10^{-7} cm/sec; fine sand and silt have slightly higher estimated hydraulic conductivities, of 3.5×10^{-7} to 3.5×10^{-5} cm/sec; and the alluvium deposits have a range of 3.5×10^{-3} to 3.5×10^{-1} cm/sec. A field program to obtain site-specific measurements of the upward seepage velocity through the river bed at the RM 10.9 Removal Area in support of the current design effort was completed in April 2013. The representative site-specific seepage velocity is used in the cap design model discussed in **Section 7.2**.

Bedrock of the Passaic Formation rises sharply on the west side of the LPR, forming a relatively impermeable barrier to the west. A small outcrop of the formation occurs approximately 2,500 ft west of the LPR. The upper portion consists of shale and sandstone. Water generally is present in weathered joint and fracture systems in the upper 200 or 300 ft (Barksdale et al., 1958). Groundwater in the Passaic Formation is often unconfined in the shallower, more weathered part of the aquifer and confined or semi-confined in the deeper part of the aquifer. The primary groundwater flow within the Passaic Formation is through secondary permeability resulting from a series of interconnected fractures. The upper part of the Passaic Formation aquifer system is typically unconfined. However, near-surface bedrock units are highly weathered. Silt and clay derived from the weathering process typically fill fractures, thereby reducing permeability (Michalski, 1990). This relatively low permeability surface zone reportedly extends 50 to 60 ft into the formation. This groundwater flow from the bedrock would then need to flow through the approximately 20 ft of the Rahway till and 20 ft of the glacial lake deposits before reaching the alluvium sediment that makes up the river bed. The Rahway till, the surficial deposit for much of the area west of the LPR, will further reduce the amount and rate of groundwater flow from west of the LPR.

3.4 In Situ Physical and Chemical Characteristics

3.4.1 Chemical Properties

To characterize the nature and extent of contaminated sediment within the RM 10.9 Sediment Deposit Area, cores were advanced and samples were taken from 54 locations as part of the 2011 RM 10.9 Sediment Characterization Program. Of these 54 locations, 25 fall within the RM 10.9 Removal Area. In June 2012, an additional 15 locations were sampled as part of the RM 10.9 QAPP Addendum A sediment collection program to characterize sediment along the shore. Of these 15 locations, only 5 at the northern end are within the RM 10.9 Removal Area. The Low Resolution Coring (LRC – AECOM, 2011), Supplemental Sampling Program (SSP), and benthic sampling programs of the LPRSA RI/FS each have one location within the RM 10.9 Removal Area. The sampling results from these programs are summarized in **Table 3-1** and **Table 3-2** with detailed tables and figures provided in **Appendix A.**

Table 3-1 presents as a function of depth below the sediment surface the maximum, minimum, and average sediment concentrations for select COPCs measured within the RM 10.9 Removal Area. Four depth intervals are characterized in the table: 0 to 2.5 ft below ground (sediment) surface (bgs), representing the dredge interval of 0 to 2 ft bgs; and 2.5–3.5 ft bgs, 3.5–5.5 ft bgs, and 5.5 ft bgs to native, representing the material that will be left in place after the sediment removal and capping activities are completed. The highest 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and total PCB concentrations were found in the dredge interval (0–2.5 ft bgs) at 35,600 nanograms per kilogram (ng/kg) and 35 milligrams per kilogram (mg/kg), respectively. The maximum total PCB concentration measured within the Removal Area, 35 mg/kg, does not exceed the Toxic Substances Control Act (TSCA) regulatory threshold of 50 parts per million (ppm, or mg/kg).

Table 3-2 presents the 2,3,7,8-TCDD, total PCBs and mercury characterization data for the “finger” portion of the

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Removal Area, an area that will not be capped but which will be dredged to native sediment. The data indicate that COPC concentrations in the native, undisturbed sediment underlying the contaminated sediment that will be removed, are not themselves elevated. The data show that concentrations of 2,3,7,8-TCDD, for example, dramatically decrease with depth approaching the native sediments. Therefore, by dredging to native soil, a cap is not required to make the action protective in this area. The complete RM 10.9 data set can be found in the *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012).

3.4.2 Physical Properties

Physical properties were also analyzed during the 2011 RM 10.9 Sediment Characterization Program. These data were limited to the sediment above and just into the native clay layer. **Table 3-3** summarizes the results for grain size, percent moisture, percent solids, specific gravity, and total organic carbon (TOC) for depth intervals of 0–2.5, 2.5–3.5, and 3.5–5.5 ft bgs. The estimated grain size distribution for the dredged sediment, which is based on results from the 0–2.5 ft bgs depth interval, is approximately 1.7 percent gravel, 29 percent sand, and 69 percent silt and clay. The average of percent solids is approximately 50 in the top 2.5 ft of sediment. The bulk density of the dredged sediment will likely average 1.25 tons/yd^3 and range from 0.94 to 1.75 tons/yd^3 based on the 2011 sediment characterization program data. The boring logs, sieve analysis curves, and bulk density data are provided as **Appendix B**, with the complete RM 10.9 physical data set provided in the *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012).

3.5 Hydrodynamics

Portions of the LPR below Dundee Dam are a stratified estuary. The LPRSA receives inflows of marine (salt) water from Newark Bay and fresh water from the Upper Passaic River (above Dundee Dam) and its tributaries, surface runoff, combined sewer overflows, and stormwater outfalls (below Dundee Dam). The less dense freshwater flows downstream over the tidally influenced salt water that, on the flood tide, moves upstream from Newark Bay. The exact extent of the salt "wedge" (i.e., the wedge-shaped intrusion of salt water into the estuary that slopes downward in the upstream direction) is dependent on the phase of the tide and the volume of fresh water flowing downstream. Limited hydrodynamic data from the RM 10.9 Sediment Deposit Area are available. The average river flow conditions for the months July to October for the period 2007–2012 as measured at the USGS gage located at Dundee Dam are provided in **Table 3-4**.

The high-resolution hydrodynamic model of the RM 10.9 Removal Area was developed to predict the distribution of bottom shear stresses in this area under a range of flow conditions. Among the features and processes represented in the model are the secondary flow patterns in the river bend, the flow distribution across the LPR varying from the channel to the shoals, and upstream flow contribution coming from the Third River. Accordingly, a Delft-3D hydrodynamic model with a split domain consisting of four grids was developed; it had a high-resolution grid of approximately 13 m by 7 m around the area of interest and much lower resolution upstream of RM 11.5. The open source Delft-3D modeling system was chosen for its computational speed, its state-of-the-art ability to represent the essential physics of the system, and ease of model setup.

The high-resolution multibeam bathymetric and single-beam data for shoal areas that lay beyond the extent of multibeam coverage of the area were gathered in July–August 2011 (before Hurricane Irene) (Gahagan & Bryant Associates 2011) and used to develop the model bathymetry. The model included as its upper boundary the discharge at Dundee Dam and as its lower boundary the water levels at RM 10.1 from the model developed for the LPR/NB modeling program. The inflow from the Third River was scaled to the Passaic River discharge. The Physical Water Column Monitoring (PWCM) data collected in fall 2009 from acoustic Doppler current profiler (ADCP) stations at RM 10.2 and RM 13.5 was used for calibrating the model, which was done by varying the bottom roughness and eddy viscosity parameters. The calibrated model used the Manning roughness formulation with horizontal roughness coefficients of 0.023 m$^{1/3}$/sec. The horizontal and vertical eddy viscosities were set to 10^{-2} m^2/sec and 10^{-5} m^2/sec respectively. The calibration period included a 6,000 cfs discharge event towards the end of the ADCP deployment. The model during this period reproduces very accurately the observed velocities. The model was further validated by comparing model results to velocity data collected in October and November

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2011 using four different moored ADCPs between RMs 10.8 and 11.1. This was a period of relatively low to average flow, with the Passaic discharge never exceeding 3,500 cfs. The model for this period also reproduces quite accurately the observations. In addition, the velocity transects measured from boat-mounted ADCPs as part of the same data collection effort were used to qualitatively verify the cross-shore velocity distribution predicted by the model.

The velocity profiles across the river section were measured using boat-mounted ADCP at a different (mostly higher) vertical and horizontal resolution than the model representation of the system. These measurements represent averages over these horizontal and vertical bins, just as model-predicted velocities are averages over each grid cell and sigma level. Because the cross section in the model is defined by a discrete number of points, and differences between the real cross section and the model cross section should occur, a relatively small difference in the location where the model predicts the highest and lowest velocities across the river and where these are observed would result in a significant error, if a direct quantitative comparison is performed. Therefore, as is done for most projects, and in particular in the hydrodynamic model report of the LPR/NB model prepared by HQI for USEPA, a qualitative comparison of velocity distribution plotted from data and the closest model output is used to assess the validity of the model results.

This model was then applied to simulate a 1-month period that included the Hurricane Irene event, which produced a 25,000 cfs discharge in the Passaic River on August 31, 2011. The downstream boundary near RM 10.9 used modeled water levels from the AECOM hydrodynamic model of LPR-Newark Bay for water year 2011, and the upstream boundary by hourly average of discharge at Dundee Dam measured by the U.S. Geological Service (USGS) gauge. The model required a 1.2-second (sec) time-step to produce stable results under the high-current conditions observed during Hurricane Irene. The maximum total shear stress predicted by the model is as high as 26 pascals (Pa) in the channel near RM 10.9, and the channel bottom velocities predicted were up to 2 m/sec.

Analysis for the 100-year flood flow used the standard extreme value analysis using peak annual flow records spanning from 1896 to 2012 at the USGS Little Falls gauge station to estimate flow return periods. A Fisher-Tippett Type II probability distribution was found to best describe these data. Based on this analysis, the Hurricane Irene flow (20,800 cfs at Little Falls) corresponded to a near 80-year return period event, with 100-, 200-, and 500-year events being roughly 22,000 cfs, 25,000 cfs, and 29,000 cfs at Little Falls, respectively. The 35,800 cfs event in 1903 was the consequence of a dam failure as reported by the USGS. Because of this reason it was not included in the CPG's extreme value analysis. For extreme events beyond the 100-year flow, it seems reasonable to expect a small incremental effect on model velocities, as much of that increased flow volume could be expected to translate to more flooding of shoals/banks because of the limited capacity of the existing river cross section. The flow during Hurricane Irene could be considered to be close to a 100-year event, while a 32,000 cfs flow at Dundee Dam is close to a 500-year event. A synthetic 32,000 cfs event corresponds roughly to a 500-year return period. The values of maximum total shear stress and bottom velocities within the RM 10.9 Removal Area predicted by the model for this synthetic event were 34 Pa and 2.3 m/sec, respectively. The maximum total shear stress and bottom velocities for the 100-year flow are approximately 23 Pa and 1.8 m/sec, respectively.

Depth-weighted velocity and water depths for the river for a 1-year event (6,000 cfs) are provided in **Figure 3-1** and **Figure 3-2**, respectively. Depth-weighted velocity and water depths for a 100-year flow of 22,000 cfs are provided in **Figure 3-3** and **Figure 3-4**, respectively. This hydrodynamic information is used in **Section 7.0** to determine the appropriate armor layer for an estimated 100-year flow event. **Figure 3-5** provides the shear stresses associated with the 100-year flood conditions. The shear stresses for a synthetic 32,000 cfs event (close to a 500-year event) are provided in **Figure 3-6**. At USEPA's request, the impact of designing cap for a more intense storm than the 100-year return period flood was also evaluated. The 500-year return period flood was utilized for this additional evaluation.

3.6 Climate Conditions

Meteorological conditions such as precipitation, wind, and freezing can affect the project's implementation by restricting the work schedule or necessitating temporary shutdown of operations. Climate data for Newark, NJ, approximately 7 miles south/southwest of RM 10.9, are summarized in **Table 3-5**. This table presents monthly

30-year normal baseline statistics from 1981 to 2010. The average high temperatures in the summer months range from the mid to high 80s. Heat advisories are not uncommon during the summer months, when temperatures can reach 100°F. Average monthly rainfall ranges from 2.9 to 4.7 inches (in.). Average low temperatures below freezing generally occur from December through February. Ten years of hourly meteorological data (1981 through 1990) were obtained from the Newark Airport Meteorological Station to generate wind rose diagrams. Prevailing winds over this period are generally from the southwest with average wind speeds ranging from 4.0 to 4.6 m/sec (9.0 to 10.3 miles per hour). During project implementation an onsite meteorological station will provide real time monitoring of the conditions.

Weather predictions and data as well as flow and tidal predictions will be reviewed during the Removal Action to address specific needs of the project. This information will provide the possible conditions for planning purposes.

3.7 Bridges

There are no bridges within the RM 10.9 Removal Area. However, the 17 bridges located between the Removal Area and the mouth of the river represent a key navigational consideration for sizing barges and other construction support vessels that must travel from RM 10.9 to the Newark Bay area. The location of each of these bridges is provided in **Figure 3-7**. The type, horizontal clearance, and vertical clearance at low water level are provided in **Table 3-6**. A more detailed table is provided in **Appendix C**, which in addition to the clearance data also includes the bridge owner, contact information, opening coordination requirements, and if any construction/maintenance is currently scheduled or planned for during next year's construction season. The navigation route to be taken to the mouth of the river is provided in the design drawings (**Appendix D**).

Ten bridges on the Lower Passaic River and one bridge on the Hackensack River will need to be opened to support mobilization and demobilization of equipment and to support the transport of dredged materials and capping materials to and from the Removal Area. Five of these bridges have significant vehicle traffic: the DeJessa Park Avenue Bridge (RM 10.37), Rutgers (Route 7) Bridge (RM 8.53), Clay Street Bridge (RM 5.83), Bridge Street Bridge (RM 5.41) and Jackson Street Bridge (RM 4.37). The bridge openings must occur within 2 hours of high tide. Bridge openings will try to be scheduled during non-peak traffic times, including overnight, but it may be necessary to open the bridges during the day as well.

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TABLE 3-1
RM 10.9 Removal Area Summary of Chemical Parameters
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Analyte	Conc.	Depth Interval											
		0 to 2.5 ft bgs			2.5 to 3.5 ft bgs			3.5 to 5.5 ft bgs			5.5 ft bgs to native		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
2,3,7,8-TCDD	ng/kg	35,600	2.1	8,874	29,800	1.0	9,478	18,750	0.35	3,493	6,230	0.50	498
Total PCB	mg/kg	35	0.0048	11	28	0.00012	10	25	0.000013	4.5	13	0.000011	2.0
Mercury	mg/kg	24	0.023	8.9	19	0.0078	7.6	17	0.0043	6.0	83	0.0010	7.0
Benzo(a)pyrene	mg/kg	7.8	0.015	3.6	7.3	0.012	4.0	18	0.0015	4.8	59	0.00019	5.6
HMW PAH	mg/kg	110	0.16	31	64	0.017	32	188	0.0031	37	539	0.00015	35
LMW PAH	mg/kg	25	0.049	5.7	14	0.00046	6.4	62	0.00011	9.2	144	0.000066	9.3

Data Sources: *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012); additional delineation data from RM 10.9 QAPP Addendum A (AECOM, 2012) and the LPR Supplemental Sampling Program.
Values represent detected data from sediment cores only (i.e., no grab samples) with duplicate samples averaged prior to data compilation.
2,3,7,8-TCDD, 2,3,7,8-tetrachlorodibenzo-p-dioxin;
Total TEQ, total toxicity equivalency quotient
PCB, polychlorinated biphenyl;
HMW PAH, high molecular weight polycyclic aromatic hydrocarbon;
LMW PAH, low molecular weight polycyclic aromatic hydrocarbon;
ft bgs, feet below ground (sediment) surface;
ng/kg, nanograms per kilogram;
mg/kg, milligrams per kilogram.

