Superfund Program
Proposed Plan

U.S. Environmental Protection Agency, Region II

HORSESHOE ROAD AND ATLANTIC RESOURCES CORPORATION SITES

May 2008

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the preferred alternative for addressing sediment contamination at two Superfund sites, the Horseshoe Road site and the adjoining Atlantic Resources Corporation (ARC) site, and provides the rationale for that preference. The Horseshoe Road site was placed on the National Priorities List (NPL) of Superfund sites in 1995 and the ARC site was placed on the NPL in 2002. While they are considered two separate sites on the basis of past disposal activities, their proximity and commingled wastes have led the U.S. Environmental Protection Agency (EPA) to address the sites jointly. Both sites are contaminated with a variety of chemicals, which have entered drainage channels that run off into an 8-acre marsh adjacent to the Raritan River. EPA's proposed alternative addresses marsh and river sediments through excavation/dredging, off-site disposal and backfilling.

EPA is issuing this Proposed Plan as part of its community relations program under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, or Superfund). This Proposed Plan summarizes information that can be found in greater detail in the May 1999 Remedial Investigation and Feasibility Study (RI/FS) report, the February 2008 OU3 Focused Feasibility Study, and other documents contained in the Administrative Record file for these sites. EPA and the New Jersey Department of Environmental Protection (NJDEP) encourage the public to review these documents to gain a more comprehensive understanding of the sites and the Superfund activities that have been conducted.

This Proposed Plan includes summaries of all the cleanup alternatives evaluated for use at these sites. This document is issued by the EPA, the lead agency for site activities, and NJDEP, the support agency. EPA, in consultation with NJDEP, will select the final remedy for the sites after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with NJDEP, may modify the preferred alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore,

MARK YOUR CALENDAR:

PUBLIC COMMENT PERIOD:
July 21 – August 20, 2007
U.S. EPA will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING:
August 12, 2008, 7:00pm
U.S. EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at the Council Chamber in the Sayreville Town Hall 167 Main Street, Sayreville, New Jersey.

For more information, see the Administrative Record at the following locations:

U.S. EPA Records Center, Region II
290 Broadway, 18th Floor.
New York, New York 10007-1866
(212)-637-3261
Hours: Monday - Friday 9 am to 5 pm

Sayreville Public Library
1050 Washington Road
Parlin, New Jersey 08859
(732)727-0212

the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

SITE HISTORY

The Horseshoe Road site is a 12-acre property located in Sayreville, Middlesex County, New Jersey. The site includes three areas: (1) the Sayreville Pesticide Dump (SPD); (2) the former Atlantic Development Corporation facility (ADC); and (3) the Horseshoe Road Drum Dump (HRDD). (See Figures 1 and 2.)

The adjacent ARC site is a 4.5-five acre property also located on Horseshoe Road. It was the location of a precious metals recovery facility which was operated by several companies, including the Atlantic Resources Corporation.

East of the sites is a railroad right-of-way belonging to Conrail, on the opposite side of which lies the Middlesex County Utilities Authority (MCUA) property. To the southwest of the site lies the Gerdau Ameristeel facility.

A residential neighborhood with approximately 50 homes is located approximately one-half mile to the southeast of the site. The areas described above are served by municipal water; about 14,000 people obtain drinking water from public wells within four miles of the sites.

Both sites are located on the south shore of the Raritan River. Surface water from them drains into a fresh water marsh area of approximately 8.2 acres, and this wetland then drains to the Raritan. (See Figure 1) The shoreline up-river (southwest) of the sites is undeveloped, but portions are wetland and the remainder was at one time used to dispose of dredge spoils from local shipping channels. The southern edge of the Horseshoe/ARC marsh is partly bounded by the remnants of the Crossman Company. Crossman, a producer of sand, clay and other aggregates, operated Crossman Dock just off the Horseshoe/ARC marsh, and pilings from the dock are found in the Raritan in front of the sites. Surface water drainage from the ARC site also discharges into a small bay just north of the sites. Just north of this bay is the first of a series of man-made ponds associated with the former NL/Titanium Pigments facility, which is down-river (northeast) of the sites.

DESCRIPTIONS OF THE SITES(See Figure 1)

HORSESHOE ROAD SITE AREAS

Sayreville Pesticide Dump (SPD): Covers approximately 3 acres. Test pit and soil boring samples from this former dump area shows buried refuse and soil contamination as deep as 10 feet below the ground surface.

Atlantic Development Corporation (ADC): Covers approximately 6.0 acres. Test pit and soil boring samples from this former process area shows soil contamination and buried refuse 3 to 14 feet below the ground surface in source areas.

Horseshoe Road Drum Dump (HRDD): Covers approximately 1.2 acres. Test pit and soil boring samples from this former dump area shows buried refuse down to 12 feet

ATLANTIC RESOURCES CORPORATION SITE (ARC)

ARC covers approximately 3.7 acres. Test pit and soil boring samples from this former precious metals recovery facility shows soil contamination covering much of the lot. Subsurface soil contaminants were found as deep as 10 feet below the ground surface in source areas.

DOWN-STREAM MARSH

The marsh covers approximately 6.0 acres and has been impacted by stream run-off from the site. Arsenic and mercury contamination have been found as deep as 42 inches below the sediment surface.

THE RARITAN RIVER

EPA has defined an area of elevated sediment contamination in the river bordering the marsh that is approximately 2.5 acres in area. As with the marsh, arsenic and mercury contamination have been found as deep as 42 inches below the sediment surface.

Problems on Horseshoe Road first came to EPA's attention in 1981, when a brush fire at the HRDD area exposed approximately 70 partially filled drums containing acetonitrile, silver cyanide and ethyl acetate. The HRDD area was used for disposal until the early 1980s. The SPD area was also used for disposal, from about 1957 into the early 1980s. These two dump areas do not contain any buildings or structures.

The ADC facility contained three buildings that were owned or leased by many companies from the early 1950s to the early 1980s. The various operations over time included the production of roofing materials, sealants, polymers, urethane and epoxy resins, resin pigments, wetting agents, pesticide intermediates and recycled chlorinated solvents.

The ARC site contained several inter-connected buildings and structures, including a series of incinerators used for precious metals recovery. The facility recovered gold and silver from fly ash, x-ray and photographic film, circuit boards, building material and other materials. The operation also accepted spent solvents, which were used to fuel the incinerators. The ARC facility, like ADC, ceased all commercial operations in the early 1980s.

Since 1985, when NJDEP requested that EPA take the lead role in the cleanup of the sites, EPA has performed 10 removal actions. These removals stabilized the sites by removing more than 3,000 drums, cleaning up dioxin and mercury spills, emptying and disposing of materials found in numerous tanks and vats on both sites, and excavating and disposing of contaminated soils and debris.

The Horseshoe Road site was proposed for inclusion on the NPL in 1993, and formally placed on the NPL on September 29, 1995. The ARC site was initially included in the description of the Horseshoe Road site, but it was removed from the NPL listing after the potentially responsible parties (PRPs) for ARC challenged the joint listing.

In the summer of 1997, EPA initiated a remedial investigation and feasibility study (RI/FS) to jointly characterize the nature and extent of contamination at the sites. An RI report was released in 1999. The RI evaluated groundwater, surface water, surface soils, subsurface soils, sediments and building material.

EPA is addressing these sites in separate phases, or operable units. In September 1999, a Focused Feasibility Study was completed for Operable Unit 1 (OU1), the buildings and structures on the ADC and ARC facilities. A September 2000 Record of Decision (ROD) for OU1 called for demolition and off-site disposal of buildings and above-ground structures. On April 10, 2001, EPA completed the OU1 remedy for the Horseshoe Road site, removing the buildings and surface debris from the ADC facility.

Based on additional data gathered from the ARC site during the RI, together with previously obtained data, EPA proposed the ARC facility as a separate NPL site in September 2001. The site was formally placed on the NPL on September 5, 2002.

In May 2003, the OU1 remedy for the ARC site was completed. A PRP group for the ARC site, with EPA oversight, demolished and disposed of all on-site buildings and above-ground structures, and removed several under-ground storage tanks discovered during the cleanup.

EPA completed the Operable Unit 2 (OU2) FS report in 2004, using the results of the 1999 RI pertaining to soils and groundwater. A September 2004 ROD for OU2 selected soil and groundwater remedies for the two sites. A group of PRPs has agreed to perform the OU2 remedial action for the ARC site, and is also performing the remedial design activities for the HRDD portion of the Horseshoe Road site. The ARC RD is in the work plan stage. EPA began the OU2 remedial action earlier this year, and it is expected to take 30 months to complete.

In 2004, the ARC PRP group also agreed to complete an FS for the remainder of both sites, to address sediments in the marsh and river. This phase is known as Operable Unit 3 (OU3). This FS is the basis for the development of this Proposed Plan. The FS and other relevant documents are included in the Administrative Record for the sites.

SITE CHARACTERISTICS

Horseshoe/ARC Marsh Sediments

The Horseshoe Road site includes the former ADC facility, the SPD areas (allegedly used by ADC), and the HRDD area, which was used by ARC. One drainage channel collects most of the surface water from the ADC and SPD areas (please refer to Figure 2). This ADC/SPD drainage channel appears to provide a majority of the fresh water flow into the marsh, and the most distinguishable surface water flow through the marsh can be traced back to this channel.

A second drainageway begins at a small depression that approximately divides the ADC and ARC operations, travels just south of the HRDD area, and discharges into the marsh at the base of the HRDD mound. Both sites contribute surface water flow to this HRDD drainageway.

Surface water runoff from the HRDD mound enters into the HRDD drainageway or releases directly into the marsh. The ARC site has its own drainage swale just north of the HRDD area, and most of the surface water runoff from ARC currently travels through this swale. Unlike the other surface water routes described above, which appear to be natural water courses, portions of this swale are man-made. Surface water travels through a culvert under the MCUA right-of-way to reach the ARC swale, and water from the swale discharges to the bay north of the marsh.

Approximately 95 Percent of the Horseshoe/ARC marsh is dominated by Common Reed (Phragmites) and is considered a freshwater emergent wetland. The remaining 5 percent is a fringe that is an average of 25 feet wide at the edge of the Raritan River, and dominated by salt-tolerant cordgrass (Spartina), indicative of an intertidal wetland environment. A natural berm formed by tidal deposition separates these two wetland zones. This berm is only breached in one location where the surface water enters the river from the marsh.

WHAT ARE THE "CONTAMINANTS OF CONCERN"?

The primary contaminants are those which pose the greatest potential risk to human health and the environment. Although the primary contaminants vary from area to area on the sites, the following are the major risk contributors; Arsenic, mercury and PCBs are primary contaminants that drive the risk in sediments in the marsh and in the Raritan River.

Arsenic - Arsenic is a naturally occurring element in the earth's crust. It is a known carcinogen and can also cause adverse health effects that are not related to cancer.

Mercury - Mercury is a naturally occurring element in the earth's crust. It is a known carcinogen and can also cause adverse health effects that are not related to cancer.

PCBs (Polychlorinated Biphenyls) - PCBs are not naturally occurring compounds. They are very persistent in the environment and tend to accumulate in animal tissues. EPA has classified PCBs as "Probable Human Carcinogens."

Site topography, which includes the drainage channels previously described, influenced EPA to investigate the down-gradient marsh which is approximately 8.2 acres in size. EPA evaluated surface and subsurface sediment samples collected from the marsh. For its studies, EPA considered surface sediments to be within the first 12 inches of the surface within the marsh. Subsurface samples were taken from 12 to 42 inches. Reference samples were collected in an area of marsh sediments about 400 feet south of the former Crossman Dock, and these results were one of a number of data points used to screen marsh sediments for contaminants of concern. Three contaminants of concern were identified in the marsh and associated drainageways: arsenic; mercury; and polychlorinated biphenyls (PCBs). The reference sample results appear in Table 1, along with representative Horseshoe/ARC marsh sediment data. All mercury sampling at the sites

was analyzed for total mercury.

The ADC/SPD drainage channel is clearly the most highly contaminated portion of the marsh. PCBs are found at highest concentrations in shallow surface sediments of the stream channel,

TABLE 1
Horseshoe/ARC Marsh Surface Sediment Data (2006 Sampling Only)

COC (mg/kg)	Reference Samples (range)	Marsh Sediments (range)
Arsenic	6.7-49.9 mg/kg	16.6-17,800 mg/kg
Mercury	0.18-1.4 mg/kg	0.36-385 mg/kg
PCBs	0.01-0.77 mg/kg	0.08-32 mg/kg

and at lesser concentrations within the marsh itself and at depth. Arsenic and mercury were also generally found at their highest concentrations within the ADC/SPD drainage channel; however, these two metals were also found throughout the marsh and at depth at elevated concentrations. In several cases, the deepest sediment samples collected (about 30 to 42 inches below the ground surface) were at concentrations greater than the reference sample results. Some arsenic concentrations were an order of magnitude greater than that found in the reference area samples.

The distribution pattern for arsenic and mercury suggest that these contaminants were discharged into the marsh in a relatively soluble form, allowing dissolved constituents to pass deeper into the marsh sediments before the subsurface geochemistry forced the arsenic and mercury to precipitate.

Raritan River Sediments

The sites are about four miles from the mouth of the Raritan River where it meets the Atlantic Ocean, and the river is approximately 2,600 feet wide at this point. This reach of the Raritan River is a tidal estuary.

The Raritan River Estuary has been identified as an impaired water under section 303(d) of the Clean Water Act as a result of metals (including arsenic and mercury) contamination, and New Jersey has established fishing advisories within the Raritan River as a result of PCB contamination found in American Eel, White Catfish, White Perch, Striped Bass, Bluefish, and Blue Claw crab.

The U.S. Army Corps of Engineers (USACE) maintains a commercial shipping channel, the "Main Channel," along the north shore of the Raritan. For much of the 20th century, a second channel served the NL Industries/Titanium Pigments facility ("the Titanium Reach"), and a smaller extension ("the South Channel") served Crossman Dock and other brick-related businesses in Sayreville. At one time, the South Channel was dredged to a depth of 15 feet (measured at low tide) and was 150 feet wide. Now, the South Channel is mostly silted in, with an average depth of 4.2 feet. The USACE has no plans for dredging the Titanium Reach or the South Channel, neither of which serves any commercial interests at this time. It is possible that Sayreville may consider a marina as part of its waterfront development plans, however there are no current plans for a marina at this location, and furthermore, the area is too shallow. In order to locate a marina at this location, the river would need to be dredged much deeper than any of these alternatives would require.

Pilings from the Crossman Dock are still present in the river in front of the Horseshoe/ARC marsh. A depositional area can be found in front of the Horseshoe/ARC marsh, between the shoreline and these pilings. Because the marsh drains directly into this depositional area, through a breach in the berm that runs along the river, EPA sampled this area and the area around it.

Reference samples were collected from near-shore sediments up-river and down-river from the sites. Other Raritan River sediment data were also consulted to provide a better picture of the current contaminant loading in river sediments. The FS compared the site-specific reference data to results

from NL Industries sampling events (collected in 2003 at the direction of NJDEP) for arsenic. The FS also compared the site-specific reference data to results from USACE sampling of the Main Channel (2004) for arsenic, mercury and PCBs.

The reference data in Table 2 presents the combined (site-specific and river-wide) sediment sampling results. The river-wide results include data from the 2004 USACE survey which is not in the FS, but is included in the Administrative Record. The near-site river sampling areas are shown on Figure 3.

TABLE 2
Horseshoe/ARC Raritan River Sediment Data

COC (mg/kg)	Reference data	Near-site River Sediments (range)
Arsenic	6 - 47 mg/kg	9.1 - 2,200 mg/kg
Mercury	0.09 -1.3 mg/kg	0.062 - 7 mg/kg
PCBs	6 - 0.89 mg/kg	0.021- 9.5 mg/kg

Surface (0 to six inches) and subsurface (six inches to 42 inches below the river bottom) sediment samples were collected. Raritan River sediment contamination was characterized by arsenic and mercury in surface and subsurface sediments. PCBs were much less frequently detected relative to the marsh sediments.

The sampling results indicate that the depositional area behind the dock pilings contains elevated levels of arsenic and mercury relative to the surrounding sediments. The surrounding sediments have contaminant levels that are more consistent with background levels for the river, as indicated by both the off-site sample results and other off-site data from the NL Industries site and Army Corps surveys.

Based on analytical results and past site practices, it appears that contamination migrated to the marsh and Raritan River through runoff from the sites, and groundwater transport does not appear to be a contributing mechanism to sediment contamination, though the contaminated sediments appear to be a likely continuing source to the river.

Contaminants in surface soils on both the Horseshoe Road and ARC sites have been identified as “principal threat wastes” because these contaminants have demonstrated a potential for migrating to the groundwater; no principal threat wastes have been identified in the sediments.

WHAT IS A "PRINCIPAL THREAT"?

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in groundwater may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

ENFORCEMENT

Various companies operated at the ADC and ARC facilities from the late 1930s until the mid 1980s. The available information indicates that the various operators at ADC used the SPD area as a dump site, and the operators at the ARC site used the HRDD area for dumping. In 1995, EPA notified a number of former operators that they were considered potentially responsible parties (PRPs) for the cleanup of the Horseshoe Road site. Based upon the information available at this time, EPA has concluded that neither the property owner nor any of the former operators are viable companies that have the resources to perform the necessary work at the site. Therefore, EPA is performing the OU2 remedial action for the SPD

and ADC areas with state and federal funds.