TABLE 3-2

RM 10.9 Removal Area Summary of Chemical Paramters Within Uncapped Area

RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Depth Interval	2,3,7,8-TCDD (pg/kg)	Total PCB Congeners (mg/kg)	Mercury (mg/kg)	Top of Native
Core 12E-0365				
0–0.5 ft	29,000	22.7	10.6	4.68 ft
0.5–1.5 ft	31,000	28.8	11.9	
1.5–2.5 ft	4,030	6.81	6.43	
2.5–3.5 ft	3,280	2.69	14.7	
3.5–4.68 ft	18.2	0.477	6.09	
4.68–6.1 ft	2.86	0.011	0.899	
Core 12E-0366				
0–0.5 ft	26,600	22.4	9.65	2.2 ft
0.5–1.5 ft	16,500	15.8	8.4	
1.5–2.2 ft	9,170	10.7	11.6	
> 2.2 ft		No Sample		
Core 12E-0367				
0–0.5 ft	203	1.64	2.02	0.65 ft
> 0.5 ft		No Sample		
Core 12E-0368				
0–0.5 ft	1,070	5.68	3.28	1.83 ft
0.5–1.5 ft	714	2.16	1.91	
1.5–2.2 ft	2.36	0.012	0.114	
Core 12E-0369				
0–0.5 ft	7,390	15.3	8.61	2.51 ft
0.5–1.5 ft	1,110	4.03	1.01	
1.5–2.75 ft	3.915	0.157	2.365	
Core 12A-0481				
0–0.5 ft	23,200	16.4	11.8	2.6 ft
0.5–1.5 ft	35,600	24.3	13	
1.5–2.5 ft	67.8	0.546	4.05	
> 2.5 ft		No Sample		

TABLE 3-3
RM 10.9 Removal Area Summary of Physical Parameters
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Physical Characteristic	Depth Interval								
	0.0–2.5 ft bgs			2.5–3.5 ft bgs			3.5–5.5 ft bgs		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Grain Size									
% Cobble	—	—	—	—	—	—	—	—	—
% Gravel	37	0.0	1.7	24	0.0	1.7	26	0.0	3.3
% Sand	98	2.5	29	88	2.6	39	88	11	44
% Silt and clay	98	2.0	69	97	3.0	59	89	4.5	53
Other									
% Moisture	213	11	111	147	15	85	122	15	71
% Solids	91	27	49	89	40	56	88	45	62
Specific gravity of dry solids	3.0	2.3	2.5	2.7	2.3	2.5	2.7	2.3	2.5
Bulk density of dredge sediment (tons/yd^3)	1.75	0.94	1.25	1.67	1.06	1.37	1.59	1.13	1.45
Dry bulk density of dredge sediment (tons/yd^3)	—	—	0.61	—	—	0.77	—	—	0.90
TOC	12	0.34	5.9	9.5	0.13	5.6	9.0	0.050	4.8

Data Source: *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012).
Values represent data from sediment cores only (i.e., no grab samples) with duplicate samples averaged prior to data compilation.
ft bgs, feet below ground surface; Max., maximum; Min., minimum; Avg., average; %, Percent; TOC, total organic carbon.

TABLE 3-4
Historical Average River Flow Conditions (ft^3/sec)
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Year	2007	2008	2009	2010	2011	2012	6–Year Average	6-Year Maximum
July	662	333	908	328	505	300	506	1,720 (2009)
August	984	240	1,189	350	3,582	361	1,118[1]	23,800 (2011)[a]
September	165	653	464	177	6,029	323	1,302[1]	15,700 (2011)[a]
October	459	380	700	634	1,956	610	790	3,190 (2011)[b]

Source: United States Geological Survey (USGS) Water Resources Data for Passaic River at Dundee Dam at Clifton, NJ (#01389890) from 2007–2012.
[a] The maximum flow rate for years 2007-2012 excluding 2011 data (Hurricane Irene) are 2,580 cfm and 2,760 cfm for the months of August and September, respectively.
[b] Hurricane Irene made landfall August 28, 2011 resulting in higher than normal flow rates for the period August 28 to September 14, 2011. Excluding 2011 data, the 6 year average flows for August and September were 625 cubic feet per minute (cfm) and 356 cfm, respectively.

TABLE 3-5
Local Climate and Wind Rose Data
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily high (°F)	72	74	86	97	99	102	105	105	100	89	81	76
Average high (°F)	39.4	42.9	51.3	62.6	72.8	82.1	86.6	84.7	77.3	66.0	55.3	44.1
Average low (°F)	25.1	27.5	34.2	44.3	53.9	63.8	69.2	68	60.3	48.5	39.6	30.2
Daily low (°F)	5	14	23	30	49	55	67	61	54	44	31	10
Precipitation (in.)	3.53	2.88	4.18	4.20	4.09	4.02	4.76	3.70	3.82	3.60	3.65	3.80
Snowfall (in.)	8.9	9.5	4.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.4
Wind Rose Summary												
Average Wind Speed (m/sec)	4,89	5.05	5.41	5.17	4.59	4.05	4.55	4.05	4.03	4.13	4.81	4.67
Average Direction	W	N/NW	W/NW	NW	S/SW	SW	SW	SW	SW	SW & N/NE	W	W/NW

Source: Local Climate Data 1981–2010 Normals, NOAA (2012). Wind rose data from 1981 to 1990 were generated using WRPLOT View Version 7.0.0, Lakes Environmental Software, available at http://www.webLakes.com (2012). Met data were obtained through the WRPLOT View software, which is linked to the Meteorological Resource Center, http://www.webMET.com (2012). Newark Airport Station #14734 met data.

Table 3-6 **RM 10.9 Removal Project Bridges,** RM 10.9 FINAL DESIGN REPORT, LOWER PASSAIC RIVER STUDY AREA, NEW JERSEY

Bridge Name	River Mile	Bridge Type	Max. Horizontal Clearance (ft)
Lower Hack Lift Bridge Hackensack River	3.4	Lift	150
Wittpenn Bridge Hackensack River	3.1	Lift	158
RR Howell Street Bridge/Harsimus Branch Lift Hackensack River [a]	3.1	Lift	158
PATH Lift Bridge Hackensack River	3.1	Lift	168
Central Railroad of NJ *(not in use)*	0.91	Lift (dismantled)	145
Lincoln Highway Bridge (US-1 Truck) (Passaic and Hackensack)	1.57	Lift deck	300
Pulaski Skyway (Routes 1 & 9)(Passaic and Hackensack)	1.75	Fixed span	520
Point-No-Point Conrail[a]	2.33	Swing	103
NJ Turnpike Bridge (I-95)	2.41	Fixed span	352
Jackson Street Bridge (Frank E. Rodgers Blvd. S./County Rd. 697) [a]	4.37	Swing	72
Amtrak Dock Bridge[a]	4.75	Lift deck	200
Penn RR at Market Street[a]	4.75	Draw	75
Penn RR at Center Street[a]	4.75	Draw	80
Bridge Street Bridge[a]	5.41	Swing	80
Morristown Line RR Bridge / (Newark-Harrison) Erie Swing Bridge[a]	5.57	Swing	77
Stickel Bridge (I-280)	5.61	Lift deck	200
Clay Street Bridge (Central Ave)[a]	5.83	Swing	75
Fourth Ave Conrail Bridge	6.07	Single-leaf truss bascule (fixed open)	126
Erie/Montclair-Greenwood Lake RR Bridge (West Arlington Street Bridge)	7.81	Fixed rail (decommissioned swing)	48
Rutgers (Route 7) Bridge[a]	8.53	Lift deck	100
DeJessa Park Avenue Bridge[a]	10.37	Open truss swing	65

Lyndhurst-Delaware Rail Bridge	11.4	Opening swing	—
Rutherford Avenue (Route 3) Bridge	11.65	Double leaf bascule	—

Source: Lower Passaic River Commercial Navigation Analysis Rev 2 (USACE, 2010); Lower Resolution Coring Characterization Summary, Lower Passaic River Study Area RI/FS (AECOM, 2011).
Maximum vertical clearance is measured at low tide. If a lift bridge, vertical clearance in parenthesis refers to clearance when bridge is open. Maximum horizontal clearance is measured between abutments or piers of bridge. [a] Bridge requires opening during sediment and material transport operations.

SECTION 4

4 Dredging

The dredging design includes the removal of contaminated sediment from the RM 10.9 Removal Area, barge transport of contaminated sediment to the stabilization facility, and environmental monitoring during construction (i.e., air, water, and noise).

4.1 Design Criteria

The design criteria were developed in accordance with the following documents:

- *Action Memorandum/Enforcement: Determination of Need to Conduct a CERCLA Time Critical Removal Action at the Diamond Alkali Superfund Site, Lower Passaic River Study Area, River Mile 10.9 Removal Area* (USEPA, 2012b) (the Action Memorandum/Enforcement)
- *Lower Passaic River Study Area RM 10.9 Removal Action and Pilot Tests: Statement of Work* (USEPA, 2012c)

4.2 Estimated Volume of Dredged Material

4.2.1 Sediment

The target dredge depth used to remove material from the RM 10.9 Removal Area is 2 ft below the existing sediment surface, plus or minus a vertical dredge tolerance of 4 in. Removal to the 2 ft target depth equates to approximately 20,000 yd^3 of contaminated sediment. An illustration of target dredge elevation and the associated vertical dredge tolerance is provided in **Figure 4-1**. The basis for the removal volume is provided in **Appendix C** and shown on the design engineering drawings provided in **Appendix D**. Dredging specifications are provided in **Appendix E**.

Figure 4-2 shows existing site conditions with the river center line divided into stations every 50 ft. The area north of Station 32+00 will be dredged to native material (based on boring logs) because the relatively steep slope here will not support cap material. The existing site conditions, design post-dredge bathymetry, and example cross sections for the 2 ft removal depth are provided in **Figures 4-2**, **4-3,** and **4-4**, respectively.

4.2.2 Debris

Visual observations of the sediment surface during typical low tide conditions indicate that debris of various types and sizes (i.e., concrete debris, rocks, tree limbs) will be encountered during the removal operations. While this debris may temporarily slow down the dredging operations it is not anticipated to significantly affect the overall daily production rate. The debris will be removed with the excavator using either a clamshell or conventional bucket depending on the size/shape of the debris. The removed debris will be placed in sediment barges for transport to the designated off-loading facility. If large debris (over 3 ft in any one dimension) is encountered, it will be segregated to one end of the barge to minimize delays during unloading. Should debris be encountered that is determined to extend below the removal depth, it may be left in place following evaluation of the extent of embedment at the time of the work. The riprap associated with the Township of Lyndhurst's pump station will not be disturbed. As indicated in the technical specifications, the dredging contractor will be required to address debris removal as part of their Dredging and Operations Plan, which will include a Contingency Plan for dealing with unanticipated debris conditions.

A geophysical survey and demonstration dredge have not been conducted for the Removal Area, so the amount of potential debris that will be generated as part of this Removal Action has not been quantified. However, given the relatively shallow dredge depth (2 ft), limited visual observations, and assumptions used for the Phase 1 removal action, a working assumption is that nominally 5 percent (by volume) of the dredged sediment will contain debris over 4 in. As part of a utility survey, there will be some visual survey work conducted that will identify large debris if present.

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4.2.3 Slope Stability

Given the relatively shallow depth of the dredging operations (2 ft), dredging will be conducted with box cuts, and no sloping will be performed. The temporary excavation surfaces need only to remain stable during excavation of the contaminated material and prior to cap placement. However, should the dredge surface fail, it is assumed to be at the natural angle of repose. For relatively cohesionless material, a 3H:1V slope is considered to be stable; however, with increasing cohesion, the slope is expected to be stable at higher angles. Therefore, based on the geotechnical data and boring logs, the face of the excavation will likely remain stable at an angle of repose exceeding 3H:1V. However, for the design it was assumed that the final excavation would result in a nominal 3H:1V slope along the perimeter of the dredge cut. Following the completion of dredging a bathymetric survey of the post-dredge surface will be performed and the final dredge surface must meet the acceptance criterion of the technical specification. Any areas along the perimeter or within the Removal Area where the final elevation does not meet this criterion due to material sloughing will require additional dredging before capping.

For the portion of the Removal Area that will not be capped, the majority of the soft sediment overlying the stiffer native sediment will be removed, with a resulting stable slope anticipated.

4.2.4 Utilities

Two identified water pipelines and a solid wire cable crossing the Removal Area footprint are indicated on **Figure 4-5**. A third pipeline, owned by the Passaic Valley Water Commission, is located just outside the Removal Area, approximately 75 feet upriver.

The 72-inch water pipelines crossing the removal area footprint are separated by approximately 40 ft and are owned by Jersey City Municipal Utility Authority (JCMUA), which has indicated that a 30 ft offset must be established for these utilities. This area will be designated a “No Dredge Zone” in order to protect the integrity of the pipelines which supply the water to Jersey City, New Jersey. In addition, the dredging contractor will be responsible for conducting pre-construction utility checks to confirm the information provided on the design drawings.

The wire cable crossing the Removal Area does not appear to be associated with a utility or specific use and will be removed by the contractor within the approximate dredging footprint unless determined otherwise by CH2M HILL through additional discussions with the local municipalities.

4.3 Dredge Performance Criteria

4.3.1 Equipment Type and Size

4.3.1.1 Dredge

Dredging will be performed with shallow draft vessels capable of removing all the sediment from the water side of the RM 10.9 Removal Area in water depths of approximately 2.5 to 4 ft, depending on the type and size of barges utilized. The dredging work will be carried out using a hydraulic articulated fixed arm excavator situated on a spud barge. The excavator will be equipped with a 3 to 5 yd^3 environmental clamshell bucket (see next section) specifically designed for removal of contaminated sediment at approximate in situ conditions while minimizing turbidity. It is anticipated that the dredge will be required to reposition three or four times per day to meet the estimated daily production rate.

4.3.1.2 Environmental Bucket

Contaminated sediment within the RM 10.9 Removal Area will be dredged using an environmental clamshell bucket capable of making a level cut during the closing cycle (see **Figure 4-6**) that meets the performance requirements of the technical specifications. The environmental dredge bucket will be equipped with hardware that allows the bucket to be operated by using positioning and machine-control software to meet the horizontal and vertical accuracy requirements. In addition, the software will allow the operator to control bucket penetration depth to avoid overfilling and minimize the resuspension of sediment. The environmental dredge bucket will have sensors to confirm that the bucket completely encloses the dredged sediment and captured water. The environmental dredge bucket will not have teeth and will be equipped with escape valves or vents that close when the bucket is withdrawn from the water.

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The cut depth of the bucket will be such that a theoretical bucket fill of approximately 80 percent of the bucket volume is achieved. This limitation will minimize potential for releasing dredged materials and help to control turbidity. For a 5 yd^3 environmental bucket, this equates to a cut depth of approximately 12 in. For the purposes of the dredge designs it is assumed that the sediment will be removed to the target depth of 2 ft in one pass consisting of two to three lifts with an average cut depth of approximately 10 to 11 in. for each lift. This average cut depth results in an average quantity of water within each bucket grab of approximately 31 percent (1.6 yd^3).

The majority of the Removal Area has a slope of 3H:1V or less; only areas upriver of Station 32+00 have slopes greater than 3H:1V. Dredging on slopes can be less operationally efficient and result in increased removal of sediment below the target cut depth. The control and excavating force of the fixed arm will allow articulated buckets to more effectively remove material from slopes at the desired cut elevation and better control the desired position and overlap. The articulated fixed-arm dredge can also place, hold, and close its bucket on slopes with more control than wire-supported buckets.

4.3.1.3 Barges

The dredged material and debris will be transported to the off-loading facility in barges capable of operating in approximately 2.5 to 4 ft of water. For the purposes of this design, it is assumed that two (2) 1500 yd^3 barges 150 ft long and 40 ft wide with a vertical clearance (when empty) of approximately 22 ft will provide sufficient capacity to match the required daily production rate of the dredge. Once fully loaded, these hopper barges will be transported from the dredge area to the material processing location via the use of properly sized tugboats. This larger barge will reduce the number of trips up and down the river.

4.3.2 Position Accuracy and Dredge Tolerance

The dredging accuracy and progress will be managed by software capable of monitoring the *x*, *y*, and *z* positions of the bucket in real time. The software will provide the dredge operator a real-time view of the barge and bucket position. The software will display the surface (derived from existing hydrographic survey data) and provide real-time feedback showing current horizontal position, current elevation, final project elevation, target elevation, and current bucket elevation.

This software aids the operator in placing the bucket in the predefined target location and within the dredging tolerance (horizontally and vertically) where the grab is made. The operator views each of the proposed bucket grabs ("targets") on the dredge guidance screen. These bucket targets are based on offset information from the center of the bucket to the proposed target elevations. The operator works off of a computer screen showing typically a color-coded, three-dimensional terrain model (matrix) of the river bottom. The matrix colors are referenced to the thickness of material remaining above (and below) the targeted elevation. Once a grab has been made, the color matrix is automatically updated by the software to the elevation of the bucket at grab closure. The operator continues to dredge bucket targets until the matrix shows that all available material above grade has been removed (typically, the matrix turns red).