In 1995, EPA notified a number of companies that sent waste to ARC, referred to as "generators," and Jack Kaplan, the former president of ARC, that they were considered PRPs with respect to the cleanup of the ARC site and the HRDD portion of the Horseshoe Road site.

In 2001, EPA entered into an order with a group of PRPs to undertake the OU1 remedy for the ARC site.

In 2003, EPA entered into a second order with certain PRPs to complete the OU3 RI/FS, and this work served as the basis for this Proposed Plan.

In July 2007, EPA and the PRP Group entered into a judicial consent decree to perform the OU2 remedial design for both the ARC site and HRDD portion of the Horseshoe Road site, and the remedial action for the ARC site. The PRPs are currently in the design phase of that action.

SCOPE AND ROLE OF THE ACTION

EPA is addressing these sites in operable units. During OU1, buildings and above-ground structures were demolished. OU1 is complete for both sites. OU2 addresses the final remediation of soils and groundwater, and is currently in progress. OU3, the subject of this Proposed Plan, addresses sediments in the adjacent marsh and Raritan River, and is the final action planned for the sites.

SUMMARY OF SITE RISKS

As part of the RI/FS, a human health risk assessment (BHHRA) and a baseline ecological (BERA) risk assessment were performed to determine the current and future effects of contaminants on human health and the environment. The current use of the neighboring properties is industrial (the MCUA sewage treatment plant, and a steel mill) or residential. EPA has consulted with Sayreville with regard to its plans for the upland (OU2) portions of the sites, and its interest in re-use of the area. The town's plans may include a new roadway and the development of the waterfront between the former NL facility to the east and Sayreville's public boat launch to the west for a variety of commercial, recreational or parkland uses.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

***Hazard Identification**:* In this step, the contaminants of concern at the site in various media (i.e., soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

***Exposure Assessment**:* In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil. Factors relating to the exposure assessment include, but are not limited to, the concentrations that people might be exposed to and the potential frequency and duration of exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

***Toxicity Assessment**:* In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response) are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health effects, such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health effects.

***Risk Characterization**:* This step summarizes and combines exposure information and toxicity assessments to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk). For non-cancer health effects, a "hazard index" (HI) is calculated. An HI represents the sum of the individual exposure levels compared to their corresponding reference doses. The key concept for a non-cancer HI is that a "threshold level" (measured as an HI of less than 1) exists below which non-cancer health effects

Residential re-use is not contemplated. The baseline human health risk assessment for OU3 focused on health effects to trespassers in the marsh, and the ecological risk assessment focused on ecological receptors that inhabit fresh water marshes.

The Horseshoe/ARC marsh, has not been discussed in the context of any redevelopment plans, but EPA assumes that future development plans would not substantially change the size or character of the marsh, and that the existing human health risk assumptions with regard to trespassers will be pertinent in the future as well, and that the current wetland habitat will be maintained.

Human Health Risks

The BHHRA identifies contaminants of potential concern (COPCs) that are representative of Site risks. The BHHRA identified the following COPCs in the sediments in the marsh and Raritan River: polycyclic aromatic hydrocarbons (PAHs) (specifically, benzo[a]pyrene, benzo[b]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene), polychlorinated biphenyls (i.e., Aroclor 1254), arsenic, and copper. In addition, manganese, aluminum, antimony, thallium, and vanadium were identified as COPCs in the surface water.

Next, the BHHRA calculates the potential non-cancer hazards and carcinogenic risks from exposure to OU3 sediments and surface water. The health hazards of non-carcinogens are assessed by comparing the chronic daily intake (CDI) of a contaminant to its reference dose (RfD); the RfD being a benchmark for safety by virtue of its being based on the contaminant's threshold for causing adverse health effects, to which multiple safety factors are added. The ratio of the chronic daily intake to the reference dose (CDI/RfD) is referred to as the Hazard Quotient (HQ). A HQ greater than 1 may be associated with adverse health effects. To assess the overall potential for non-carcinogenic effects posed by simultaneous exposure to multiple contaminants, EPA has developed the Hazard Index (HI), which is the sum of all HQs within a particular exposure pathway. In the event that the addition of multiple sub-threshold HQs (i.e., HQ less than 1) exceeds an HI = 1, adverse health effects may result if the individual contaminants are believed to share a similar mechanism-of-action or toxic endpoint.

Carcinogenic risk is expressed as a probability of developing cancer over the course of a lifetime as a result of a given exposure level. To assess overall cancer risk, risks from various COPCs are assumed to be additive and are summed. EPA uses a range of cancer risks of 1×10^{-4} to 1×10^{-6} as an acceptable risk range and the Agency strives to ensure that risks are within or below this range as part of a Superfund cleanup.

The receptors that were evaluated included current and future adolescent trespassers and future adult and child residents. The results of the BHHRA indicate that non-cancer hazards and carcinogenic risk exceed EPA target levels (i.e., hazard index of 1; risk range of 1×10^{-6} to 1×10^{-4}) for all three receptor groups, with the exception of the cancer risk for adolescent trespassers, which were within the acceptable cancer risk range (Table 3). The estimated cancer risk for the adolescent trespasser increases to 1.2×10^{-4}, which exceeds the USEPA target level when the exposures from the two areas of concern are summed.

Table 3 summarizes hazards and risks associated with sediment, surface water, and shellfish exposure for the marsh and Raritan River sediments, and is taken from Tables 10.1 and 10.2b of the BHHRA.

Table 3

Area	Receptor	Hazard Index	Cancer Risk
Down-	Area Residents	2.1	7.9×10^{-5}

Area	Receptor	Hazard Index	Cancer Risk
stream Marsh	ages 12-17	(arsenic)	(arsenic)
	Adult Residents	2.6 (arsenic)	3.9×10^{-4} (arsenic)
	Child Residents	1.5 (arsenic)	5.6×10^{-4} (arsenic)
Raritan River	Area Residents ages 12-17	1.1 (arsenic)	4.2×10^{-5}
	Adult Residents	1.2 (arsenic)	1.9×10^{-4} (arsenic)
Sum of both Areas	Area Residents ages 12-17	3.2 (arsenic)	1.2×10^{-4} (arsenic)
	Adult Residents	3.8 (arsenic)	6.8×10^{-4} (arsenic)
	Child Residents	1.5 (arsenic)	5.6×10^{-4} (arsenic)

* Note that the shellfish consumption for the river was reevaluated in an addendum to the risk assessment, which resulted in the hazard index increasing to 1.8 and the cancer risk increasing to 2.5×10^{-4}.

The non-cancer hazards and carcinogenic risks for all three receptor populations include exposure to sediment, surface water and consumption of contaminated shellfish; however, it is exposure to sediments in the marsh and Raritan River that is responsible for the non-cancer hazards and carcinogenic risk exceeding the EPA acceptable target value and range. Arsenic is the main driver of non-cancer hazards and carcinogenic risk for OU3. Arsenic, therefore, has been identified as the primary contaminant of concern ("COC").

PAHs, PCBs, and other metals identified as COPCs in the sediment and surface water did not contribute significantly to the non-cancer hazards or carcinogenic risk.

Ecological Risks

A four-step process is utilized for assessing site-related ecological risks for a reasonable maximum exposure scenario:
Problem Formulation - a qualitative evaluation of contaminant release, migration, and fate; identification of contaminants of concern, receptors, exposure pathways, and known ecological effects of the contaminants; and selection of endpoints for further study.
Exposure Assessment - a quantitative evaluation of contaminant release, migration, and fate; characterization of exposure pathways and receptors; and measurement or estimation of exposure point concentrations.
Ecological Effects Assessment - literature reviews, field studies, and toxicity tests, linking contaminant concentrations to effects on ecological receptors.
Risk Characterization -measurement or estimation of both current and future adverse effects.

A Screening Level Ecological Risk Assessment (SLERA) was conducted for the Horseshoe Road site to determine which contaminants and exposure pathways presented ecological risks based on conservative assumptions. Receptor species selected to represent the different habitat and trophic levels of the site were the red-tailed hawk, short-tailed shrew, marsh wren, spotted sandpiper, green frog, fiddler crab, and the benthic invertebrate community. The assessment endpoint for the SLERA was the disruption of ecological community structure by the reduction of ecological populations.

Food chain risks were estimated for the modeled receptors (red-tailed hawk, short-tailed shrew, marsh wren, spotted sandpiper) by comparing estimated exposure levels with ecologically-based toxicity reference values. The risks to the green frog and fiddler crab were evaluated by comparing surface water concentrations to aquatic toxicological benchmarks. The comparison of sediment and surface water contaminant concentrations to ecologically-based screening values was conducted to determine risks to benthic invertebrates.
Consequently, a SLERA Addendum was completed to collect additional samples in the marsh and the Raritan River. Forage fish samples were collected to estimate contaminant concentrations in fish tissue. Toxicity tests were conducted at five sampling locations with Leptochirus Plumulosus using a 28-day chronic

bioassay.