The nominal horizontal and vertical accuracies of the positioning software are ±3 in. and ±2 in., respectively. The nominal horizontal and vertical removal tolerances (allowable over dredge) are ± 1 ft and ±4 in., respectively.

Outside influences such as wind, waves, tides, and boat traffic could impact the stability of the barge vessel, which could potentially result in a decrease in the removal accuracy. To keep these outside influences to a minimum, the excavation barge will be spudded in all locations.

4.3.3 Production Rate

The dredge production rate will be dependent on the size of bucket, size of barges, hours of operation, tide movements, and operational parameters (e.g., cycle time, excess water, equipment up time, time to change barges). The parameters used to estimate the dredge production rate are provided in **Table 4-1** and, as shown in **Table 4-2,** the projected unrestricted dredging rate can vary from 293 to 924 yd^3/day, depending on the bucket size (3 yd^3 or 5yd^3) and whether the operation is restricted to 12 hours per day rather than 24 hours per day due to noise/neighborhood restrictions. The calculations to support these production rates are provided in **Appendix C**. The capacity for stabilizing dredge material is anticipated to be a minimum of 2,000 yd^3/day and, therefore, is not considered to be a constraint to the dredging production rate.

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For planning purposes, it is assumed that dredging will be performed with a 5 yd^3 environmental bucket and that operations will be conducted only for 12 hours/day, resulting in an estimated average daily production rate of 462 yd^3.

TABLE 4-1
Dredge Production Rate Parameters
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Parameter	Value
Environmental bucket size	5 yd^3
Average excess water per bucket grab	31% of in-bucket dredge material volume
Average bucket cycle time	2.5 minutes
Average dredge uptime	65%
Average Dredge Movement time	15 minutes
Average barge change-out time	20 minutes
Hours of operation per 12-hour shift	10

TABLE 4-2
Comparison of Potential Dredging Production Rates
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Process	Production Rate (yd^3/day)
Maximum dredging production (3 yd^3 bucket, 12 hrs/day)	293
Maximum dredging production (3 yd^3 bucket, 24 hrs/day)	587
Maximum dredging production (5 yd^3 bucket, 12 hrs/day)	462
Maximum dredging production (5 yd^3 bucket, 24 hrs/day)	924
Stabilization treatment rate (12 hrs/day)	2,000

4.3.4 Dredging Operations

To obtain the best results with environmental clamshell buckets, operational protocols are followed. To avoid suspending sediment from the creation of a pressure wave in front of the bucket, the bucket is not allowed to free fall through the water column. With the vented environmental clamshell bucket, most of the sediment loss during the dredging cycle occurs either at the river bottom when the bucket is closed and hoisting begins or at the water surface when the vents flap to adjust to the sudden pressure change as the bucket breaks the surface. To minimize sediment loss, the bucket is lowered and hoisted in a controlled manner. Lowering and hoisting speeds of approximately 1 ft/sec generally provides good results, and at no time should this speed exceed 2 ft/sec. When hoisting, the operator pauses at the water surface to allow excess water in the bucket to drain and equalize pressures. Swinging the bucket to the material barge with the bucket vents positioned at the water surface and then raising the bucket to the dump height works better than immediately hoisting the bucket to the dump height

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and then swinging it to the barge through the air.

Before hoisting the bucket from the river bottom, the operator checks the control system to verify that the closure switches indicate the bucket has sealed. If debris or foreign objects prevent the bucket from closing, two approaches are generally used. Because sediment released near the riverbed settles back to the bottom quickly and does not break apart and disperse like material released high in the water column, the operator can reopen the bucket immediately above the riverbed, relocate the bucket slightly in the *x-y* plane, and reclose the bucket. This procedure often relocates the foreign object into the bucket, allowing the bucket to close. Relatively small debris, including rocks, bricks, tires, and fishing tackle, are generally handled with this technique. With large sunken logs, pilings, and similar long or irregularly shaped objects, there is sometimes no alternative to grabbing the object with the bucket and placing it into the material barge as rapidly as possible to minimize the amount of time that sediment leaks from the unsealed bucket.

It is important that the positioning software has been properly calibrated and that the dredge operator match as closely as possible the target depth shown by the dredging software. The environmental clamshell buckets are designed to be completely filled at a specific penetration depth, usually between 1 and 1.5 ft. If the bucket penetration is too deep, excess sediment extrudes through the vents and is resuspended as the bucket is lifted through the water column. Therefore, care must be taken to avoid overfilling the bucket. Excess water from dredging will be contained during barge transport and removed at the off-loading facility for subsequent handling and treatment prior to disposal. The off-loading and management of the dredged material and excess water will be the responsibility of the stabilization contractor and the procedures to be utilized are provided in **Section 6.2.1**.

For environmental dredging with mechanical equipment, generally accepted BMPs, including resuspension management are described in **Section 4.4**. Dredging is planned to be performed from up-current areas to down-current areas with the barge situated parallel to the shore, as practicable. However, due to the Removal Area being exposed at low tide, the dredging operations will be required to begin in the deeper water and progressively proceed towards the shallower water in order to maintain sufficient draft for the marine equipment.

4.3.5 Material Transport

Dredged material will be transported in barges from the dredge site downriver to a treatment facility's off-loading location located within the Newark Bay area. This operation will be constrained by the vertical and horizontal clearances of several bridges located between the removal site and the treatment facility. These clearances are directly affected by the tidal fluctuations, river stage and whether the bridges are opened during material transport. Dredge material transport and barge return are assumed to require the opening of a minimum of 11 bridges. These openings are assumed to only occur during non daylight hours in order to minimize the disruption of local surface traffic.

A minimum of two barges will be used for the material transport operations. It is assumed that one barges will be available daily at the dredge site for loading and the other barge will be staged at the unloading facility for unloading and transport back to the dredge site.

4.3.6 River Operations

Dredging activities will be upriver of most existing in-river commercial activities and are not anticipated to adversely affect these river operations. Several High School rowing clubs may periodically row through the LPR reach that includes the RM 10.9 Removal Area. The competitive high school rowing season should be complete by June 15. There may still be other recreational rowers and a few fishing boaters in the vicinity of the work area during construction. A layout of the dredging operations is provided as **Figure 4-7**. Barges and dredges transiting river working areas will be required to coordinate with ongoing in-river operations and recreational water activities. Only about half of the river width will be used for dredging/capping operations and this area will be designated with highly visible warning buoys, lights, and floating and shoreline signage to direct the recreational boaters/ rowers. Details are provided in the Project and Community Health and Safety Plans (HSPs) in Appendices F and G, respectively. Therefore, to minimize the impact on harbor and river operations/activities, dredging works will require close cooperation with other river users, particularly when barges are transporting material to the

designated off-loading facility. The CPG, through its contractor, will be responsible for notifying the Newark Port Authority, USACE, USCG, and other affected parties.

4.3.7 Hours of Operation

Dredging operations are assumed to be 12 hours per day, 6 days per week, with the seventh day reserved for maintenance activities. As described above, to accommodate height restrictions associated with several of the bridges and the tidal influences, the dredge material transport could occur during any time of the day, 7 days per week.

4.3.8 Operability, Reliability, and Maintainability

Design parameters for operations and maintenance include the following assumptions:

- Bucket efficiency is approximately 70 percent.
- Maintenance is scheduled for 1 day per week.
- Average operational uptime of dredging-related facilities is 65 percent.

4.4 Resuspension Management

This section presents the rationale for managing sediment resuspension primarily with operational controls during sediment removal operations.

4.4.1 Relevant Site Conditions and Impact on Resuspension Risks

The RM 10.9 Removal Area conditions are favorable for minimal sediment resuspension and transport of the contaminants for the following reasons:

- The average river flow for the implementation months of July through October is anticipated to range from 500 to 800 cubic feet per minute (cfm) (see **Table 3-3**), which is below the annual average flow rate of approximately 1,200 cfm. This lower flow range represents an average river velocity of approximately 1.5 ft/sec (0.45 m/sec). The highest river velocities under normal flow conditions are expected on the ebb tides at 1.64 ft/sec (0.5 m/s). Therefore, the potential transport of resuspended material from the dredge area will be reduced.
- Bathymetry of the Removal Area is relatively shallow with the entire area having an average water depth of less than about 4 ft during typical tidal conditions. In addition, approximately one-third of the area is exposed at low tide resulting in some removal occurring “in the dry.” Therefore, the site tidal conditions significantly reduce the water column heights through which resuspension occurs.
- Most of the in-place sediment consists of particles greater than 50 micrometers (µm) in size which will result in the settlement of resuspended sediment in close proximity to the dredging operations.
- No free product contamination has been found in the Removal Area, and the COPCs are hydrophobic; thus, the mechanism of contaminant release is sediment resuspension.

4.4.2 DREDGE Model

The DREDGE Model developed by the USACE was used to make an assessment of the potential environmental impacts from the proposed dredging operation at the RM 10.9 Removal Area. DREDGE estimates the mass rate at which bottom sediment becomes suspended into the water column as the result of mechanical dredging operations and the resulting suspended sediment concentrations. The DREDGE estimates are combined with information about site conditions to simulate the size and extent of the resulting suspended sediment plume and the resulting total suspended solids estimates.

The DREDGE Model only supports the dredge types for which sufficient resuspension data has been collected to support the development of a limited source generation model—cutterhead and open bucket dredges. The RM 10.9 Removal Action will be utilizing an environmental bucket that will resuspend less sediment than open bucket dredges; therefore, the output from the Dredge Model is considered conservative and an overestimate of resuspension associated with the RM 10.9 Removal Action .

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The input parameters used for the DREDGE Model are provided in **Table 4-3** and a summary of the results are provided in **Table 4-4**. The complete DREDGE Model output results are provided in **Appendix C**.

TABLE 4-3
DREDGE Model Input Parameters
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Parameter	Inputs
River flow conditions	Average annual flow (1,200 ft^3/min) Average July–Oct. flow (~600 ft^3/min) 1 year maximum flow (6,000 ft^3/min)
Average velocity	Average annual flow (0.53 m/sec) Average July–Oct. flow (0.45 m/sec) 1 year maximum flow (0.89 m/sec)
Dredge production rate	86 yd^3/hr
Dredge bucket size	5 yd^3
Bucket cycles per hour	17
Seconds per cycle	150 (2.5 minutes)
Total volume removed	20,000 yd^3
Loss rates (% of total mass)[a]	- 0.5% - 1.0%
Average depth of water	Average flow (1.4 m) 1 year maximum flow (1.8 m)
Settling particle size	50 µm
Particles less than 74 microns	54%
Diffusion rate	Average flow (98.44 cm^2/sec) 1 year maximum flow (143.51 cm^2/sec)

[a] Palermo et al. (2008) concluded that "the conservative characteristic resuspension factor for mechanical dredges with environmental buckets without overflow is about 0.5 percent."

TABLE 4-4
DREDGE Model Results for RM 10.9
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Sediment Release Rate	Estimated TSS Concentration from Dredging Operations (mg/L)							
	Average Monthly Flow (July-Oct)				1 Yr Max Flow			
	200 m	400 m	600 m	1,000 m	200 m	400 m	600 m	1,000 m
0.5%	12.17	4.99	2.361	0.615	7.89	4.43	2.88	1.41
1%	23.12	9.48	4.49	1.17	14.98	8.43	5.47	2.68

TSS, total suspended solids.

DREDGE model results indicate that the total suspended solids (TSS) concentrations within the water column decrease markedly between 200 m and 400 m down current of the dredging operations. Therefore, the zone of

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influence associated with the uncontrolled (i.e., having no silt curtain system) dredging operations is assumed to be 300 m. This distance is consistent with other dredging projects, such as on the Hudson River, where the near-field monitoring station is located 300 m downstream of the dredging operation. .A silt curtain system and other BMPs will be utilized for the Removal Action in order to be protective of the river environment and further minimize the potential impact of resuspended sediment. The use of silt curtains will help further promote TSS settling at the dredging location, thus reducing the TSS beyond the near field.

4.4.3 Proposed Resuspension Control Approach

Based on the existing river conditions and the relatively low estimated impact of dredging operations on the river, it is proposed that the following BMPs be implemented and evaluated to control turbidity:

- Deploy a localized heavy-duty silt curtain close to the active dredging areas.
- Monitor the river velocity and suspend operations the velocity increases above the effective velocity of a silt curtain system (2 knots) which based on historical data would only happen during a significant storm event on the order of 6,000 cfm or greater.
- Utilize a closed, watertight (i.e., environmental) clamshell.
- Maximize the size of the “bite” taken by the clamshell.
- Slowly withdrawing the clamshell through the very short water column.
- Prohibit barge overflow or rinsing sediment off the sides/gunwales of the barge.
- Maintain expeditious movement of the closed bucket to the receiving barge after completing a cut to reduce water leakage from the clamshell bucket into the river to the extent practicable.
- Prohibit “re-handling” or stockpiling of material on the river bottom.
- Prohibit raking for debris removal.
- Avoid grounding of marine vessels and allowing water levels to rise before attempting to free grounded vessels.
- Minimize the number of trips by support vessels.
- Restrict the draft of workboats and barges.
- Restrict navigational speeds.
- Restrict the size and power of workboats.
- Prohibit any type of prop-washing.

The proposed water quality monitoring to be conducted is described in **Section 4.6**.

4.4.4 Silt Curtains

As there has been no free product identified within the sediment, and the RM 10.9 characterization did not identify any significant dissolved COPCs, resuspension of dissolved and colloidal phases of contaminants is unlikely. All removal activities will be conducted within a silt curtain/boom system to conservatively manage potential resuspension during dredging operations for the RM 10.9 Removal Action. The use of silt curtains to manage resuspension during dredging is a USACE-recognized project management practice (USACE, 2005, 2008). These silt curtain/ boom systems are designed specifically for silt control in rivers, intercoastal waterways, bays, and harbors and will be deployed around the perimeter of the dredge plant as shown in **Figure 4-7**. This alignment represents the minimum perimeter for the silt curtain configured around the barge vessels and dredging area. The contractor may choose revise the alignment, based on the capabilities of their equipment.

The perimeter of the silt curtain system will be marked by buoys. The silt curtain skirt will be long enough to direct resuspended sediment toward the bottom, and booms will be located sufficiently far from dredging activities that any potentially suspended materials will reach the surface before the current carries them beyond the boom.

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4.4.4.1 Description

The silt curtain systems are designed to provide sufficient residence time to allow the larger sediment particles to settle out of suspension within the area being dredged. The silt curtain systems must be flexible and adaptable to both the environmental conditions of the river as well as all activities associated with dredging. These silt curtains will be constructed of PVC sheeting that is weighted on the bottom and suspended from marine-quality floatation buoys. Floating, flashing marker lights designed for use with turbidity control curtains will be installed.

4.4.4.2 Installation

The alignments of the silt curtain/boom systems will be established by Great Lakes Dredge and Dock (GLDD) who will determine the locations of all the anchors taking into consideration the capabilities of dredge plant and tidal fluctuations. The silt curtain/boom systems will be loaded onto work boats and transported to the designated area. Once on station, the silt curtain/booms will be lowered into the water and secured to the river bottom with anchors and/or tied off to the marine vessel(s). The silt curtain will be placed just above the sediment floor, avoiding contact with the bottom. After dredging an area, the silt curtains will be removed in the reverse order of installation prior to repositioning the dredge plant.

The dredging/capping contractor will utilize a single full silt curtain system to enclose the dredging/ capping operations. This single silt curtain system will be utilized for multiple deployments as the dredging/capping operations move through the Removal Area. Currently, three deployments are planned for the silt curtain system. These deployments include the “Finger Area”, an area up river of the “Jersey City Municipal Utility Authority (JCMUA) No Dredge Zone” and the area down river of the “JCMUA No Dredge Zone”.

A gate will be configured within the silt curtain system to allow the dredge barge, material barge and work boats to enter the dredge/ capping area inside the silt curtain system. The dredge and material barge will work within the silt curtain system where the site conditions allow such operations. However, in areas where there is insufficient room or tidal fluctuations do not allow the contractor to maneuver equipment efficiently, the material barge will be positions outside the single curtain system. When the material barge is located outside the main silt curtain system an additional silt curtain may be used to surround the material barge. The silt curtains will be specifically designed, manufactured by an external contractor specializing in environmental sediment control.

The silt curtains will have a drop which can be adjusted to prevent the silt curtain from dragging on the river bottom. Where the water elevations is less than -3 ft MLW only a floating boom will continue to the shoreline anchor in order to prevent the silt curtain fabric from dragging on the bottom. The silt curtain system will be secured in place using anchors initially spaced 50 feet apart and will be adjusted dependent on site specific conditions. The silt curtain will not be moved/removed until the turbidity levels within the silt curtain system are less than the trigger level for the project.

4.4.5 Rationale for No Sheet Pile Wall

Sheet pile walls can be used for many different reasons during sediment removal projects. The primary purpose is to hold adjacent non-excavated materials from entering the Removal Area. In limited situations, sheet pile walls may help to contain resuspended sediment during the removal process. The excavation at the RM 10.9 is only 2 ft deep and immediately adjacent to the bank so there is no need for structural support from a sheet pile wall. While maximum concentrations of COPCs in the sediment to be removed at RM 10.9 are elevated, they are greater than 100 to 1,000,000 times lower than the Tierra Phase I project (see **Table 4-5** for a select set of COPCs), where sheet pilings were required. Given the significant difference in concentrations, sheet pile walls are not needed as a chemical containment measure at RM 10.9. The overall effectiveness of a sheet pile wall to further reduce resuspension beyond implementation of BMPs is uncertain because of the following factors:

- Near-shore sheet pile installation would require pre-dredging (with associated resuspension) in order to provide sufficient draft for marine equipment to place portions of the sheet pile wall.
- Installation and resetting/removal of a sheet pile wall will generate resuspension.
- Sheet pile installation (including pre-dredging for installation) and removal would increase the duration of in-river work, resulting in an increased opportunity for resuspension.

- The installation of sheet piling would also narrow a significant portion of the river's width for a 4- to 5-month duration, exacerbating river flooding and while the sheet piling was in place.
- The geotechnical data indicates that sediment is unlikely to result in significant downcurrent resuspension of sediment is not likely due to the physical properties (i.e., high solids content, clay-like characteristics and particle distribution) of the sediment.

Therefore, the relatively small potential impact of resuspended material on areas outside the RM 10.9 Removal Area, the uncertain benefit of installing a sheet pile wall, and the potential for adverse flood-related impacts do not warrant the use of a sheet pile wall to control resuspension.

TABLE 4-5
Comparison of Key COPCs Sediment Concentrations for the Tierra Phase I and RM 10.9 Projects

Comparison of RM 10.9 and Tierra Phase I Sediment		Average Concentration (When Detected)		Ratio of Phase I COPC Concentrations to RM 10.9 COPC Concentrations
COPC	Units	RM 10.9	Tierra Phase I	
2,3,7,8-TCDD	ng/kg (ppt)	8,874	338,000	38
Total PCB	mg/kg (ppm)	11.6	9.3	0.8
4,4-DDT	mg/kg (ppm)	0.20	648	3,240
2,4-DDT	mg/kg (ppm)	0.0025	159	63,600
Chlorobenzene	mg/kg (ppm)	0.0008	2,449	3,061,250
Comparison of RM 10.9 and Tierra Phase I Sediment		**Maximum Concentration Detected**		**Ratio of Phase I Maximum COPC Concentrations to RM 10.9 Maximum COPC Concentration**
COPC	**units**	**RM 10.9**	**Tierra Phase I**	
2,3,7,8-TCDD	ng/kg (ppt)	35,600	9,410,000	264
Total PCB	mg/kg (ppm)	35	87	2
4,4-DDT	mg/kg (ppm)	17	21,990	1,294
2,4-DDT	mg/kg (ppm)	0.024	5,200	216,667
Chlorobenzene	mg/kg (ppm)	0.0017	72,000	42,352,941

4.5 Waterside Site Requirements

The Township of Lyndhurst has stated its preference that the adjacent municipal recreation area not be used for staging, processing, and disposal of sediment removed from the river. Therefore, the municipal recreation area or the Bergen County Riverside Park will not be used for staging construction support trailers or a temporary dock. However, the CPG field facility in East Rutherford will be made available for support activities (i.e., personnel transport. All other waterside facilities required for equipment and material will be located offsite at the contractor's designated property.

4.6 Environmental Constraints

4.6.1 Water Quality

Dredging will be conducted in a manner that will minimize resuspension of dredged sediment in the Removal Area. Calculations in **Section 4.4** show that the concentration of TSS would be less than 5 mg/L without the use of resuspension controls within 400 m downcurrent from the dredging operations. This level is significantly below acceptable NJ surface water quality thresholds as summarized below. However, monitoring will be performed during dredging activities to assure that dredging BMPs are effectively reducing resuspension. The objectives of the dredge monitoring activities include the following:

- Monitor the water quality beyond the silt curtains for increased resuspension during dredging operations.
- Quantify select COPC levels in the water column during dredging operations.
- Compare water quality results to the extent practical with applicable NJ Surface Water Quality criteria
- Adjust operations as needed to achieve desired water quality during dredging.

Section 2.0 identifies NJAC 7:14A, Surface Water Discharge Criteria, and NJAC 7:9B, Surface Water Quality Standards, as relevant and appropriate requirements. In particular, NJAC 7:14A-12, Effluent Standards Applicable to Direct Discharges to Surface Water and Indirect Discharges to Domestic Treatment Works, and NJAC 7:14A-13, Effluent Limitations for Discharge to Surface Water Permits, have been considered. The NJAC 7:9B surface water criteria for FW2-NT for TSS and turbidity are 40 mg/L (maximum) and 15 NTU (30-day average), respectively. The one time maximum for turbidity is 50 NTU. The water column monitoring data collected at RM 10.2 in 2009 and 2010 as part of the LPRSA RI/FS PWCM Program indicate that the average TSS concentration was 29 mg/L, with a standard deviation of 29 mg/L, and a maximum of 174 mg/L. The average turbidity was 20 NTU, with a standard deviation of 165 NTU and a maximum of 220 NTU. Because water quality in the area already exceeds on a regular basis the state water quality criteria, trigger/action values for the RM 10.9 project will be based on TSS and turbidity values that are detected at concentrations above ambient conditions.

Turbidity provides a suitable parameter to assess potential construction-related water quality impacts, and was selected for water quality monitoring because it can be measured in real time during the dredging/capping operations. TSS and COPC sampling data cannot be collected and analysed in a timeframe that will allow real-time management of dredging operations.

The key tasks to be performed as part of the water quality monitoring program are summarized below and discussed in more detail in the following sections:

1. Pre-Dredge Baseline Suspended Solids Sampling (10 days)
2. Pre-Dredge Baseline Transect Sampling (3-4 days)
3. Initial Dredging Monitoring (First 2 weeks)
4. Weekly Resuspension Monitoring (during dredging activities with re-evaluation of the weekly frequency prior to capping activities)
5. Event Based Sampling (as needed during dredging and capping activities)

Turbidity monitoring buoys were installed May 30-31, 2013 to record real-time measurements of turbidity continuously at all times for the duration of the project. These data will be used to establish average non-dredging baseline conditions, measure ambient turbidity upstream and downstream of the Removal Area, and monitor for elevated turbidity associated with the dredging and capping operations. The locations of the buoys are summarized below:

- Fixed Turbidity Buoy #1: Downstream “ambient” location at RM 10.2, approximately 0.5 miles (2,650 ft) downstream of the Removal Area’s southern perimeter boundary
- Fixed Turbidity Buoy #2: Downstream location approximately 200 ft downstream of the RM 10.9 Removal Area’s southern perimeter boundary
- Fixed Turbidity Buoy #3: Upstream location approximately 200 ft upstream of the RM 10.9 Removal Area’s

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northern perimeter boundary

- Fixed Turbidity Buoy #4: Upstream "ambient" location at RM 11.7, approximately 0.5 miles (2,650 ft) upstream of the Removal Area's northern perimeter boundary
- Mobile Turbidity Buoy #5: This mobile operational buoy will be moved as needed to monitor turbidity within the Removal Area outside of the resuspension management system, silt curtains.

At each buoy location, the turbidity monitors were placed at the approximate midpoint of the water column depth as measured at low tide (Buoy #1 – 5 ft below water surface, Buoy #2 – 5 ft, Buoy #3 – 5.5 ft, and Buoy #4 – 7.0 ft). The farthest downstream and upstream monitoring sites (Buoys #1 and #4, respectively) are intended to reflect the ambient conditions of the river (depending on tidal and river stage conditions) and were placed such that they would not be affected by the dredging and capping operations. The monitoring sites adjacent to the Removal Area (Buoys #2 and #3) are intended to reflect conditions due to the dredging and capping operations. The fifth mobile monitoring location (Buoy #5) is intended to provide operational early detection of elevated turbidity levels and allow the project to make adjustments to prevent the trigger level from being exceeded.

4.6.1.1 Pre-Dredge Baseline Suspended Solids Sampling

The pre-dredge baseline suspended solids sampling event will include concurrent measurement of in-situ turbidity (NTU) and collection of surface water samples for laboratory analysis of TSS. The resulting data will be used to refine the historical turbidity–TSS relationship.

This pre-dredge baseline event will be conducted over a 10-day period, targeting 3 different tidal periods (ebb, slack [high or low], and flood) each day. Samples for TSS characterization will be collected at the four fixed buoy locations from two depths, surface (1 ft below water surface) and mid-depth (mid-point of the water column).

4.6.1.2 Pre-Dredge Baseline Transect Sampling

To evaluate spatial variability, surface water grab samples will be collected along transects at each of the four fixed buoy locations. Six surface water grab samples and one composite sample will be generated from each transect. The grab sample locations will be spaced horizontally across the river at 3 locations (mid-channel and 50-feet off each shoreline as measured from mean low water) and vertically at 2 depths (surface and mid-depth). Final transect locations will be determined in the field. The grab samples will be collected with concurrent measurement of in-situ turbidity and will be characterized for TSS, POC, and DOC. One composite sample will be generated from a given transect by combining equal aliquots from each of the six grab locations along the transect. The composite sample will be analyzed for PCDD/PCDF, total PCB congeners, mercury (total and dissolved), POC, DOC, and TSS.

This pre-dredge baseline event will be conducted over a 3 to 4-day period at each of the four fixed buoy locations, targeting 3 different tidal periods (ebb, slack [high or low], and flood). A total of ten buoy/tide combinations were selected:

- Ebb tide: Buoys #2, #3, and #4
- Flood Tide: Buoys #1, #2, and #3
- Slack Tide: Buoys #1, #2, #3, and #4

4.6.1.3 Initial Dredging Monitoring

During the first two weeks of dredging, samples will be collected at the four fixed buoy locations indicated in **Section 4.6.1** for analysis of TSS and COPCs**.** During week one, two days will be selected for collection of a daily composite sample to be generated at each of the four fixed buoy locations. Each composite sample will comprise aliquots collected at mid-depth at a frequency of approximately 1 – 2 hours over the dredging period for the given day. During week two, two days will be selected for collection of TSS samples. The samples will be collected from mid-depth at each of the four fixed buoy locations every 2 hours over an 8-hour period during dredging.

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In addition, during the first week of dredging monitoring, a two-person crew in a small vessel (e.g., a jon boat) will monitor for the presence of a visible turbidity plume downstream of dredging activities. This boat will be equipped with the same type of turbidity monitor as used at the turbidity buoy locations. If a plume is observed, turbidity will be recorded and TSS samples will be collected from mid-depth (as measured at low tide) with sampling to start at the dredge and continue at 100 ft intervals in the direction of current flow within the center of the visible suspended solid plume until the downstream point is reached where turbidity levels return to no more than 110 percent of current ambient levels as determined by turbidity buoys #1 and #4. Surface water TSS sample/turbidity monitoring locations will be surveyed via GPS and recorded.

4.6.1.4 Weekly Resuspension Monitoring

Weekly resuspension monitoring will begin the second week of dredging. In-situ turbidity will be continuously monitored during dredging and capping operations at the five monitoring locations described in **Section 4.6.1**. The correlation curve generated as part of the baseline monitoring will be used to estimate TSS concentrations from the measured turbidity values. If the results indicate that there are consistent vertical (surface and mid-depth) concentrations in turbidity and TSS at a given buoy location, the proposed resuspension monitoring discussed herein may be modified. Moreover, if the data collected during dredging indicate that a sampling frequency interval greater than one week is adequate for the subsequent capping activities, a modification may be made to the weekly frequency currently proposed as part of the resuspension monitoring.

The resuspension monitoring program includes weekly synoptic (within same tidal cycle) transect sampling at each of the four fixed buoy locations. Each transect comprises three grab sample locations spaced horizontally across the river at 3 locations (mid-channel and 50-feet off each shoreline as measured from mean low water) and vertically at mid-depth. Final transect locations will be determined in the field. The transect grab samples will be collected for analysis of TSS, POC, and DOC. In addition, a weekly composite sample will be generated at each of the four transect locations by combining equal aliquots from each of the three grab locations along the transect. The composite sample will be analyzed for PCDD/PCDF, total PCB congeners, mercury (total and dissolved), POC, DOC, and TSS.

4.6.1.5 Response Process

The U.S. Environmental Protection Agency (EPA) has established turbidity trigger and action criteria and response procedures as discussed herein. Turbidity values will be monitored real-time against the following trigger and action criteria:

- **Trigger Criteria** – Exceedance of ambient turbidity + 30 NTU measured continuously over a one-hour period (4 consecutive 15-minute intervals). Tide specific: Ebb = Buoy #2 (downstream) vs Buoy #4 (ambient) and Flood = Buoy #3 (downstream) vs Buoy #1 (ambient).

- **Action Criteria** – Exceedance of the Trigger Criteria plus total turbidity greater than 50 NTU at the near field downstream buoy (Buoy #2 or #3) measured continuously over the same one-hour period. Tide specific, as detailed above.

If turbidity is measured at or above the trigger criteria the dredging/capping operator will be notified of the event and directed to evaluate the project's dredging BMPs. Should the cause of the increase be attributed to the RM 10.9 activities, then the project BMPs will be adjusted accordingly. Dredging/capping activities will not be stopped as a result of this 'trigger criteria' exceedance.

If the measured turbidity is at or above the action criteria, the dredging/capping operations will be suspended after an evaluation of site conditions lasting no longer than 30 minutes. If operations are suspended, the sampling team will be deployed to commence transect composite sampling. Dredging/capping will resume when the turbidity levels return to below the 'trigger criteria' of 30 NTUs above ambient conditions or dredging is determined not to be the source.

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Further details on the response actions are proviced in the RM 10.9 Water Quality Monitoring Plan.

4.6.1.6 Monitoring Frequency and Duration

Sample collection and turbidity monitoring for the RM 10.9 Removal Action will occur for the duration of the dredging/capping operations as summarized in **Table 4.6**.

Table 4.6 Removal Action Surface Water Monitoring Details

Monitoring Location	Type of Monitoring Point	Monitoring	Description of Location
Fixed Turbidity Buoy #1	Real time turbidity (NTU)	Continuous—15 minute	Downstream "ambient" location at RM 10.2, approximately 0.5 miles (2,650 ft) downstream of the Removal Area's southern perimeter boundary
	TSS sample collection	Baseline TSS – 240 samples Baseline Transect – 60 samples Initial 48 hrs- 80 samples Weekly Resuspension – 24 samples per week	
	COPC Samples	Baseline Transect - 10 composite samples Initial Monitoring - 8 composite samples Weekly Resuspension – 4 composite samples per week	
Fixed Turbidity Buoy #2	Real time turbidity (NTU)	Continuous—15 minute	Downstream location approximately 200 ft downstream of the RM 10.9 Removal Area's southern perimeter boundary
	TSS sample collection	Baseline TSS – 240 samples Baseline Transect – 60 samples Initial Monitoring- 40 samples Weekly Resuspension – 12 samples per week	
	COPC Samples	Baseline Transect - 10 composite samples Initial Monitoring - 8 composite samples Weekly Resuspension – 4 composite samples per week	
Fixed Turbidity Buoy #3	Real time turbidity (NTU)	Continuous—15 minute	Upstream location approximately 200 ft upstream of the RM 10.9 Removal Area's northern perimeter boundary
	TSS sample collection	Baseline TSS – 240 samples Baseline Transect – 60 samples Initial Monitoring- 40 samples Weekly Resuspension – 12 samples per week	
	COPC Samples	Baseline Transect - 10 composite samples Initial Monitoring - 8 composite samples Weekly Resuspension – 4 composite samples per week	
Fixed Turbidity Buoy #4	Real time turbidity (NTU)	Continuous—15 minute	Upstream "ambient" location at RM 11.7, approximately 0.5 miles (2,650 ft) upstream of the Removal Area's northern perimeter boundary

	TSS sample collection	Baseline TSS – 240 samples Baseline Transect – 60 samples Initial Monitoring- 40 samples Weekly Resuspension – 12 samples per week	
	COPC Samples	Baseline Transect - 10 composite samples Initial Monitoring - 8 composite samples Weekly Resuspension – 4 composite samples per week	
Mobile Turbidity Buoy #5	Real time turbidity (NTU) Early detection location	Continuous—15 minute	This mobile operational buoy will be moved as needed to monitor turbidity within the Removal Area (will be placed approximately 50 ft down current of silt curtain system surrounding dredging/ capping operations)

Note: The target COPCs are PCDD/PCDF, total PCB congeners, and mercury (total and dissolved).