The SLERA and the SLERA Addendum identified the potential for ecological risks for all the receptors evaluated with exposure to contaminants in sediment, surface water, and surface soil. Therefore, it was concluded a Baseline Ecological Risk Assessment (BERA) was warranted.

The assessment endpoints in the BERA focused on aquatic macroinvertebrate and terrestrial invertebrate community abundance and population in the marsh sediment, estuarine fish population abundance and community structure in the Raritan River, and wildlife population abundance in the marsh and the river. Representative species for the marsh were the short-tailed shrew, muskrat, marsh wren, and red-tailed hawk. The species selected for the Raritan River included the osprey and the herring gull.

The BERA used oligochaete and earthworm sediment toxicity tests to assess risks to benthic and terrestrial invertebrate communities. Risks to estuarine fish were analyzed by comparing contaminant concentrations in fish tissue to effects based literature values. Additionally, food web modeling was utilized to evaluate risks to bird and mammal populations.

The BERA indicated that there may be potential risk to benthic organisms from contaminated Raritan River sediment in the area immediately adjacent to where the main channel from the marsh enters the river. The marsh sediment was also found to pose potential adverse effects on the growth of aquatic and terrestrial invertebrates. Additionally, potential adverse effects on bird and mammal receptor species may be associated with the elevated contaminant concentrations in the marsh sediment. The risk drivers for these ecological receptors were identified as arsenic, mercury, and PCBs.

REMEDIAL ACTION OBJECTIVES

EPA developed the following Remedial Action Objectives (RAOs) to mitigate current and/or potential future risks associated with contamination at the sites:

Sediments - Marsh

Reduce human health risks from exposure, including ingestion, inhalation and dermal contact, to contaminants in the surface and sub-surface sediments to acceptable levels.

Reduce risks to environmental receptors from exposure to contaminants in the sediments to acceptable levels.

Minimize the migration of contaminated sediments to the Raritan River through surface water runoff or flooding.

Sediments - River

Reduce the potential for human health risks from exposure to river sediments within the low-tide mudflat in front of the site, through ingestion or dermal contact, to acceptable levels.

Reduce exposure to sediments deposited in the river adjacent to the site with highly elevated contaminant concentrations that contribute to the degradation of the Raritan River Estuary, and result in risks to ecological receptors, including benthic aquatic organisms, shellfish, fish, birds and mammals.

Remediation Goals

Sediments - Marsh

The Remediation Goals discussed below balance several factors in addressing arsenic, mercury, and PCBs. EPA has identified criteria only for these contaminants, because when these criteria are met, risks from other COCs, which are co-located, would be addressed as well. Furthermore, given the distribution of PCBs in the marsh sediments and river, by addressing

arsenic and mercury, PCBs will also be remediated.

In developing Remediation Goals for marsh sediments, EPA considered sediment risk levels for each COC identified in the BHHRA and BERA, available background values, and other ecological receptor reference values such as sediment quality guidelines adopted by NJDEP.

The BHHRA presented preliminary remediation goals (PRGs) for exposure to arsenic in sediments for the three receptor populations. The values presented in Appendix F of the BHHRA were calculated for a hazard index of 1 and a cancer risk of 10^{-4}. Typically, PRGs are presented as a range of values that span the acceptable risk range. Table 4 presents the PRGs that are associated with the acceptable hazard index of 1 and cancer risk range, as well as calculated background values and ecologically relevant values. All of these values were taken into consideration when selecting the appropriate remediation goal.

Identifying a Remediation Goal for arsenic in the marsh provides the broadest range of factors to consider. From the starting point of direct ecological effects to receptors within the marsh, the BERA results were used to calculate site-specific Apparent Effects Thresholds (AETs) of 32 mg/kg and 1,050 mg/kg (biomass reduction in blackworms and earthworms, respectively), and BERA-derived Lowest Observed Apparent Effects Levels (LOAELs) for higher trophic species ranging from 339 mg/kg (muskrat) and 1,420 mg/kg (marsh wren). After considering screening values used by NJDEP and the recommendations of the other Natural Resource Trustees, EPA has identified 32 mg/kg as the Remediation Goal for the benthic zone of the marsh (within the first foot of the marsh sediments). Applying this Remediation Goal to the surface sediments addresses most of the RAOs, and in particular, satisfies the Agency's desire to minimize the marsh as a continuing source to the Raritan.

Table 4

Site-Specific Receptor	Hazard /Risk	Arsenic (mg/kg)	Mercury (mg/kg)
Human Health Receptors			
Adolescent trespasser	10^{-6}	44	n/a
	10^{-4}	4,400	n/a
	HI = 1	2,000	n/a
Adult resident	10^{-6}	12	n/a
	10^{-4}	1,200	n/a
	HI = 1	1,850	n/a
Child Resident	10^{-6}	7.5	n/a
	10^{-4}	750	n/a
	HI = 1	285	n/a
Ecological Receptors			
Blackworm (biomass)	HI = 1	32	3.6
Earthworm (biomass)	HI = 1	1,050	15.5
Blackworm (survival)	HI = 1	17,800	68
Earthworm (survival)	HI = 1	17,800	68
Muskrat	HI = 1	183	24
Marsh Wren	HI = 1	1,470	8.86
Burrowing animals	HI = 1	160	n/a
Benthic organisms	HI = 1	n/a	2
Background	n/a	14.7	0.14

*n/a – not applicable

EPA has identified 160 mg/kg arsenic as the Remediation Goal for deeper marsh sediments (below the benthic zone). EPA concluded that the RAOs would be very difficult to achieve by only addressing the surface sediments for several reasons. Through biotic activity, such as burrowing, animals can expose themselves to the deeper sediments and bring them to the surface. In addition, the uncertainties of the setting cannot be accounted for by only addressing the surface sediments. These uncertainties include flooding and scouring from peak storm events, and the likelihood that the primary ADC stream channel may meander over time, resulting in newly

exposed sediments.

This deep sediment Remediation Goal is considered sufficiently below the muskrat LOAEL to conservatively protect a variety of higher trophic species, presuming that the remediated marsh would develop from its current state as a degraded Phragmites monoculture to support a more robust, high quality habitat.

Applying a similar approach to mercury, from the starting point of direct ecological effects to receptors within the marsh, Exponent (the RI/FS contractor) identified site-specific AETs of 3.6 mg/kg and 15.5 mg/kg (biomass reduction in blackworms and earthworms, respectively), and BERA-derived LOAELs for higher trophic species range from 7.5 mg/kg (muskrat) and 8.7 mg/kg (marsh wren). EPA has identified 2.0 mg/kg total mercury as the Remediation Goal in the surface sediments, using the Severe Effects Level (SEL) adopted by NJDEP from the Ontario Ministry of the Environment, rather than the lowest of the site-specific values, because the potential for bioaccumulation with mercury, and because of a desire to eliminate releases to the Raritan (discussed in more detail, below). Given the sensitivity of ecological receptors to mercury in the environment, EPA considered a lower Remediation Goal, such as NJDEP's Effects Range-Median of 0.71 mg/kg; however, since EPA's Remediation Goal is just above background levels, lower levels may not be attainable. EPA did not identify a separate Remediation Goal for deeper mercury contamination, expecting that actions to address arsenic would also address deeper mercury that might become exposed.

Sediments - Raritan River

By addressing marsh sediments, the OU3 remedial action would address a continuing source of contamination to the river. However, because much of the lower Raritan River system sediments are contaminated with arsenic, mercury and PCBs, and the sites contribute some incremental part to that sediment contamination, a river response is also appropriate. This is particularly important for mercury and PCBs, because while the site footprint (where elevated levels can clearly be attributable to site releases) is less than six acres and is probably too small to result in quantitative food-chain level affects, the overall contribution of the sites to the lower Raritan ecosystem cannot be ignored.

While PCBs can be found in sediment throughout the river from multiple sources, the site-related footprint of PCB contamination is much smaller and is within the footprint for mercury and arsenic; therefore, EPA only developed chemical-specific sediment cleanup criteria for mercury and arsenic. The criteria for mercury is 2 mg/kg, and for arsenic, 100 mg/kg. These values offer the best balance between several factors. Blue crab and estuarine fish collected near the site do not appear to be adversely affected by the area of very high sediment contamination found in the river adjacent to the site. The absence of affects on higher trophic species taken from the site sediment depositional area needs to be balanced against the amphipod chronic sublethal bioassay study, which suggests a LOAEL of 194 mg/kg for arsenic and 2.6 mg/kg for mercury. NJDEP has identified marine/estuarine sediment quality screening guidelines, where direct toxic affects or food-chain affects can be expected to riverine receptors, and the near-shore sediments exceed these screening values (for arsenic, mercury and PCBs) by several orders of magnitude. EPA considered using NJDEP's Effects Range-Medium (70 mg/kg for arsenic, 0.71 mg/kg mercury) as Remediation Goals, but given the background levels in the Raritan River Estuary, lower levels would not be attainable. EPA expects that any areas of the river remediated during OU3 will be recontaminated to levels similar to the reference values identified in Table 2.