4.6.1.7 Spill Response Plan

The contractor will implement a spill response plan for the containment, cleanup, and removal of any oil spills and other oil releases that may occur as a result of project activities. As part of this spill response plan, mobile spill response kits will be available on all riverside equipment, at the river-to-land unloading location(s), and in required site vehicles. The spill kits will include the following:

- 50 pads Bale Oil HD (or equivalent)
- 1 Pillow Oil HD (or equivalent)
- 6 Boom Oil K-Sorb (or equivalent)
- 50 lbs of FloorSweep (or equivalent)
- 10 bag disposal units
- 1 plug and dike unit

In the event of a significant release of oil/fuel or other pollutant into the river (based on criteria to be established in Spill Response Plan and approved by USEPA and NJDEP), these steps will be followed:

- The affected area will first be made safe and secure.
- Operations will be suspended, and any potential for further spills will be prevented (where possible), and the existing spill contained.
- Recovery and clean up of the contaminant will be undertaken.
- Relevant statutory authorities, including the USEPA and NJDEP, will be notified, as will nearby and/or downstream stakeholders who may be affected.
  - To report environmental incident in NJ, call 24-Hour Environmental Incident Hotline: 1-877-927-6337 (1-877-WARNDEP)
  - USEPA Superfund—Emergency Response
  - National Response Center: 1-800- 424-8802
  - New Jersey Department of Environmental Protection (NJDEP)—Site Remediation and Waste Management Emergency Response, NJ Office of Emergency Management

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- Response measures implemented will be monitored and assessed for effectiveness in controlling the pollution event and likelihood of preventing a repeatable event

4.6.2 Air Quality

Dredging activities using BMPs will be performed to minimize odor or particulates from being emitted beyond the limits of the RM 10.9 Removal Area. Air emission sources are regulated by both the USEPA and the NJDEP and the substantive requirements of these regulations will be completed. Preliminary emissions calculations suggest that dredging activities will not result in emissions exceeding the USEPA or NJDEP reporting thresholds or applicable regulatory requirements associated with project-related emissions sources. Air monitoring details are provided in the Perimeter Air Monitoring Plan.

4.6.2.1 Dust

It is expected that there will be no significant dust impacts attributable to dredging and related activities, including those onshore because the dredged material has a high moisture content, thereby reducing its potential to generate dust during handling. Continual visual monitoring of conditions, including dust, will further mitigate any dust risk.

4.6.2.2 Exhausts

Dredging equipment, cranes, self-propelled barges, tug boats, and other operating equipment at the Removal Areas in the river or bay will be a source of exhaust emissions. All equipment will be fitted with exhaust systems and maintained in a proper and efficient manner.

4.6.3 Noise

All dredging activities will be completed in such a manner that the noise levels do not exceed the maximum noise contribution limits established for the project. As described in Table 2-2, NJAC 7:29 is considered a relevant and appropriate requirement, although this type of activity does not fit the definition of a regulated activity under that rule. The dredging will be conducted to achieve the noise limitations stated therein. It is expected that all noise levels at the nearest sensitive receptors will be below the site-specific noise criteria (**Table 4-7**).

TABLE 4-7
Noise Limits
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Noise Level Monitoring Station	Location	Maximum Hourly Average	
		Daytime	Evening
1	North perimeter 100 ft upstream of Removal Area on east shore	75 dBA	65 dBA
2	South perimeter 100 ft downstream of Removal Area on east shore	75 dBA	65 dBA
3	Center perimeter of Removal Area on east shore	75 dBA	65 dBA

Day is defined as the period from 7:00 a.m. to 6:00 p.m., Monday to Saturday; evening is defined as the period from 6:00 p.m. to 10:00 p.m.

The following measures will be taken to prevent noise levels from exceeding the limits:

- All equipment will be operated and maintained in a proper and efficient manner to reduce the potential for noise and other issues.
- Daily prestart equipment inspections will be undertaken and include inspection of key noise attenuation devices (e.g., mufflers).
- Any defects that are reported will be scheduled for repair.
- Equipment will not be operated if a 75-dBA emission is exceeded.

Additional noise control measures are not considered warranted based on current available information. This

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information includes dredging experience on other urban projects to date and the RM 10.9 river operations being conducted at least 1,000 ft from the nearest residential area most of the time. The possible exception would be when dredging is to occur within the narrow area in the northern portion of the Removal Area. No blasting or installation of sheet piles is part of dredging and capping operations.

All activities that could possibly exceed the noise criteria specified above will be undertaken only within the hours specified below:

- Throughout the 24-hour period for a maximum of 12 hours as daylight allows safe operating conditions between Mondays and Saturdays
- At no time on Sundays or public holidays

4.7 Project and Community Health and Safety

A Project Health and Safety Plan has been developed to include the dredging and in-river material transport operations. A number of potential occupational health issues are associated with the proposed dredging operations that are addressed in the Project Health and Safety Plan (**Appendix F**).

The dredging and material transport operations have the potential to impact the local community surrounding the dredging operations and possible up and down the river. It is very important that the community is informed of the work to be completed and the plans in place to protect the public during these activities. A community health and safety plan was developed and is subject to review by agencies and public groups. A Final Community Health and Safety Plan is provided in **Appendix G**.

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SECTION 5

5 Rationale for Not Conducting Sediment-Washing Pilot Test(s)

In August 2012, bench-scale treatability tests were performed by two sediment-washing technology vendors (BioGenesis and Pear Technology) using bulk sediment samples collected in accordance with the *Lower Passaic River Study Area River Mile 10.9 Characterization Quality Assurance Project Plan Addenda A* (AECOM, 2012) and *B* (CH2M HILL, 2012c). Preliminary results for key site constituents are summarized below and in the technical memorandum *RM 10.9 Removal Action—Sediment Washing Bench-Scale Testing Report, Lower Passaic River Study Area—CERCLA Docket No.02-2012-2015* (CH2M HILL, 2012d) included as **Appendix H**.

The bench-scale tests were performed to evaluate the potential effectiveness and implementability of sediment washing as a treatment and beneficial reuse option for RM 10.9 Removal Area sediment. In order to qualify for beneficial reuse, the treated sediment is expected to meet residential criteria for dioxins/furans, PCBs, PAHs, and other constituents. The sediment-washing bench-scale tests were not able to achieve the degree of removal required to meet the stringent beneficial reuse concentration objectives for dioxins/furans, PCBs, and PAHs in the RM 10.9 Removal Area sediment. Therefore, the treated sediment would not be eligible for beneficial reuse and would need to be further treated or disposed of at a permitted landfill.

Sediment washing without the benefit of an economical reuse or disposal option (e.g., disposal at a Subtitle D versus Subtitle C landfill) is not a cost-effective approach to treating and disposing of RM 10.9 Removal Area sediment. Sediment-washing technology will not be pursued by the CPG for the RM 10.9 Removal Area sediment. The CPG has determined that both stabilization and mechanical dewatering are significantly more cost-effective treatment alternatives for the RM 10.9 Removal Area sediment than sediment washing, and both will be further evaluated as part of the removal action design.

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SECTION 6

6 Sediment Treatment: Stabilization

The sediment treatment design package includes specific design criteria for all sediment activities that occur from the time the contaminated sediment and residual water are removed from the barge to the time the stabilized material is loaded into trucks for transport to the offsite landfill for disposal. The sediment stabilization treatment steps include the following:

1. Pump the supernatant from the barge to water holding tanks/barges.
2. Remove the dredged material from the barge.
3. Screen the dredged material to remove debris and oversize material.
4. Convey the sediment to the pug mill mixer.
5. Stabilize the sediment by mixing it with Portland cement.
6. Transfer treated sediment to a storage/staging area.
7. Load the treated sediment into haulage trucks or rail cars for transport to the approved offsite disposal facility.

The mass balance/process flow diagram for the stabilization operations is provided in **Figure 6-1**.

6.1 Design Criteria

The key design criterion associated with the treatment operations is amending the dredged material so that it passes the paint filter test and can be transported to a designated offsite disposal facility. The treated material would also be required to meet the acceptance criteria of the designated offsite disposal facility, subject to USEPA's offsite disposal policy.

6.2 Preliminary Design Elements

The design elements of the stabilization treatment operations consist of the following:

- Barge dewatering
  - Once the material barge has been secured at the off-loading facility, any freestanding water within the barge will be removed with submersible trash pumps; the water will be transferred to onsite storage tanks for storage prior to offsite treatment and discharge or disposal.
- Coarse material separation
  - Large debris will be removed from the barge, stockpiled at the treatment facility, assessed, and decontaminated (if necessary).
  - Once the large debris has been removed, the sediment will be offloaded to a feed hopper, where material over 4 in. will be separated with a grizzly and/or shaker screen; as with the large debris, the screened material will be segregated, stockpiled, assessed and transported offsite for disposal.
  - The undersized sediment will be conveyed to the pug mill system for stabilization.
- Stabilization
  - The weigh feeder on the conveyor belt will transmit the weight of the incoming sediment to the variable-speed screw conveyor on the cement silo.
  - Cement will be added to the sediment at an average of approximately 10 percent by weight of wet sediment. This ratio will be adjusted as needed to ensure that the stabilization design criteria are achieved.
  - The cement and sediment will be mixed in the pug mill for the time required to achieve thorough mixing.

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  - The treated sediment will be discharged directly to the storage facility using a stacker conveyor system.
- Loading
  - Paint filter testing will be conducted on the treated sediment to verify material meets transportation and landfill requirements.
  - The treated sediment will be loaded onto trucks and rail cars for transportation to the offsite disposal facility.

6.2.1 Barge Water Removal

Excess water that can be decanted and pumped off the barges, will be removed and transferred to the facility water storage tanks. The maximum volume of free water expected to be removed is based on an assumed bucket efficiency of approximately 70 percent; therefore, approximately 31 percent of each barge load is assumed to be free water. For purposes of design criteria, it was assumed that for an in situ dredging production rate of 462 yd^3/day (a 5 yd^3 bucket and a 12-hour day), approximately 40,400 gallons/day of excess water would be placed in the barges. Of this, 90 percent (36,300 gallons/ day) would be pumped off the barges and would require treatment. The decant water is expected to contain suspended and dissolved constituents. The water will be pumped out of the barges with submersible pumps mounted on a hydraulic excavator or HIAB crane system and stored in temporary onsite storage tanks until removed and transported offsite. The stored water will be transferred into trucks and/or rail for transport to a permitted wastewater treatment and discharge facility (i.e., Clean Harbors of CT, Inc., or Clean Harbors of Baltimore, Inc). In order to reduce TSS concentrations to less than 1 mg/L TSS, wastewater will be settled and/or be filtered prior to being transferred into trucks for offsite disposal.

6.2.2 Material Off-Loading

The RM 10.9 dredged material will be transferred from the barges to the sediment treatment facility with a long-reach excavator equipped with a 4.5 yd^3 hydraulic clamshell bucket. Upon arrival at the facility, each loaded barge will be moored securely against the dock using a series of winches and cables. A spill protection plate, which reaches between the work barge and the offloading platform and is a permanent part of the process system, will be deployed. The spill plate will be deployed under the excavator bucket and tilted toward the barge so that any material spilled during offloading will flow back into the barge. The spill plate will be scraped and washed routinely to prevent buildup of material.

The unloading rate for a 250 yd^3 barge is anticipated to be approximately 1.8 hours (108 minutes). The parameters used to estimate the unloading rate are provided in **Table 6-1** and include debris removal, the time required to remove excess water, and the time to resolve potential logistical issues.

TABLE 6-1
Barge Unloading Rate Parameters (250 yd^3 Capacity)
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Parameter	Value
Bucket size	4.5 yd^3
Average fill capacity per bucket grab	80%
Average bucket cycle time[a]	40 seconds
Average time to remove excess water[b]	30 minutes
Average time to remove large debris	30 minutes
Average time to unload remaining sediment within barge[c]	33 minutes
Average time to shift barge	15 minutes
Total time to unload barge	**108 minutes**

[a] Based on visual observations.
[b] Assumes 90% of excess water (70 of 78 yd3) will be removed from barge.
[c] Assumes an average of 180 yd3 of sediment/excess water requires removal.

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6.2.3 Material Separation

The offloaded sediment will be placed in a feed hopper where the material over 4 in. will be separated with a vibrating grizzly screen. The oversize material will be transferred to a segregated storage area/facility where it will be chemically characterized for offsite disposal designation. The undersized material will be transferred via a conveyor belt to the pug mill system for stabilization. For the purposes of the design it assumed that the dredged sediment will contain 5 percent (by volume) material over 4 in. (See **Section 8** for a discussion of Toxicity Characteristic Leaching Procedure (TCLP) values that show these sediments do not qualify as characteristic hazardous wastes.)

6.2.4 Stabilization

The screened material will be stabilized in a pug mill system with Portland cement. The sediment will be weighed on the conveyor and approximately 10 percent (by weight) Type I/II Portland cement will be added to the material prior to its entering the pug mill. The percent of Portland cement added to the sediment will be adjusted as necessary in order to ensure the final cured sediment meets the paint filter test (USEPA Method 9095A) and yields a non-plastic material as defined by American Society of Testing Materials (ASTM) D4318. The mixing residence time will be sufficient to ensure that the materials are completely mixed prior to exiting the pug mill. The treated sediment will be transferred to the storage area/facility via a stacker conveyor system. The treated sediment will be held onsite for a minimum of 2 days to ensure that the material has properly cured prior to being loaded into trucks for offsite disposal.

6.2.5 Material Storage

The debris, oversize material, and treated sediment will be stored onsite in a dedicated storage area or bin until characterized for offsite disposal. The storage areas will be sized to store between 2,000 to 3,000 yd^3 of stabilized sediment. Debris will be segregated from the sediment in a separate area or within roll-off containers. Once the appropriate disposal facilities for debris and treated sediment have been identified, they will be loaded into trucks for offsite transportation.

6.2.6 Water Treatment

Water decanted from the barges prior to the stabilization process will be stored in tanks onsite and transported offsite for treatment at a commercial industrial wastewater facility. The barge water is expected to contain some suspended and dissolved constituents.

The water will be stored onsite until removed and transported offsite by truck and/or rail for treatment and discharge at a permitted wastewater treatment facility (i.e., Clean Harbors of CT, Inc., or Clean Harbors of Baltimore, Inc.). Residuals from the onsite storage or treatment will be managed along with the RM 10.9 sediment. The details of the water treatment system will be provided once the transportation and disposal contractor has been selected.

6.3 Waterside Site Requirements

Because the existing sediment stabilization facilities being considered are currently in operation, all required infrastructure and utilities are already in place. However, prior to receiving the dredge material the facility is required to receive an Acceptable Use Determination (AUD) from the NJDEP. Additional operational requirements for stabilization of the material may be required under the AUD.

6.4 Hours of Operation

There are no restrictions for the stabilization operations, so it is assumed to be a 12-hours-per-day, 6-days-per-week operation. One day per week will be reserved for maintenance activities. However, the stabilization facility will be capable of receiving barges 24-hours per day.

6.5 Environmental Constraints

Sediment stabilization will be undertaken in a manner that will minimize impacts on water quality, air quality, and

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noise. These operations will be conducted and monitored in accordance with applicable laws and regulations. All administrative and substantive aspects of the regulations will be complied with, and necessary permits will be obtained. These will be in accordance with the facilities' existing permits and monitored according to applicable statutory guidelines.

6.6 Sediment Stabilization Monitoring

If required, monitoring procedures will be developed once a stabilization facility has been selected and an AUD has been provided by the NJDEP. At this time it is not anticipated that any additional operational monitoring will be required.

6.7 Operability, Reliability, and Maintainability

The operability, reliability, and maintainability of the sediment stabilization process will be sustained by using modularized equipment and have sufficient storage onsite to ensure that production is not halted by a mechanical failure during operations.

- Maintenance is assumed to require 1 day per week.
- Average operational uptime of unloading facilities is typically 90 percent.

6.8 Project and Community Health and Safety

The project specific and a community health and safety plan will include the sediment stabilization process and operations. The stabilization facilities are operating facilities and have health and safety programs to address potential occupational health issues associated with the process. A Project specific Health and Safety Plan (**Appendix F**) has steps to review these facility plans. The stabilization facilities are operational and so potential impacts to the local community have been taken into account through the permitting process of the facilities. Changes in processing and handling related to this project, if necessary, will be addressed and included in both the project specific HASP as well as the Community Health and Safety Plan when and if identified. A Community Health and Safety Plan has been developed in conjunction with the appropriate government agencies and stakeholders. A Final plan is provided in **Appendix G**.

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SECTION 7

7 Capping

7.1 Design Criteria

The main objective of the sediment cap is to protect human health and the environment. This will be achieved through the placement of a cap which includes both active containment and erosion protection (armor) layers to chemically/physically isolate and sequester the transport of particulates and dissolved constituents from the underlying contaminated sediment into the water column.

To ensure the cap will be protective of current and future conditions, the design of the chemical containment layer is based on site-specific values for key parameters and computer modeling to simulate the cap's chemical containment processes and evaluate long-term cap performance.

The cap system was designed to meet the following physical and chemical performance criteria:

- The armor layer will be physically stable under flow of 22,000 cfs, which is a 100-year return period flood flow.
- The armor layer will prevent the sand/active layer from being disturbed by ice, bioturbation, and effects of consolidation.
- The cap will be resistant at all depths to forces resulting from expected propeller scour (recreational boating; no commercial traffic).
- The sand/active layer will prevent the breakthrough of 2,3,7,8-TCDD, PCBs, and mercury for at least 100 years. New Jersey Surface Water Quality Standards NJAC 7:9B (Fresh Water Criteria for Human Health) were used for the evaluation criterion.

Other key design considerations are as follows:

- There is recreational boating, but no large commercial vessels operating adjacent to RM 10.9.
- Ice scour is assumed to have a minimal impact on the cap based on the lack of historical evidence of ice scour in the LPR at or near RM 10.9.
- Cap is located adjacent to, not within, the federal navigation channel.
- Design Darcy velocity (upwelling velocity) is based on RM 10.9 site-specific measurements from the field seepage tests.
- Design COPC pore water concentrations are based on pore water concentrations that have been collected from RM 10.9 sediment samples.

7.2 Cap Design

A cap will be placed over the post-dredge sediment surface to physically and chemically isolate the remaining contaminated sediment from the environment by means of physical containment, chemical containment, and erosion protection. The cap design incorporates several aspects of the physical environment including water body dimensions, depth and slope of the sediment bed, flow patterns, and potential disturbances such as ice scour. The cap also prevents against bioturbation and the effects of consolidation, which will ensure its integrity over time.

The design of the chemical containment layer and protection from erosion and bioturbation are described in this section and follows guidance provided in the "Guidance for In Situ Subaqueous Capping of Contaminated Sediments" (Palermo et al., 1998), and "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites" (USEPA, 2005). The general sequence of steps is as follows:

1. Establish cleanup objectives/performance criteria.

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2. Characterize the contaminated sediment (horizontally and vertically) including physical, chemical, and biological characteristics.
3. Make a preliminary determination on the feasibility of in situ capping based on information obtained about the site and sediment.
4. Identify potential sources of capping materials, including commercial sources for sand, gravel, and stone.
5. Design the cap composition and thickness for both short and long-term chemical isolation of contaminants, bioturbation, consolidation, erosion, and other pertinent processes.
6. Select appropriate equipment and placement techniques for the capping materials.
7. Evaluate if the capping design meets the cleanup objectives/performance criteria.
8. Develop an appropriate monitoring and management program to include construction monitoring during cap placement and long-term monitoring following cap placement.
9. Develop cost estimates for the project to include construction, monitoring and maintenance costs.

7.2.1 Final Active Layer Cap Design

The site-specific data collected by the CPG for pore water concentrations and groundwater flux were used to develop the final design of the active layer of the cap. The steps involved in developing the final active layer design include the following:

1. Measure site-specific pore water concentrations.
2. Measure site-specific Darcy velocity.
3. Identify active cap layer material options.
4. Run CapSim model (version 2.6; Reible 2012) with site-specific data to predict breakthrough (breakthrough criteria are the New Jersey Surface Water Quality Standards) for various thicknesses and configurations of active cap materials (further details regarding the CapSim Model are provided in **Section 7.2.2.1**).
5. Screen CapSim model results for breakthrough of no less than 100 years for 2,3,7,8-TCDD, PCB-52 (surrogate for total PCBs), phenanthrene (surrogate for total PAHs), and mercury (further details regarding the CapSim Model are provided in **Section 7.2.3.1**).
6. Identify optimal thickness and configuration of active cap layer material resulting in a breakthrough of no less than 100 years.
7. Consider installation feasibility in recommending thickness and configuration of active layer.

7.2.2 Chemical Containment

Preliminary chemical containment modeling using estimated parameters indicated that a sand-only cap would not provide effective chemical containment at RM 10.9 because of COPC concentrations remaining following dredging and groundwater upwelling through the sediment. Therefore, an active cap layer amended with chemical sequestering amendments will be incorporated into the cap to chemically isolate the contaminated sediment from the environment. The specific amendment, activated carbon, will be mixed with sand rather than being placed as a separate layer to create more favorable conditions for adsorption and isolation of COPCs.

7.2.2.1 Cap Performance Model

The numerical model CapSim (version 2.6; Reible 2012) was used to predict the potential transport of select COPCs through the active cap using site-specific values for key input parameters. The CapSim model estimates pore water concentrations through and above the various cap layers, which are influenced by contaminant migration from the sediment below the cap (i.e., the sediment remaining after dredging). Four COPC groups, characterized by a representative chemical constituent, were included in the CapSim modeling activities: dioxins/furans (2,3,7,8-TCDD), total PCBs (PCB-52), PAHs (phenanthrene), and mercury. The representative chemical constituent for each COPC group was selected for its toxicity and/or mobility. Phenanthrene was

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selected as a representative constituent to characterize PAH transport through the cap based on its lower molecular weight and moderate sorption capacity in sediment. These properties make phenanthrene more mobile compared to the heavier and stronger sorbing PAHs, thereby providing a potential breakthrough indicator compound for long-term cap monitoring.

Conservative estimates of mercury transport were modeled based on activated carbon partition coefficients provided by Dr. Upal Ghosh (personal communication, Ghosh, 2012) and site-specific pore water concentrations for total dissolved mercury. Site-specific mercury speciation results indicate that the levels of methyl mercury were less than 10 percent of the total mercury in the pore water and therefore methyl mercury was not modeled independently from total mercury.

Although the design criteria was finalized for a period of 100 years, the effectiveness of the cap remains greater than 250 years and even longer for the strongly adsorbing constituents including dioxin. Summaries of the final CAPSIM model runs are presented in **Appendix C**.

7.2.2.2 Supporting Field Activities

To provide site-specific input parameters for the chemical containment numerical modeling, field activities were conducted to collect sediment cores for extraction of pore water and groundwater flux through the sediment was measured as presented below.

Sediment Cores for Pore Water Extraction

Pore water generated from site sediment was analyzed for select COPCs. Sediment cores were collected from within the Removal Area to obtain sediment representing the material remaining after dredging (i.e., from 2 to 4 ft below the mud line). Core locations were targeted to generate pore water with the highest COPC concentrations as determined from sediment concentrations measured during the 2011 RM 10.9 Characterization Program. The cores were sent intact to the laboratory for extraction of pore water via centrifugation and subsequent analysis of dioxin/furan congeners, PCB congeners, PAHs, and mercury speciation.

The total number of sediment cores collected in the field provided sufficient sediment volume to prepare three composite pore water samples for the organic COPCs and two pore water composites for the mercury samples. Excess pore water available after the preparation of the primary composite samples was used to generate field duplicates. Results are summarized in **Table 7-1**. The average pore water concentrations for each COPC, which are based on composites that were generated from sediments collected from conservatively biased locations (i.e., high concentration areas), were used in the CapSim model simulations.

TABLE 7-1
Site-Specific Composite Pore Water Concentrations
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Chemical	Units	Minimum	Maximum	Average
2,3,7,8-TCDD	µg/L	0.0042	0.0052	0.0046
Total PCB Congeners	µg/L	11.2	16.3	13.9
Total Dissolved Mercury	µg/L	0.0012	0.0028	0.0020
Phenanthrene	µg/L	0.69	1.7	1.3
Dissolved Organic Carbon	mg/L	81	129	95

Groundwater Seepage Velocity

Direct measurements of groundwater flux through the sediments in the RM 10.9 Removal Area were obtained through the temporary installation of ultrasonic seepage (UltraSeep) meters. UltraSeep meters perform time

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series flow rate measurements, which capture both positive and negative discharge at the surface water–sediment interface. The UltraSeep meters were installed at the four monitoring locations shown in **Figure 7-3** (along the -4 ft elevation contour) and continuously monitored seepage velocity for approximately 3 days.

The measured seepage velocities for Stations 1 through 4 were 215, 942, 26, and 73 cm/year, respectively. The average seepage rate for all 4 stations, 314 cm/year, was used in the CapSim modeling to determine the active layer thickness. The maximum seepage velocity was observed from the station located in an area with higher sand content and lower COPC concentrations; the model was run using pore water generated from high COPC concentration sediments. The areas with elevated COPC concentrations in the RM 10.9 sediments are generally associated with the finer grained materials that yield lower seepage velocities. Thus, using the average seepage velocity for the CapSim model run gives a conservative result as the model utilizes pore water concentrations generated from sediments in areas that would have low seepage velocities and high COPC concentrations (i.e., areas with predominantly fine-grained silts and clays).

7.2.3 Cap Armoring

An armor layer is required to prevent erosion of the cap material during high river flows or because of other environmental forces. These erosive forces preclude the use of enhanced nature recovery via thin-layer capping. The armor layer design is based on a flow of 22,000 cfs which is the 100-year return period flood flow, as noted previously. Use of the 100-year return period flood for the design is consistent with recommendations in USEPA (2005) guidance and other cap designs (e.g., Hudson River); however, the cap is expected to remain generally intact even if the 100-year return period flow is exceeded. The velocity and associated erosive forces across the River are not uniform; the highest velocities used for design impact occur over only small portions of the cap. Thus, the vast majority of the cap is expected to withstand flows that are higher than the 100-year return period flood. At USEPA's request, the impact of designing for a more intense storm was also evaluated. The velocities and water depths associated with a 32,000 cfs, 500-year return period flood were utilized for that evaluation. The long-term monitoring of the cap will include event-based monitoring that will inspect the cap's physical integrity following large flow events such as the 25-, 50-, and 100-year return period flows.

Vessel traffic in the area of the site is consists largely of recreational boating. It is assumed that the effects of propeller wash associated with maneuvering larger commercial vessels will not be an issue with this site and that breaking waves along the shoreline due to boat wakes will be negligible compared to erosive forces during flood flows. The Draft Focused Feasibility Study (MPI, 2007) discusses ice scour as follows:

> A limitation in colder regions is the potential erosion of a cap due to ice jam formations. According to the Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database, there have been three ice jam events recorded in the Passaic River at Chatham, New Jersey in the freshwater section of the river. Although ice forms in the Lower Passaic River, no records of ice jams were found in the Area of Focus. Therefore, cap erosion due to ice jams is not considered a major concern for the Area of Focus. Although ice scour at the shoreline could be an issue, it could be mitigated via biostabilization or installation of armoring materials at the shoreline.

Chatham is located in the Upper Passaic above Little Falls in Paterson, which is not near RM 10.9. Based on the lack of historical evidence of ice scour in the LPR and the substantial armoring that will be used to protect the cap from erosion during high river flows, no additional provisions are included to protect the cap from ice scour other than increasing the armor stone's size and layer thickness in the shallower depths to account for any shoreline impacts from ice formation.

7.2.3.1 Preliminary Armor Layer Sizing

Preliminary armor cap sizing was performed using methods presented in Palermo et al. (1998) based on water velocities and depths determined through three-dimensional (3D) hydraulic modeling of the 100-year return period flow and using the following equation to calculate the D_{50} armor stone size:

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where:

D_{50} = characteristic stone size of which 50 percent is finer by weight
S_f = safety factor, minimum = 1.1
C_s = stability coefficient for incipient failure (0.30 for angular rock, 0.35 for rounded rock)
C_v = vertical velocity distribution coefficient
C_T = thickness coefficient = 1.0 if thickness = D_{100}(max) or 1.5D_{50}(max)
C_G = gradation coefficient = $(D_{85}/D_{15})^{1/3}$

D_{85}/D_{15} = gradation uniformity coefficient (typical range = 1.8 to 3.5)

d = local water depth
$\tilde{a}_w$ = unit weight of water (assumed 62.4 lb/ft^3)
$\tilde{a}_s$ = unit weight of stone (assumed 165 lb/ft^3)
V = local depth averaged velocity
K_1 = side slope correction factor (assume 1.0 for flat bottom)
g = gravitational constant

Results from the 3D hydraulic modeling were used to determine depth averaged velocities and local water depths over the area of the site for the design flow. These results are shown in **Figures 3-4** and **3-5**, respectively. Armor size was calculated for combinations of water depth and velocity for each model cell within the footprint of the Removal Area downstream of Station 32+00.

It was assumed that the armor layer consists of angular rock (C_s = 0.3) with a gradation such that D_{85}/D_{15} = 2.5. Rounded rock and a more well-graded layer would result in greater stone size requirements and therefore, depending on the source of stone used, recalculation of rock size may be necessary. The vertical velocity coefficient, C_v, was assumed to be 1.0, as recommended for locations on the insides of bends, and the thickness coefficient (C_T) was set to 1.0.

The side slope correction factor, K1, can be calculated as:

where:

K_1 = side slope correction factor
Θ = bottom slope angle
φ = angle of repose (assumed 40 degrees)

Initial calculations assumed a K_1 value of 1.0 consistent with a flat bottom. Review of cross sections through the proposed cap downstream of Station 32+00 showed slopes of the cap resulting of K_1 values of 0.93 and greater and had no impact on calculation of recommended armor sizes in this area.

Table 7-2 summarizes results of armor size calculations for the 100-year return period flow and presents the maximum calculated required armor size for the areas within the Removal Area downstream of Station 32+00 defined by the given bottom elevation ranges. Based on these results, an armor layer with a D_{50} of 4.5 in. (Armor Stone Type A) is suitable in areas deeper than the -3.0 ft bottom surface elevation contour and an armor layer with a D_{50} of 2 in. (Armor Stone Type B) would be suitable in areas shallower than the -3.0 ft contour.

TABLE 7-2
Maximum Calculated Median Armor Stone Size vs. Bottom Elevation

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RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Bottom Elevation (ft)	Maximum Calculated D_{50} (in.)
< -6.0	4.1
-6.0 to -5.0	3.3
-5.0 to -4.0	3.0
-4.0 to -3.0	2.6
-3.0 to -2.0	1.9
-2.0 to -1.0	1.4
-1.0 to 0	0.9

Palermo et al. (1998) recommended an armor layer thickness as the maximum of $1.0D_{100}$(max) or $1.5D_{50}$. It is also recommended that the layer thickness be increased by 50 percent for underwater placement. Based on these recommendations, the minimum thicknesses of Armor Stone Types A and B are calculated to be 10 in. (below elevation -3.0 ft) and 4.5 in.(above -3.0 ft), respectively. However, in order to simplify cap placement, the use of Armor Stone Type B has been eliminated in this design, and the entire cap will utilize Armor Stone Type A. The average thickness of the cap's armor stone layer will be specified to be 12 inches. Increasing the armor stone's size and layer thickness in the shallower depths (i.e., replacing the Armor Stone Type B layer with the larger-sized and thicker Type Armor Stone A layer) will also mitigate shoreline impacts from ice formation.