SUMMARY OF REMEDIAL ALTERNATIVES

Remedial alternatives for the Horseshoe Road site and ARC site are presented below. The numbering of the alternatives corresponds to the numbering in the FS report.

Upland soil contamination at the two sites could be addressed as separate problems, because the contaminants and contaminated areas are distinct and in most cases, it is possible to designate contaminants as being attributed to one site or the other. Separate remedial alternatives could not be developed for the sediments, because constituents that might be attributable to a particular facility's operation have become intermixed in the sediments. A joint remedial approach is necessary for sediments; however, because the remedial alternatives address two separate NPL sites, costs for remedial alternatives have been divided in half and attributed to each site. This is an artificial allocation for administrative reasons, and is not a basis for liability allocation between the two sites. That allocation has not been determined at this point.

MARSH ALTERNATIVES

Common Elements

Many of these alternatives include common components. With regard to the upland portions of the two sites, the FS assumes that the OU2 remedies would eliminate these areas as ongoing sources of contamination to sediments. It is expected that OU2 remedies would be performed prior to, or at least concurrently with, implementation of the active remedial alternatives evaluated below.

As discussed already, EPA has identified different remedial goals to address surface and subsurface sediments to satisfy the RAOs for the marsh. The FS went further, dividing the deeper zone into three zones based on contaminant levels and distance from the stream channel. The first zone is targeted for the deepest excavation and encompasses an area within 20 feet of the channel. This zone tends to be the most contaminated, and also has the greatest potential for erosion.

The second is characterized by arsenic contamination above 1,050 mg/kg (which is based on the biomass reduction in earthworms).

The third zone is characterized by levels between 1050mg/kg and EPA's remediation goal of 160 mg/kg for arsenic.

The alternatives presented in the FS address these zones to varying degrees with several technologies.

The remedial alternatives also address marsh sediments to varying depths, up to 42 inches. EPA concluded that sediment contamination deeper than 42 inches would be inaccessible under current conditions, and would remain inaccessible in the future, assuming that post-remedy topography is similar to current conditions.

For remedial alternatives that include excavation of sediments, contaminated sediments would be dewatered on site and transported off site for disposal at an appropriate land facility. Based on current information, treatment would not be required prior to disposal of marsh sediments.

For all alternatives except M1 (No Action), some wetlands will be adversely affected. Each of these alternatives will require wetlands restoration and/or off-site mitigation.

Because any combination of remedial alternatives will result in some contaminants remaining on the site above levels that would allow for unrestricted use, five-year reviews will be conducted, unless determined otherwise. In addition, while the land is currently open space and could not be used without extensive landfilling, institutional controls such as a deed notice, would be appropriate to prevent a change of land use in the future.

Alternative M1: No Action

Estimated Capital Cost:	$0
Estimated Operation & Maintenance (O&M) Cost:	$0
Estimated Present Worth Cost:	$0

Estimated Construction Time frame: None
Area excavated/backfilled: 0.0 acres
Area capped: 0.0 acres

Regulations governing the Superfund program expect that the "no action" alternative will be evaluated to establish a baseline for comparison. Under this alternative, EPA would take no further action at either site to prevent exposure to contaminated sediments. Institutional controls, such as a deed notice, would not be implemented to restrict future site use. Engineering controls would not be implemented to prevent site access or exposure to site contaminants. Existing security fences would remain present in upland areas, but they would not be monitored or maintained.

Alternative M2: Channel Excavation/Armored, Thin Cover and Monitored Natural Recovery

Horseshoe Road Site Costs

Estimated Capital Cost:	$3,550,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$3,700,000

ARC Site Costs

Estimated Capital Cost:	$3,550,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$3,700,000

Estimated Construction Time frame: 3 months
Area excavated/backfilled: 0.3 acres
Area capped: 4.6 acres

Under this alternative, the stream channel would be dredged to a depth of three feet within a 20 foot-wide corridor the length of the SPD/ADC drainage, a total of approximately 2,000 cubic yards of material. The channel would then be backfilled to the original contour. Because of the high levels of contaminants in these sediments the Alternative M2 includes the establishment of an embedded channel armored with stone to prevent erosion and lateral movement. The marsh area outside the stream corridor with arsenic levels above 160 mg/kg would be covered with a thin cap (approximately six inches). The cap would be constructed in such a way as to allow for the re-establishment of a wetland on top of the cap. This alternative relies on natural sedimentation processes to bury marsh sediments that have arsenic contamination above 32 mg/kg but below the 160 mg/kg, and would be monitored to assure the reduction achieves the overall site goals.

Long-term operation and maintenance (O&M) of the cap and armored channel would be required. Institutional controls, such as a deed notice, will be required to prevent disruption of the capped area.

Alternative M3: Channel Excavation, Surficial Hot Spot Removal and Monitored Natural Recovery

Horseshoe Road Costs

Estimated Capital Cost:	$ 3,835,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$4,000,000

ARC Costs

Estimated Capital Cost:	$ 3,835,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$4,000,000

Estimated Construction Time frame: 3 months
Area excavated/backfilled: 2.2 acres
Area capped: 0.0 acres

Under this alternative, the stream channel would be dredged to a depth of three feet within a 20 foot-wide corridor along the length of the SPD/

ADC drainage, and the marsh area outside the stream corridor with arsenic levels above 1,050 mg/kg would be excavated to a depth of 1 foot (a total of approximately 4,883 cubic yards). The excavated areas would then be backfilled to the original contour. This alternative relies on natural sedimentation processes to bury marsh sediments with arsenic contamination above 32 mg/kg but below 1,050 mg/kg, and would be monitored to assure the reduction achieves the overall site goals.

Institutional controls, such as a deed notice, would be required to prevent future disruption of the recovered area.

Alternative M4: Channel Excavation, Shallow Hot Spot Removal and Thin Cover

Horseshoe Road Site Costs

Estimated Capital Cost:	$7,355,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$7,500,000

ARC Site Costs

Estimated Capital Cost:	$7,355,000
Estimated O&M Cost:	$275,850
Estimated Present Worth Cost:	$7,500,000

Estimated Construction Time frame: 3 months
Area excavated/backfilled: 2.2 acres
Area capped: 3.8 acres

Under this alternative, the stream channel would be dredged to a depth of three feet within a 20 foot-wide corridor along the SPD/ADC drainage, and the marsh area outside the stream corridor containing arsenic above 1,050 mg/kg would be excavated to a depth of two feet (a total of approximately 7,766 cubic yards). The excavated areas would then be backfilled to the original contour. Marsh sediments that are above 32 mg/kg but below the 1,050 mg/kg level would be covered with a thin cap (approximately six inches). The cap would be constructed in such a way as to allow for the re-establishment of a wetland on top of the cap.

Long-term O&M of the cap would be required. Institutional controls, such as a deed notice, would be required to prevent future disruption and to prevent disruption of the capped/covered area.

Alternative M5: Channel Excavation/Armored, Extended Shallow Removal, and Thin Cover

Horseshoe Road Site Costs

Estimated Capital Cost:	$8,300,000
Estimated O&M Cost:	$225,850
Estimated Present Worth Cost:	$8,450,000

ARC Site Costs

Estimated Capital Cost:	$8,300,000
Estimated O&M Cost:	$225,850
Estimated Present Worth Cost:	$8,450,000

Estimated Construction Time frame: 6 months
Area excavated/backfilled: 4.6 acres
Area capped: 3.8 acres

Under this alternative, the stream channel and all areas with arsenic contamination greater then 1,050 mg/kg would be excavated and backfilled to two feet. Marsh area with arsenic levels above 160 mg/kg, but less than 1,050 mg/kg would be excavated to a depth of one foot and backfilled to 1.5 feet (a total of approximately 10,970 cubic yards). This alternative also armors the channel with stone to prevent erosion and lateral movement. Marsh sediments that are above 32 mg/kg but below 160 mg/kg arsenic would be covered with a thin cap (approximately six inches). The cap would be constructed in such a way as to allow for the re-establishment of a wetland on top of the cap.

Long-term O&M of the cap and armored channel would be required. Institutional controls, such as a deed notice, would be required to prevent disruption of the capped/covered area.

Alternative M6: Channel Excavation, Extended Deep Removal and Thin Cover

Horseshoe Road Site Costs
Estimated Capital Cost: $9,230,000
Estimated O&M Cost: $225,850
Estimated Present Worth Cost: $9,300,000

ARC Site Costs
Estimated Capital Cost: $9,230,000
Estimated O&M Cost: $225,850
Estimated Present Worth Cost: $9,300,000

Estimated Construction Time frame: 6 months
Area excavated/backfilled: 4.6 acres
Area capped: 1.4 acres

Under this alternative, the stream channel would be dredged to a depth of three feet within a 20 foot-wide corridor, along the SPD/ADC drainage, and areas outside the channel with arsenic contamination greater than 1,050mg/kg would be dredged to a depth of 2.5 feet. Marsh areas with arsenic levels above 160 mg/kg but less than 1,050 mg/kg would be excavated to a depth of 1.5 foot (a total of approximately 15,015 cubic yards). The channel would then be backfilled to the original contours. Marsh sediments that are above 32 mg/kg but below 160 mg/kg arsenic would be covered with a thin cap (approximately six inches). The cap would be constructed in such a way as to allow for the re-establishment of a wetland on top of the cap.

Long-term O&M of the cap would be required. Institutional controls, such as a deed notice, would be required to prevent future disruption of the capped/covered area.

Alternative M7: Full Excavation, Restoration

Horseshoe Road Site Costs
Estimated Capital Cost: $10,265,000
Estimated O&M Cost: $125,850
Estimated Present Worth Cost: $10,350,000

ARC Site Costs
Estimated Capital Cost: $10,265,000
Estimated O&M Cost: $125,850
Estimated Present Worth Cost: $10,350,000

Estimated Construction Time frame: 6 months
Area excavated/backfilled: 6.0 acres
Area capped: 0.0 acres

Under this alternative, the stream channel would be dredged to a depth of three feet within a 20 foot-wide corridor along the SPD/ADC drainage, and areas outside the channel with arsenic contamination greater than 160 mg/kg would be dredged to a depth of 2.5 feet. Marsh areas with arsenic levels above 32 mg/kg, but less than 160 mg/kg, would be excavated to a depth of one foot (a total of approximately 21,145 cubic yards). The marsh would then be backfilled to its original contour.

Institutional controls, such as a deed notice, would be required for this remedy to prevent disruption of the covered area.

EVALUATION OF MARSH ALTERNATIVES

Nine criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. The “Detailed

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that are legally applicable, or relevant and appropriate to the site, or whether a waiver is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Analysis of Alternatives" can be found in the FS.

1. Overall Protection of Human Health and the Environment

All alternatives except the "no action" alternative would provide adequate protection of human health and the environment by eliminating or controlling risk through removal of contaminants or engineering or institutional controls. Alternative M7 (Full Excavation) would be the most protective over the long-term because it removes the most contaminated sediments from the marsh that could result in exposure or off-site migration of contaminants to the river.

Alternative M4 (Shallow Hot Spot Removal and Thin Cover), M5 (Extended Shallow Removal and Thin Cover), and M6 (Extended Deep Removal and Thin Cover), provide levels of protection through a combination of excavation and capping. The main difference between these three alternatives is the amount of contaminated sediment being excavated and, therefore, eliminated as a source for off-site migration. These alternatives also rely on caps or backfill to cover contaminated sediment that is left in place. Alternatives M4, M5 and, to a lesser degree, M6 rely on thin caps over the top of existing sediment. A thin cap would act through dilution by adding the clean cap material to the surface sediment to dilute the surface concentration. For alternatives that rely on thin caps to cover areas of contaminated sediment, resulting surface concentrations would be slightly higher, and the potential for disruption of the surface cover materials reduces the level of protection.

Alternatives M2 (Channel Excavation, Thin Cover and Monitored Natural Recovery) and M3 (Surficial Hot Spot Removal and Monitored Natural Recovery) rely on Monitored Natural Recovery (MNR), which depends on natural processes (burial/dilution by cleaner sediments) to address contaminants. The FS considered a range of factors in evaluating how long it might take MNR to achieve the remediation goals, and concluded that at it would take a minimum of five years (under favorable conditions), but as many as 45 years before the remediation goals would be reached. During this period, exposure scenarios and off-site migration of contaminants would to continue much as they are today. Based on the current distribution of sediment at the site, there is little evidence that MNR is occurring, or that

implementation of the OU2 upland remedies would help the performance of MNR. Therefore, M2 and M3 are considered minimally protective at best, and unproven.

Because M1, the "No Action" alternative, is not protective of human health and the environment, it was eliminated from consideration under the remaining eight criteria.

All the remaining alternatives would require institutional controls to some degree because some contamination will be left behind. Alternatives M2 and M3 will require long-term monitoring to assure the cleanup goals are achieved through MNR. Alternatives M2 through M7 would require O&M to ensure that the cover material remains protective.

2. **Compliance with ARARs**

Actions taken at any Superfund site must meet all applicable or relevant and appropriate requirements (ARARs) of federal state law or provide grounds for invoking a waiver of those requirements. See Appendix A of the FS for a complete listing of ARARs for this action. There are no chemical-specific ARARs for contaminated sediments, so EPA has developed site-specific remediation goals. Alternative M7 will achieve cleanup goals through excavation and backfilling. All the other alternatives would achieve the cleanup goals through a combination of excavation, capping and/or MNR.

Wetlands perform a variety of important functions such as, providing ecological habitats, spawning grounds, and assisting in flood control. The Federal Clean Water Act, Section 404, and Federal Executive Order No. 11990 protect existing wetlands, and portions of these laws are ARARs for the site. Generally these laws seek to prevent the disruption of existing wetlands when possible; however, because preserving the existing wetland would have precluded most of the remedial technologies available for cleanup, preservation of the existing wetland was not a remedial action objective.

All the active remedial alternatives result in the disturbance of the existing wetland, to varying degrees. The whole marsh drainage area is approximately 8.2 acres, and the area that is contaminated, as defined by arsenic concentrations greater than 32 mg/kg, is 6.0 acres. Alternative M3 disturbs the smallest area within the wetland, (2.2 acres) followed by Alternative M2 (4.6 acres). The remaining four alternatives disturb 6.0 acres of wetland. While each alternative assumes that any disturbed wetlands would be restored, from the point-of-view of wetlands disruption alone, Alternative M3 is preferable because it leaves the majority of the marsh untouched.

Several of the remedial alternatives result in altering the land surface or surface water flows within the marsh in subtle but potentially important ways. Alternatives M4, M5 and M6 all rely on thin layer capping, which would raise the land surface over portions of the marsh to limit access to contaminated sediments below the cap. Raising the land surface can result in increasing surface water flows through the marsh, or in creating areas that are wetter or drier than pre-remedy conditions; these changes can result in adverse affects in the wetland.

Alternatives M2 and M5 rely on an "armored channel" to prevent the movement of the ADC/SPD drainage channel from its current position. This drainage channel is a slightly deeper preferential pathway for water-flow through the marsh, and it is the area of highest sediment contamination. Because the meandering channel could expose contaminated sediments that are currently buried, armoring (lining the channel with stone) prevents the channel from meandering in the future. An armored channel has a potential adverse affect on the wetland, because during low flow periods, when the much of the surface water would be found in the channel itself, the armored channel has the potential to "hurry" surface water out of the

marsh, further drying it out.

Capping and armoring the channel cause relatively small changes in how the marsh functions, and engineering techniques are available that minimize adverse affects from these changes. But even small changes may warrant a "mitigation" under the Clean Water Act, in the form of some kind of further restoration elsewhere to compensate for a localized disruption of wetland function. Of the six active alternatives, only Alternatives M3 and M7 leave the contours of the marsh unchanged, and are, therefore, neutral with regard to affects on the wetland.

Based upon the available documentation regarding the source of contamination, and sediment testing, EPA has concluded that the marsh sediments are neither listed hazardous waste or exhibit hazardous characteristics, and therefore do not require treatment to meet RCRA Land Disposal Restrictions.

3. **Long-term Effectiveness and Permanence**

Long-term effectiveness and permanence would be achieved by all the active alternatives to varying degrees. Alternative M7 (complete removal) would achieve the highest level of long-term effectiveness and permanence because the most contaminated sediments would be permanently removed from the marsh. The remaining Alternatives (M2 through M6) would leave behind contaminated sediment that would need to be managed in place. With these alternatives there is the possibility that the cover could be breached by a large storm event, dredging, or some other disruption. Alternatives M6 through M4 would rely entirely on clean cover material to prevent exposures to the contaminated sediment that remains, M6 excavating the most contaminated sediment and consequently providing the most cover to the remaining contamination. M5 and M4 leave behind progressively more contaminated sediment, and therefore, achieve a slightly lower level of permanence. Alternatives M3 and M2 each rely to some degree on MNR to address the lower level contamination, which assumes that with time these materials would eventually be covered with clean sediments through the natural sedimentation processes. Monitoring would be required to determine if these processes are achieving the remediation goals in a reasonable timeframe. Therefore, EPA would consider M3 and M2 less reliable when considering long-term effectiveness and permanence.

Alternatives M2 and M5 armor the channel to prevent the channel from migrating and eroding out the deeper sediments in adjacent areas. The armored channel minimizes the potential for the channel to meander and expose currently buried contaminants, and so would add to the long-term permanence of these alternatives.

4. **Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment**

None of the alternatives treat contaminated sediments. Alternative M7 would provide the greatest reduction of contaminant mass at the sites, but does not rely on treatment.