If a 500-year return period storm were to be used to design the cap, the minimum D_{50} for Armor Stone Types A and B would be 7 in. and 4 in., respectively. The calculated minimum thicknesses of the Armor Stone Types A and B layers would be 16 in. and 9 in., respectively. The corresponding average cap thicknesses would be specified as 18 in. and 12 in., respectively.

7.2.4 Physical Separation and Stabilization Layers

Sand will be mixed with the active material to form a combined sand/active layer. A combined sand/active layer provides a more efficient use of active material than separating the sand and active layers as chemical diffusion within the combined sand/active layer is slower than within two separate layers. A geotextile will be placed between the sand/active layer and the armor layer. The function of the geotextile is to protect the sand/active layer during placement of the armor layer and prevent the sand/active layer from being eroded or gouged by the protective stone layer. The geotextile, in addition to the armor stone layer, acts as a bioturbation barrier—preventing burrowing benthic organisms from passing into the sand/active layer and the underlying contaminated sediment.

7.2.5 Design Cap Plan and Sections

The cap plan is shown in **Figure 7-4**. The area to be capped extends only to 32+00. Upstream of this point, from Station 32+00 to 37+50, the sediment surface slopes at greater than 3:1 (see **design drawings sheets C-18, C-19, and C-20**), which is too steep to effectively cap. As a result, the soft sediment in this area will be removed in entirety. Following removal of the soft sediment additional sampling will be conducted to document the COPC concentrations of the noncapped surface.

The typical example design cap section is shown in **Figure 7-5**. The nominal thickness of the cap section is 22 in., which consists of 12 in. of armor stone plus a sand/active layer thickness of 10 inches.

7.2.6 Post-capping Habitat

Placement of the cap will consolidate the underlying soft sediment, as the cap weighs more than the sediment removed during dredging. The amount and rate of consolidation is dependent on the sediment characteristics and thickness and the weight of the cap versus the sediment removed. Based on experience at other alluvial sandy

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capping locations, up to several inches of consolidation are anticipated, with most of the consolidation typically beginning immediately after cap placement and occurring in the first year. Most of the cap will be submerged, even at low tide (see **Figure 7-4**). The top of the armor layer will be an average of approximately 2 in. less than the current sediment surface prior to sediment consolidation.

Following placement of the armor stone, sand will be placed over the stone to fill in the spaces between the stones to create a smooth surface on the top of the armor layer. Thus, the volume of sand added to the top of the armor stone will not result in any increase in the armor layer's calculated volume. This sand will be placed such that the average top of cap elevation is approximately 2 in. less than the original sediment surface elevation. The shape of the armor stone (i.e., angular versus rounded) will have limited impact on the new habitat because the stone will be buried by the sand . Thus, there is no advantage to the habitat in using rounded stone for the armor layer. As noted in **Section 7.2.3**, the armor and geotextile will create a barrier to bioturbation reaching the contaminated sediment and sand/active layer.

7.3 Cap Materials

The cap's active material will be AquaGate™, which are composite particles manufactured by AquaBlok® and contain 10 percent activated carbon (by weight). The AquaGate™ material will be mixed with sand to form a combined sand/active layer containing 25 percent AquaGate™ and 75 percent sand by volume. The design sand gradation is shown in **Table 7-3**. This sand material meets a more restrictive standard than the ASTM C33 gradation for fine aggregates because it reduces the #200 sieve from 0–3 percent to 0–1 percent passing. The reasons for this material selection are as follows:

1. It is readily available as concrete sand (i.e., sand for making concrete) that has been additionally washed to reduce the fine content.
2. Its medium-coarse nature allows it to be readily cast by either broadcast spreading equipment or clamshell.
3. Less fines content minimizes material loss and associated turbidity during placement activities.

The geotextile material between the sand/active layer and armor stone will be a nonwoven 100 percent plastic high-strength dimensionally stable filter fabric. It will be designed so that the average opening size, permeability, permittivity, UV resistance, thickness, strength, and elongation properties meet ASTM criteria according to the site conditions and materials. Engineering properties of geotextile are presented in **Table 7-4**.

TABLE 7-3
Sand Gradation (Modified ASTM C33 Fine Aggregate)
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Sieve Size	% Passing
3/8 in.	100
#4	95–100
#8	80–100
#16	50–85
#30	25–60
#50	10–30
#100	2–10
#200[a]	0–1

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[a] Specification for passing #200 sieve reduced from 0 to 3 percent to 0 to 1 percent for ASTM C33 Fine Aggregate.

TABLE 7-4
Geotextile Properties and Applicable Standards
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Property[a]	Test Method	Units	MARV[b]
Grab strength	ASTM D 4632	N	1400
Sewn seam strength[c]	ASTM D 4632	N	1260
Trapezoidal tear strength	ASTM D 4533	N	500
Puncture strength	ASTM D 6241	N	2750
Permittivity	ASTM D 4491	sec^{-1}	0.5[d]
AOS	ASTM D 4751	mm	0.5[d,e]
UV stability (retained strength)	ASTM D 4355	percent	50 (after 500 hours)

AOS, apparent opening size; UV, ultraviolet; N, newton; mm, millimeter; sec, second.
[a] AASHTO Standard Specification M 288, Type 1 geotextile for erosion control, separation, and survivability.
[b] Minimum average roll value in weaker principal direction, except as noted otherwise.
[c] If sewn seams required; otherwise overlap.
[d] AOS and permittivity are perpendicular to plane of geotextile.
[e] AOS is maximum size allowed.

The 12-inch-thick armor stone layer will have a D_{50} of 4.5 inches.

The active layer materials will be procured from a specialty company and with certifications of the material composition. Sand and armor material will be procured from local/regional vendors of this type of material. The selection of the vendor will include an evaluation of the vendor's operations to ensure the material is free of contaminants. This evaluation will be included as part of the Construction Quality Control Plan (**Appendix I**).

The quantities of cap materials, which were estimated using plan projection and average end area methods, are summarized in **Table 7-5**. The volume of cap materials to be placed is calculated to be approximately 14,500 yd^3, which is less than the approximately 16,600 yd^3 of sediment to be removed in the capped area. Therefore, the net impact of the RM 10.9 Removal Action will be to reduce the volume of materials in the LPR (i.e., no net fill), while maintaining the approximate existing sediment surface profile. No net fill is a requirement of the Flood Hazard Area Control Rules (N.J.A.C. 7:13), which are intended to prevent actions that would exacerbate flooding in flood hazard areas. Placement of the cap materials will also consolidate the underlying sediment, thereby further reducing the apparent volume of the capping materials.

TABLE 7-5
Material Quantities
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Material	Units	Quantities

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10 in. thick sand/active layer	ft^2	213,221
	yd^3	6,581
Geotextile	ft^2	213,221
Armor stone	ft^2	213,221
	yd^3	7,897
	tons[a]	11,846-
Sand covering armor stone	ft^2yd^3	213,221[b]

[a] Tons estimated at rate of 1.5 tons per cubic yard.
[b] Volume included in neat line calculation of armor stone volume.

7.4 Cap Materials and Transport

The cap materials may be transported to the capping contractor's staging area via truck or barge and will be delivered to the RM 10.9 Removal Areas by barges.

Therefore, material transport operations will be constrained by the vertical and horizontal clearances of several bridges located between the capping material staging area and the removal site. As discussed in **Section 4.3.5** these clearances are directly affected by the tidal fluctuations and river stage. Material transport is assumed to be a 24-hour/day operation to accommodate expected logistical constraints related to barge and equipment coordination, and tidal limitations for under-bridge passage. The maximum vertical clearance and passage time are determined by low tide conditions and the allowable time to safely clear the constraining bridges between RM 4.75 and RM 6.07. The tugs/work boats will be sized so that they are not a constraint on the dredging operations.

7.5 Cap Placement Equipment

The cap placement activities are assumed to occur from equipment located on barges with material supplied by material barges; however, determination of the actual equipment to be used will be the responsibility of the selected cap placement contractor.

The AquaGate™ material will be placed with the sand as a combined layer from a barge by a conveyor. The combined sand/active material will be placed in layers to minimize disturbing the sediment and, thus, minimize intermixing the sand/active material and sediment.

The geotextile between the sand/active layer and the armor stone will be unrolled onto the sand/active layer surface by a crane on a barge. Armor stone will be placed by a clamshell bucket from a barge.

7.6 Cap Placement

7.6.1 Placement Thickness Criteria

The minimum and average thicknesses of the sand/active layer are 8 in. and 10 in., respectively. The minimum and average percentages of active material (i.e., AquaGate™ composite particles containing 10 percent activated carbon (by weight)) within the total sand/active layer are 25 percent and 30 percent by volume, respectively. The minimum and average thicknesses of the armor stone layer (Armor Stone Type A) are 10 in. and 12 in., respectively.

7.6.2 Placement Accuracy and Tolerance

Specifications for placement accuracy and tolerances of the cap's sand/active and armor layers are based on the cap design for the Lower Fox River Operable Unit 1 (CH2M HILL et al., 2008). The placement accuracy for and tolerance specifications of the capping layers is provided in **Table 7-6**.

TABLE 7-6
Cap Layer Thickness Requirements

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Cap Layer	Minimum Thickness (in.)	Minimum Average Thickness (in.)
Combined Sand/Active	8	10
Armor Type A	10	12

The applied thickness of the sand/active layer will be monitored during and post-construction via push cores. The actual percentage of active material in the sand/active layer will be monitored during placement by measuring the proportion of active material added to the sand as it is being placed. Details of this measurement system will be developed in conjunction with the capping contractor's work plan and will be included in the Construction Quality Assurance Plan. The armor layer will be monitored during and after construction using gauge sticks and/or buckets. These physical measuring devices will be placed on the surface of the underlying layer prior to application of the material in the layer being constructed.

The statistical criterion for determining whether the minimum thickness has been achieved is as follows: the probability of applied thickness being met in less than 80 percent of the capped area is no more than 10 percent. An example of how the statistical criterion is applied is provided in **Appendix C**.

7.6.3 Placement Rate

Placement of sand on the Hudson River with clamshell buckets of 1 to 3 yd^3 averaged approximately 40 yd^3/hr (Louis Berger Group, 2010). Broadcast spreaders have achieved a sand placement rate on the order of 70 yd^3/hr on larger scale projects. A placement rate of 40 yd^3/hr is expected for the RM 10.9 Removal Area because of the relatively small scale of the project, the impact of the tidal cycle on operations, and expected use of a conveyor for placement. The armor stone placement rate is expected to be 40 yd^3/hr for a 3 yd^3 bucket.

7.6.4 Placement Sequence

The cap will be placed following completion of the dredging to control residuals generated during dredging and minimizing the risk of contaminating the clean cap material. The sediment that is uncovered during dredging does not have significantly different concentrations of COPCs or physical characteristics than the existing surficial sediment; thus, there is no additional risk to the environment or cap stability from the newly exposed sediment. The physical constraints of the site make it difficult to have both dredging equipment with material barges and capping equipment with material barges operating at the same time. The cap will be placed as soon as practical after the dredging operations have been completed.

7.6.5 Hours of Operation

Placement of cap materials is assumed to take place 12 hours per day or during daylight hours only, whichever is less. Capping operations will take place 6 days per week, with the seventh day reserved for maintenance activities.

7.6.6 Operability, Reliability, and Maintainability

Operational uptime for the capping activities is typically expected to be in the range of 70–80 percent. However, the relatively small area to be capped may result in a lower effective uptime because mobilization and other essential, but nonproductive, activities take a greater proportion of time on smaller projects such as this one than on larger projects.

7.7 Waterside Site Requirements

The capping contractor will be required to provide their own waterside site(s) as necessary to implement the capping activities, including land with marine access for staging/temporarily stockpiling and loading and transporting cap materials and capping equipment. However, an area may be available adjacent to the site for construction support trailers.

7.8 Environmental Constraints

The environmental impacts from the cap placement activities will be mitigated by the design requiring that control procedures be incorporated into the cap placement activities.

7.8.1 Water Quality

Turbidity management for capping activities will consist of removing most of the turbidity-causing fines from the capping materials before they are placed in the LPR. This approach has been effectively used on other capping projects (Foth et al., 2009) and is much more effective than attempting to control the fines after they occur as turbidity in the LPR. The fines are minimized in the sand capping materials by specifying a low fine content, which can be achieved by additional washing of the sand by the sand supplier.

The cap placement operation is not expected to generate significant turbidity or promote further disturbance of the post-dredge sediment surface. The sand/active material layer will be carefully placed over the post-dredge surface to minimize disturbing and resuspending the sediment. Once the sand/active material layer has been placed, no significant sediment resuspension will occur. Turbidity generated by sand/active material placement will be minimized by reducing the fines in the sand cap material. No significant fines are associated with the AquaGate™ material, so no appreciable turbidity would be generated by their placement. No turbidity-generating fines are associated with the geotextile material that is placed above the active layer. The cap armor stone will be relatively free of fines and, therefore, will not generate an appreciable amount of turbidity during placement. No other water quality impacts related to the cap placement operation, except those associated with equipment movement, are anticipated.

The water quality monitoring requirements established for the dredging operations (**Section 4.6.1**, Water Quality) will also be followed during the capping activities. As with dredging, BMPs and control measures will be used during cap placement to further minimize any increased turbidity. These BMPs may include the following:

- Utilizing proper placement techniques for capping materials
- Specifying washed sand materials to minimize fines content prior to placement
- Avoiding grounding of marine vessels and allowing water levels to rise before attempting to free grounded vessels
- Minimizing the number of trips by support vessels
- Restricting the draft of workboats and barges
- Restricting navigational speeds
- Restricting the size and power of workboats

7.8.2 Air Quality

Dust generation from the capping activities is not expected because the capping materials (e.g., extra-washed sand) will not contain appreciable amounts of fine particles, and the cap itself will be placed on the sediment beneath the water surface.

No odors are expected from the capping activities because none of the capping materials (i.e., sand, stone, geotextile, and AquaGate™) have odors associated with them. Cap placement will occur below the water surface after dredging has occurred. The AquaGate™ material will be placed over the sediment surface while minimizing disturbance to the underlying sediment and, therefore, any potential release of odors from the sediment.

7.8.3 Noise

All capping activities will be completed in such a manner that the noise levels do not exceed the maximum noise contribution limits established for the project. Placing stone for the cap's armor layer will unavoidably generate noise as this material is loaded and unloaded into and from the material supply barges and by handling with the cap placement equipment. The noise generated by the cap placement operations will be restricted to the

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placement operation hours (i.e., daylight hours or 12 hours per day, whichever is less) and will be compliant with the noise requirements described in **Section 2.0**. As described in **Table 2-2,** NJAC 7:29 is considered relevant and appropriate, although this type of activity does not fit the definition of a regulated activity under that rule. The capping will be conducted to target achieving the noise limitations stated therein. The noise-monitoring program established for dredging operations will also be utilized for the capping activities see **Table 4-7**.

7.9 Project and Community Health and Safety

A project-specific health and safety plan and a community health and safety plan were developed to include the capping and in-river capping material transport operations. A number of potential occupational health issues are associated with the proposed dredging operations that are addressed in the Project Health and Safety Plan (**Appendix F**). The capping and material transport operations have the potential to impact the local community surrounding the capping operations and possible up and down the river. It is very important that the community is informed of the work to be completed and the plans in place to protect the public during these activities. A community health and safety plan has been developed in junction with the necessary agencies and public groups. A draft of the plan is provided in **Appendix G**.

7.10 Long-Term Cap Monitoring and Maintenance Plan

A plan for long-term post-construction cap monitoring and maintenance and the associated QAPP Addendum are included as **Appendix J.** The objective of the monitoring will be to identify and evaluate changes in the physical or chemical properties of the cap that would significantly reduce its protectiveness. No aspect of the cap design needed to be modified to accommodate the LTMMP's monitoring requirements.

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SECTION 8

8 Overland Transportation and Offsite Disposal

8.1 Design Criteria

A transportation and disposal contractor will be acquired by means of a request for proposal and evaluated using a cost/technical trade-off approach. The contractor will be selected based on corporate experience, experience of key personnel, technical and managerial capabilities, record of past performance, and cost.