5. **Short-term Effectiveness**

All the active alternatives involve at least some excavation and thus present a potential for minor short-term challenges. Alternative M2 requires the least excavation and presents the lowest short-term difficulties to the community or site workers, with M3 only slightly more difficult. Alternatives M4, M5, M6 and M7 would pose greater challenges in the short term compared to Alternatives M2 and M3 because larger and deeper excavations would pose an increased risk of short term exposure as well as increased materials handling. However, proper health and safety measures can mitigate these risks.

The risk of release during remedy implementation is principally limited to wind-blown transport or

surface water runoff. This is expected to be minimal based on the high moisture content of the sediments. Any potential environmental impacts associated with dust and runoff would be minimized with proper installation and implementation of dust and erosion control measures. In the event of a catastrophic storm that occurred during the implementation phase of one of the active alternatives, the risk of additional sediment releases would increase over the current conditions, because vegetation that currently minimizes sediment movement would be removed; however, there is little difference in the implementation time from the shortest (three months) to the longest (six months), so no alternative is substantially more favorable from this standpoint.

Implementation times of the remedial alternatives are as follows: M2 and M3 would require three months to construct and a minimum of five years, but as many as 45 years, to reach the remediation goals for surface sediments; M4--three months; and M5/M6/M7--six months.

6. **Implementability**

Although all of the alternatives are technically and administratively implementable, because they all utilize standard construction equipment and services, and require similar permit equivalencies, it is unclear whether natural recovery would be effective in achieving the remediation goals in a reasonable timeframe, if at all. Natural recovery is a type of remedy that EPA can consider if natural processes appear likely to achieve goals for a site, or part of a site, in a timeframe that is similar to other active remedies. Using favorable assumptions about sediment rates, the FS report predicts the MNR portion of Alternatives M2 and M3 could achieve remediation goals within five years. All of the other remedial alternatives achieve the remediation goals for the marsh within the first year after implementation and while these implementation times are not similar, a five-year implementation time is still considered reasonable. The FS also considered unfavorable sedimentation rates and calculated timeframes as long as 45 years to reach remediation goals, a timeframe that is clearly unacceptable. This broad range (5 years to 45 years) suggests a level of uncertainty about whether MNR can be relied upon to achieve the remediation goals.

EPA considers Alternatives M2 and M3 to be questionable for overall implementability.

7. **Cost**

As discussed above, cost estimates were developed jointly for the two sites without regard to the relative cost contribution of each site and, therefore, costs are divided equally between the Sites. EPA has not attempted to assess the actual contribution of each Site to marsh contamination. Actual allocations will be done at a future date when more information is available. Summing the per-site costs for each alternative provides the total cost for each alternative.

Horseshoe Road Site

The estimated present worth costs of Alternatives M2, M3, M4, M5, M6 and M7 are $3.7 million, $4.0 million, $7.5 million, $8.45 million, $9.3 million and $10.35 million, respectively.

Atlantic Resources Site

The estimated present worth costs of Alternatives M2, M3, M4, M5, M6 and M7 are $3.7 million, $4.0 million, $7.5 million, $8.45 million, $9.3 million and $10.35 million respectively.

Excavation and off-site disposal of contaminated sediments is the primary cost variable across the remedial alternatives, M2 (1,291 cubic yards) excavating the smallest quantity and M7 (21,145 cubic yards) the largest. The difference in cost between M2 or M3 and the remaining alternatives is substantial, whereas the costs of Alternative M4 through M7 are generally comparable.

O&M costs for Alternatives M2, M3 and M4 are

the highest, because they rely primarily on capping or MNR, and require additional on-site management to assure protectiveness or, in the case of MNR, monitoring to assure that the remedy is reaching the remedial goals for the marsh. Alternative M7 has the lowest O&M cost, because it leaves only inaccessible deeper sediments in place at the conclusion of the remedial action, and monitoring for that alternative focuses primarily on assuring that the wetland is restored.

The potential for remedy failure (e.g., a substantial disruption of a cap following a catastrophic storm event) to a degree that would require a second cleanup effort to restore damage to a remedy is not accounted for in the estimated costs of any of the alternatives.

When comparing the cost of each of these alternatives, it is apparent that what is achieved by the increase in cost from M2 to M7 is a decreased potential for remedy failure. For the marsh, one must consider that a failure here may compromise the down-gradient river remedy. Alternatives M2 and M3 are unproven, and may require implementation of another alternative should they fail to perform as expected. Alternatives M4 through M7 progressively depend on more excavation and less thin capping. The result is a more robust remedy. M7 leaves very little contaminated sediment on site and covers it with a very thick layer of backfill, and even a major storm event would have very little chance of exposing buried contamination. At the other end of the spectrum is M4, which relies completely on a thin-layer cap to address arsenic contamination at concentrations up to 1,050 mg/kg. The potential for failure during a storm or disruption from human activity is much greater.

8. **State/Support Agency Acceptance**

The State of New Jersey concurs with EPA's preferred alternative in this Proposed Plan.

9. **Community Acceptance**

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for the site.

RIVER ALTERNATIVES

Using the Remediation Goals of 100 mg/kg for arsenic and two mg/kg for mercury in river sediments, the FS targeted an area (marked on Figure 3) for remediation. Given the difficulties of collecting reproducible data in surface sediments and the potential for multiple point sources for the COCs in the river, EPA expects to limit its river response to the mudflat areas identified in Figure 3, a depositional zone that is clearly affected by the sites.

As with the marsh sediments, the FS uses zones defined by the Remediation Goals but divides the river sediments into additional zones, to assess a wider variety of response actions. In addition to areas defined by the Remediation Goals, river sediments were further divided into an area that exceeds 194 mg/kg for arsenic and 2.6 mg/kg for mercury. These values are based on the amphipod bioassay performed as part of the BERA. This area is considered more critical, and contains most of the contaminant mass. The second zone is characterized by sediments that are less than 194 mg/kg of arsenic but exceed the Remediation Goals. As with the marsh alternatives, the river alternatives presented in the FS address these zones to varying degrees as described in the summary of remedial alternatives below.

Common Elements

Many of the alternatives include common components. The FS assumes that the OU2 remedies and marsh remedies will eliminate these areas as ongoing sources of contamination to river sediments. It is expected that these other remedies would be performed before, or at least concurrently with the active remedial alternatives

evaluated below.

Because the COCs (arsenic, mercury and PCBs) are commonly found in sediments of the Raritan River Estuary, and because only a small portion of the sediment contamination in the Estuary can be reasonably attributed to the sites, the remedial actions contemplated for the river are limited to addressing a hotspot that is clearly attributable to the sites. EPA expects that the area targeted for remediation will be recontaminated to at least the background levels found throughout the Estuary. Post-remedy sediment monitoring in the river would be needed to assess whether actions taken to address this hotspot have been effective, and whether the marsh remedy was effective at eliminating the marsh as a continuing source to the river. Five-year reviews will be conducted. In addition, EPA will identify institutional controls to prevent disruption of the remedy. Institutional controls may include a Restricted Navigation Area or other similar control that would limit activities in the river that could disturb subaqueous capped areas.

Alternative R1: No Action

Estimated Capital Cost:	$0
Estimated (O&M) Cost:	$0
Estimated Present Worth Cost:	$0

Estimated Construction Time frame: None

Area dredged: 0.0 acres
Area Backfilled : 0.0 acres
Area capped: 0.0 acres

Regulations governing the Superfund program expect that the “no action” alternative will be evaluated to establish a baseline for comparison. Under this alternative, EPA would take no further action in the river to prevent exposure to sediment contamination, or to prevent the further migration of site contamination from the hotspot area. Institutional controls, such as a deed notice, would not be implemented to limit access to this area. Engineering controls would not be implemented to prevent site access or exposure to site contaminants.

Alternative R2: Monitored Natural Recovery

Horseshoe Road Site Costs

Estimated Capital Cost:	$120,000
Estimated O&M Cost:	$410,000
Estimated Present Worth Cost:	$335,000

ARC Site Costs

Estimated Capital Cost:	$120,000
Estimated O&M Cost:	$410,000
Estimated Present Worth Cost:	$335,000

Estimated Construction Time frame: 0 months
Area dredged: 0.0 acres
Area requiring cover: 0.0 acres

This alternative relies on natural processes in the river to reduce exposures to human and ecological receptors. This alternative is similar to Alternative R1 with the exception that there would be monitoring performed to determine the rate of recovery.

Institutional controls, such as a deed notice, would be required to prevent disruption of the recovered area.