The dredged sediment will be transported to a permitted waterside stabilization facility where it will undergo stabilization prior to transport to an out-of-state Subtitle C landfill, as described in **Section 6**.

8.2 Regulatory Guidelines

The RM 10.9 Sediment characterization determined that the sediment is not RCRA hazardous and that PCB concentrations are below the TSCA regulatory threshold of 50 ppm. However, the RM 10.9 Removal Action is a CERCLA action and involves the offsite transfer of any hazardous substance, pollutant, or contaminant (CERCLA wastes). Therefore, the Off-Site Rule (OSR) (40 CFR 300.440) is applicable. The OSR requires CERCLA wastes to be placed only in a facility operating in compliance with RCRA or other applicable federal or state requirements. Sediment profiles will be submitted to commercial offsite sediment management facilities for their acceptance. Such facilities will be appropriately permitted, will have positive compliance records, and will be approved by the USEPA OSR coordinator for OSR compliance. A New Jersey AUD will be obtained for management of the dredge material, including its acceptance at either the Jay Cashman dredged material processing facility in Elizabeth, NJ (which is on Arthur Kill and within the Newark Bay Study Area) or at the Clean Earth/Koppers processing facility on the Hackensack River, which is outside of the LPRSA and the Newark Bay Study Area).

Several ARARs listed in **Section 2.0** are applicable to management of the sediment removed for this project. These include the Clean Water Act, Rivers and Harbors Act, and New Jersey Waterfront Development Act, which encompasses Coastal Zone Management. All potential treatment options being considered in this design would be implemented at an existing commercial offsite upland facility with eventual disposal at an out-of-state existing commercial landfill. All applicable regulations, both substantive and administrative, will be complied with during the offsite management of the sediment; however, those requirements are not considered ARARs because they do not apply to onsite activities and therefore are not fully identified in this Removal Action design.

A hazardous waste is either a “listed” waste or a “characteristic” waste based on RCRA designation criteria. Contaminated environmental media are not hazardous waste but can become subject to regulation under RCRA if they “contain” hazardous waste. USEPA generally considers contaminated environmental media to contain hazardous waste (1) when they exhibit a characteristic of hazardous waste or (2) when they are contaminated with concentrations of hazardous constituents from listed hazardous waste that are above health-based levels.

In 2008, Region 2 prepared a memorandum for the Diamond Alkali Superfund Site file that discussed their consideration of the Passaic River sediment pursuant to RCRA 40 CFR Section 261.31. Region 2 reviewed historical information and consulted USEPA Headquarters Office of Solid Waste, and concluded that it did not have sufficient evidence to conclude that the sediment in the Passaic River contains “listed” hazardous waste per 40 CFR 261. Dredged material that is subject to the requirements of a permit that has been issued under Section 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. The New Jersey Water Quality Certification and AUD may address the transportation and disposal of this dredged material within New Jersey. However, if the sediment exhibits a characteristic of hazardous waste, it must be managed as though it were a hazardous waste. The decision tree for RM 10.9 sediment disposal is listed below:

- The sediment will be disposed of as if it were “characteristic” hazardous waste if sample results analyzed per TCLP (SW-846 Method 1311) for regulated constituents exceed the regulatory screening levels and if such samples are deemed to be representative of the sediment waste stream.

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- If the results for one or more underlying hazardous constituents exceed 10 times the Universal Treatment Standards (UTS), then the sediment must be treated before it can be disposed of in a landfill to meet the Land Disposal Restrictions (LDR) found at 40 CFR 268. Since the sediment being removed from the RM 10.9 Removal Area contains dioxins, the only treatment currently available to achieve the standards identified in 40 CFR 268.48 is incineration.

An initial screening was completed on the available Removal Area data. Samples submitted for TCLP analysis included two investigation-derived waste (IDW) characterization samples generated during the 2011 RM 10.9 Characterization Program and two composite samples collected during the bulk sediment and delineation sampling event in May 2012 (RM 10.9 QAPP Addendum A). None of the tested TCLP parameters exceed applicable RCRA threshold criteria for designation as hazardous waste. Additional details are provided below.

Five bulk sediment sampling stations for the bench-scale testing of sediment washing technologies and dewatering technologies were chosen based on review of the RM 10.9 analytical results. PCDDs/PCDFs as represented by 2, 3, 7, 8 TCDD, total PCBs, mercury, and PAHs were selected as having relatively elevated concentrations of these COPCs, in comparison to the other sediment in the RM 10.9 Removal Area.

Sampling depth was selected by reviewing how the average concentrations of the COPCs vary with depth for all stations located within the RM 10.9 Removal Area. Five stations were selected for sediment collection. Sampling locations within the RM 10.9 Removal Area were selected to correspond to the locations with the highest values of the COPCs encountered in the sediment to 3.5 ft in depth during the 2011 RM 10.9 Characterization Program. To select these locations, an average concentration for each of the four COPCs was calculated for each of the 25 locations in the Removal Area. At each core location, the average concentrations of the four sample intervals from 0 to 3.5 ft were calculated. Each location and COPC was then ranked from 1 as the highest average concentration to 25 the lowest average concentration. The rankings for all the COPCs were then summed for each location. These summed rankings were then ranked to select the five locations with the highest average COPC concentrations.

In order to collect sufficient volume for these studies from the five stations, cores were collected as follows: each core will be 48 in. long and 4 in. in diameter, yielding a usable core 3.5 in. in diameter. The resulting volume of sediment per core was approximately 2 gallons. At each of five stations, six cores were collected for each bench-scale vendor for a total of 12 cores at the location.

Samples of the bulk sediment were submitted for analysis for chemical and physical parameters. In additional to other analysis this analysis included TCLP, volatile organic compounds (VOCs), TCLP semivolatile organic compounds (SVOCs), TCLP organochlorine pesticides, TCLP chlorinated herbicides, TCLP metals, TCLP mercury, flashpoint, oil and grease (n-hexane extractable material [HEM] and silica gel treated n-hexane extractable material [SGT-HEM; Non-Polar Material] by extraction and gravimetry), total cyanide, sulfide, pH, corrosivity, paint filter, and percent solids.

Results of the TCLP analysis for the two composite samples are provided in **Table 8-1**. None of the TCLP parameters exceed the RCRA Regulatory Value.

TABLE 8-1
RM 10.9 Composite Samples Waste Characterization Profile
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Analyte	Units	RM 10.9 Composite Samples				Average Detected	RCRA Regulatory Value	RCRA Code	UTS Screening Value
		COMP-V01AS		COMP-V02BS					
Herbicides—TCLP									
2,4,5-TP (Silvex)	µg/L	5.0E-01	U	5.0E-01	U	ND	1,000	D017	—

2,4-D	µg/L	2.0	U	2.0	U	ND		10,000	D016	—
Metals—TCLP										
Arsenic	mg/L	0.083	J	0.096	J	0.090	J	5	D004	5
Barium	mg/L	0.43	JB	0.42	JB	0.43	JB	100	D005	21
Cadmium	mg/L	0.11		0.12		0.12		1	D006	0.11
Chromium	mg/L	0.016	J	0.017	J	0.017	J	5	D007	0.6
Lead	mg/L	0.20	J	0.19	J	0.20	J	5	D008	0.75
Mercury	mg/L	0.0020	U	0.0020	U	ND		0.2	D009	0.025
Selenium	mg/L	0.0048	J	0.0071	J	0.0060	J	1	D010	5.7
Silver	mg/L	0.50	U	0.50	U	ND		5	D011	0.14
Pesticides—TCLP										
Chlordane	µg/L	12	U	12	U	ND		30	D020	—
Endrin	µg/L	1.2	U	1.2	U	ND		20	D012	—
Gamma-BHC(Lindane)	µg/L	1.2	U	1.2	U	ND		400	D013	—
Heptachlor	µg/L	1.2	U	1.2	U	ND		8	D031	—
Heptachlorepoxide	µg/L	1.2	U	1.2	U	ND		8	D031	—
Methoxychlor	µg/L	2.4	U	2.4	U	ND		10,000	D014	—
Toxaphene	µg/L	48	U	48	U	ND		500	D015	—
SVOCs—TCLP										
2,4,5-Trichlorophenol	µg/L	20.0	U	20.0	U	ND		400,000	D041	—
2,4,6-Trichlorophenol	µg/L	20.0	U	20.0	U	ND		2,000	D042	—
2,4-Dinitrotoluene	µg/L	20.0	U	20.0	U	ND		130	D030	—
2-Methylphenol	µg/L	1.3	J	4.0	U	1.3	J	200,000	D023	—
4-Methylphenol	µg/L	16	J	8.4	J	12.2	J	200,000	D025	—
Hexachlorobenzene	µg/L	20.0	U	20.0	U	ND		130	D032	—
Hexachlorobutadiene	µg/L	20.0	U	20.0	U	ND		500	D033	—
Hexachloroethane	µg/L	20.0	U	20.0	U	ND		3,000	D034	—
Nitrobenzene	µg/L	4.0	U	4.0	U	ND		2,000	D036	—
Pentachlorophenol	µg/L	40.0	U	40.0	U	ND		100,000	D037	—
Pyridine	µg/L	20.0	U	20.0	U	ND		5,000	D038	—
Total Cresol	µg/L	—		—		—		200,000	D026	—
VOCs—TCLP										
1,1-Dichloroethene	µg/L	25.0	U	25.0	U	ND		700	D029	—
1,2-Dichloroethane	µg/L	25.0	U	25.0	U	ND		500	D028	—
1,4-Dichlorobenzene	µg/L	4.0	U	4.0	U	ND		7,500	D027	—
2-Butanone	µg/L	250	U	250	U	ND		200,000	D035	—

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Benzene	µg/L	25	U	25	U	ND	500	D018	—
Carbontetrachloride	µg/L	25	U	25	U	ND	500	D019	—
Chlorobenzene	µg/L	25	U	25	U	ND	100,000	D021	—
Chloroform	µg/L	25	U	25	U	ND	6,000	D022	—
Tetrachloroethene	µg/L	25	U	25	U	ND	700	D039	—
Trichloroethene	µg/L	25	U	25	U	ND	500	D040	—
Vinyl Chloride	µg/L	25	U	25	U	ND	200	D043	—

The sample locations comprising the composite sample were chosen based on having higher concentrations of dioxin, PCBs, mercury, and PAHS. The TCLP results from these four samples were compared to RCRA screening levels, and non-TCLP analytical results from 25 cores within the Removal Area for the 0–2.5 ft sampling intervals were compiled to provide an initial composite chemical concentration profile. Results were as follows:

- The four TCLP analytical results did not exceed RCRA screening levels for any regulated constituent.

These screening results indicate that the sediment to be removed would not be designated as hazardous under RCRA. However, the sediment may require disposal at a RCRA Subtitle C landfill because many Subtitle D landfill permits prohibit acceptance of waste containing dioxins.

Sediment profiling for disposal and disposal options will be performed before the Final Design. Initial discussions with the out-of-state subtitle C landfills indicate that additional samples need to be collected for TCLP analysis.

8.3 Transportation Options

Transportation of the sediment to the disposal facility will be the responsibility of the disposal facility since much is determined by the location of the disposal facility. The means of transportation will be by truck and rail. The stabilized material will be placed in lined intermodal containers and then transported by truck to a rail loading facility. The intermodal containers will be transferred to rail cars for transport to the landfill. Once at the landfill the containers will be is transferred from the rail cars to a straight roll-off truck for delivery and discharge within the landfill. Throughout the entire loading, transportation, delivery and discharge cycle, the container will never touched the ground.

It is proposed that the following BMPs be implemented:

- Unloading cranes, buckets, hoppers and other equipment shall be designed and equipped with spill plates, drip pans, and or other mechanisms such that no dredged material or water is spilled into or allowed to run off into the water at or near the unloading site during the unloading process.
- Processed dredged material must be stockpiled on an impermeable pad and must utilize erosion and sediment control processes that control any drainage water from the dredged material processing activities and direct it to lined settlement ponds for conveyance to the dedicated decant water storage location.
- Subcontractor will provide facility route map and traffic plan to designated processed dredged material haulers and brief them on Subcontractor facility guidelines and safety issues and other requirements to ensure safe operations.

8.4 Disposal Options

The final option for disposal will be dependent on the designation of the waste material based on characteristics of the end product(s) from the treatment process. Whether designated as RCRA waste or not, the final treated

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material and its associated byproducts will be profiled for disposal in a Subtitle C landfill(s). The potential waste streams to be profiled include the following:

- Stabilized sediment
- Debris
- Material larger than 4 in.
- Excess barge water removed prior to unloading

Each of these waste streams could potentially be disposed of at a separate facility; the disposal options for each will be refined before the Final Design.

The stabilized sediment, debris and material greater than 4 in. will be disposed of at Clean Harbors Lone Mountain Subtitle C landfill, located in Waynoka, Oklahoma. The excess barge water will be treated and discharged at either Clean Harbors Baltimore, Maryland or Bristol, Connecticut Treatment facilities.

The following selection criteria were utilized to determine the most cost-effective disposal option:

- RCRA designation and characterization of waste materials
- Weight of treated material as well the associated by product materials generated (e.g., debris, material over 4 in., sand) in the stabilization process
- Method of transportation (rail or truck)
- Distance from site to disposal facility

8.5 Road Network and Existing Traffic Volumes

All of the processed sediment will be transported by truck to a rail loading facility located in Newark, NJ. Approximately 20–30 trucks per day over a time period of approximately six weeks will be required. This amount of truck traffic, which would operate on local roads in industrial areas, is not considered significant compared to existing traffic.

8.6 Proposed Transportation Strategy

The means for transporting the stabilized sediment and associated debris will be by truck to the rail transfer station and then rail to the Lone Mountain Landfill. The stabilized material will be placed in lined intermodal containers and then transported by truck to the rail loading facility, EPIC's Brills Yard, located at 319 P. Avenue in Newark. The intermodal containers will be transferred to rail cars for transport to the landfill. Once at the landfill the containers will be is transferred from the rail cars to a straight roll off truck for delivery and discharge within the landfill. Throughout the entire loading, transportation, delivery and discharge cycle, the container will never touch the ground.

The wastewater which will be stored in temporary onsite storage tanks will be transferred into tankers and/or vac trucks for transport to a permitted wastewater treatment and discharge facility (i.e., Clean Harbors of CT, Inc., or Clean Harbors of Baltimore, Inc). In order to reduce TSS concentrations, wastewaters will be settled and/or be filtered prior to being transferred into trucks for offsite disposal.

8.7 Consultation and Road Network Issues

No special consultation or road network issues are anticipated at this time.

8.8 Monitoring Requirements

Monitoring requirements for the transportation of debris, treated sediment, and process-related wastes will be determined during the final design after the landfill and sediment-processing vendor(s) have been selected.

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SECTION 9

9 Design and Preliminary Construction Schedule

A summary of the major tasks associated with the RM 10.9 Removal Action is provided in **Table 9-1**. A project schedule including all major tasks and deliverables is included as **Appendix K.** The schedule provides approximate completion dates for the design and implementation of the RM 10.9 Removal Action. Effective and open communications will be critical to achieving the aggressive milestones for the project. The status of ongoing efforts and issues that arise will be discussed at the monthly meetings.

TABLE 9-1
RM 10.9 Task Summary
RM 10.9 Final Design Report, Lower Passaic River Study Area, New Jersey

Task Description	Start Date	Finish Date
USEPA Draft Final Design Review	Feb 26, 2013	March 30, 2013
USEPA Final Design Approval	May 3, 2013	August 1, 2013
NJDEP Approves AUD Application	June 27, 2013	June 27, 2013
NJDEP Conditionally Approves Waterfront Development Permit	April 26, 2013	April 26, 2013
Baseline Water Quality Monitoring	May 31, 2013	July 26, 2013
Dredging	Aug 2, 2013	Sept 16, 2013
Stabilization	Aug 5, 2013	Sept 18, 2013
Transportation and Disposal	Aug 7, 2013	Sept 24, 2013
Capping	Oct 18, 2013	Dec 11, 2013
Demobilization	Dec 12, 2013	Dec 20, 2013
Submit Final Report	Apr 4, 2014	Apr 4, 2014

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SECTION 10

10 References

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SECTION 11

11 List of Drawings

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8		C-6	Cross-Sections (Sheet 1 of 14)
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SECTION 12

12 List of Technical Specifications

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