Alternative R3: Shallow Dredge and Thin Cover

Horseshoe Road Costs

Estimated Capital Cost:	$ 1,310,000
Estimated O&M Cost:	$410,000
Estimated Present Worth Cost:	$1,400,000

ARC Costs

Estimated Capital Cost:	$ 1,310,000
Estimated O&M Cost:	$410,000
Estimated Present Worth Cost:	$1,400,000

Estimated Construction Time frame: 1-2 months
Area dredged: 0.8 acre
Area requiring cover: 2.5 acres

Under this alternative, approximately 1,290 cubic yards of sediment in the river that exceed 194 mg/kg arsenic and 2.6 mg/kg mercury would be dredged to a depth of one foot, and clean material would be used as backfill to restore the dredged area to the original contour. The remaining sediments within the area targeted for remediation would be covered with a thin sand layer (approximately six inches) that would both dilute contaminant concentrations at the surface and act as a cap on the more contaminated sediment below.

This alternative would require monitoring to ensure that the cover material remains in place and is functioning as expected. Institutional controls, such as a deed notice, would be required to prevent disruption of the capped sediments.

Alternative R4: Extended Shallow Dredge and Cover

Horseshoe Road Site Costs
Estimated Capital Cost: $2,745,000
Estimated O&M Cost: $410,000
Estimated Present Worth Cost: $2,800,000

ARC Site Costs
Estimated Capital Cost: $2,745,000
Estimated O&M Cost: $410,000
Estimated Present Worth Cost: $2,800,000

Estimated Construction Time frame: 1-2 Months
Area dredged: 2.5 acres
Area requiring cover: 2.5 acres

Under this alternative, approximately 4,030 cubic yards of sediment within the area targeted for remediation (Arsenic >100 mg/kg) would be dredged to a depth of approximately one foot, and clean material would be used to restore the dredged area to the original contour.

This alternative would require monitoring to ensure that the cover material remains in place and is functioning as expected. This alternative will require Institutional Controls to prevent disruption of the remediated area.

Alternative R5: Deep Dredge and Natural Resedimentation

Horseshoe Road Site Costs
Estimated Capital Cost: $5,335,000
Estimated O&M Cost: $410,000
Estimated Present Worth Cost: $5,450,000

ARC Site Costs
Estimated Capital Cost: $5,335,000
Estimated O&M Cost: $410,000
Estimated Present Worth Cost: $5,450,000

Estimated Construction Time frame: 3-4 months
Area dredged: 2.5 acres
Area requiring cover: 0.0 acres

Under this alternative, approximately 14,120 cubic yards of sediment within the area targeted for remediation (Arsenic >100 mg/kg) will be dredged to a depth of approximately 3.5 feet, but no cover material would be placed in the dredged area. Natural sedimentation would be expected to fill in the dredged area over time, providing a layer of cover over any residual sediment contamination that might exist beneath the area dredged.

This dredging effort would be expected to remove most of, but possibly not all the sediments in the area that exceed the remediation goals; however, post-dredging sampling would be required to determine if this is the case. This alternative may require monitoring if contaminated sediment is left behind to ensure that natural sedimentation would be covering any remaining contaminated sediment in order to achieve the remediation goals.

Alternative R6: Deep Dredge and Cover

Horseshoe Road Site Costs

Estimated Capital Cost:	$6,710,000
Estimated O&M Cost:	$45,000
Estimated Present Worth Cost:	$6,750,000

ARC Site Costs

Estimated Capital Cost:	$6,710,000
Estimated O&M Cost:	$45,000
Estimated Present Worth Cost:	$6,750,000

Estimated Construction Time frame: 3-4 months
Area dredged: 2.5 acres
Area requiring cover: 2.5 acres

Under this alternative, approximately 14,120 cubic yards of sediment within the area targeted for remediation (Arsenic >100 mg/kg) would be dredged to a depth of approximately 3.5 feet, and 3.5 feet of clean material would be used to restore the dredged area to the original contour.

This alternative is not expected to require monitoring except to assure that the cover material is not disturbed. (River sediment sampling may still be needed to monitor the performance of the marsh remedy.) This alternative will require institutional controls to prevent disruption of the dredged and covered area.

EVALUATION OF RIVER ALTERNATIVES

1. **Overall Protection of Human Health and the Environment**

Alternatives R3, R4, R5 and R6 provide varying levels of protection of human health and the environment through combinations of dredging, covering, institutional controls, and monitoring. The “no action” alternative and Alternative R2 (Monitored Natural Recovery) take no action to reduce the potential for direct contact exposure or the potential for the hotspot area to be a continuing source of contamination to the river, and neither of these alternatives appear to satisfy the Remedial Action Objectives for river sediments. While natural sedimentation and dilution may eventually reduce the surface sediment concentrations somewhat, the timeframes for this recovery may be quite long. In the FS, MNR was modeled to take as little as three years and as long as 65 years; however, there is only marginal evidence of natural recovery to date. The site sources that would have provided a continuing source of contaminated sediments during facility operations appear to have substantially diminished, and the facilities have not operated for over 20 years; yet, this diminished sediment loading has not appeared in the surface sediment concentrations as "recovery" (a clear pattern of reduced concentrations). In addition, because most of the area targeted for remediation is in a depositional zone of the river and is currently a mudflat at low tide, it is very difficult for new, cleaner sediment to deposit on the surface, unless the more highly contaminated sediments are first removed, and if the highly contaminated sediments are removed through the natural redistribution of sediments throughout the river, it would not satisfy the remedial action objectives.

Alternatives R6 (Deep Dredge and Cover) and R5 (Deep Dredge and MNR) provide the largest mass reduction, one method of evaluating environmental protection. Alternatives R3 (Shallow Dredge and Thin Cover) and R4 (Extended Shallow Dredge and Cover) also remove a portion of the most highly contaminated and accessible sediments (those at the surface) but rely more heavily on cover material to manage deeper sediments. Alternatives R3 through R6 rely on covering contaminated sediments left in place, to varying degrees. Alternative R3 may offer a slightly lesser degree of protectiveness than the others, because a thin-layer cover is expected to mix and dilute with contaminated bottom sediments, and the resulting surface sediment concentrations may be slightly higher than for the other active alternatives.

Long-term maintenance and monitoring would be required to ensure that cover material remains in

place, and efforts made to assure that the cover material is not disturbed, through the designation of a Restricted Navigation Area, (RNA) or similar control.

Because Alternative R1, the "No Action" alternative, and Alternative R2 (MNR) do not satisfy the Remedial Action Objectives for the river sediments, they were eliminated from consideration under the remaining eight criteria.

2. **Compliance with ARARs**

Actions taken at any Superfund site must meet all applicable or relevant and appropriate requirements of federal and state law or provide grounds for invoking a waiver of those requirements. There are no chemical-specific ARARs for the contaminated river sediments. The cleanup goals are risk-based. Alternative R6 would address the cleanup goals through dredging and backfilling, and the other alternatives would achieve the cleanup goals by dredging, and capping.

Based upon the available documentation regarding the source of contamination and sediment testing, EPA has concluded that the river sediments are neither listed hazardous waste or exhibit hazardous characteristics, and therefore do not require treatment to meet RCRA Land Disposal Restrictions prior to disposal in a RCRA-compliant unit.

3. **Long-term Effectiveness and Permanence**

Long-term effectiveness and permanence would be achieved by Alternatives R3, R4, R5, and R6, to varying degrees. Alternatives R6 (Deep Dredge and Cover) would achieve the highest level of long-term effectiveness and permanence because the largest mass of contaminated sediment would be permanently removed from the river and the thickest layer of cover material would be put in place. Alternative R5 could be considered slightly less effective because it relies on natural processes to cover any residual contamination that may remain; however, after sediment dredging to 3.5 feet, the dredged area would be expected to create a local depositional environment that would accumulate sediment at a higher rate than the surrounding areas, providing cover material relatively rapidly.

Alternatives R3 (Shallow Dredge and Thin Cover) and R4 (Extended Shallow Dredge and Cover) provide long-term effectiveness and permanence by dredging the most highly contaminated and accessible sediments at the surface, and placing a sediment cap over residual contaminated sediment; these sediment caps need to be monitored to assure that they will remain in place. Alternative R4 would be considered more reliable over the long-term compared to Alternative R3, because the thin sand cover of Alternative R3 is placed on top of existing sediments and is more prone to the natural redistribution of river-bottom sediments (some portion of the cap material would be washed away), whereas cover material for Alternative R4 is placed after dredging, and the river bottom is essentially unchanged. In addition, the one foot of cover material in Alternative R4 would have little mixing and dilution of surface sediments, whereas the six-inch sand cover in Alternative R3 relies, at least partially, on mixing and dilution of the surface sediment concentrations, and the resulting surface sediment concentrations would be higher.

Alternatives R3 and R4 are more at risk of failure from sediment disturbance than are Alternatives R5 or R6, which incorporate a thicker cover layer. The most likely causes of sediment disturbance would be human activities (such as boating or dredging) or ice scour during the winter months. The capped area in the river would be designated as a Restricted Navigation Area (RNA) where anchoring would not be allowed, and access would be restricted. The RNA would also be marked on navigational charts. Alternatives R3 and R4 rely heavily on an RNA, and on the limited accessibility of this area to larger water

craft to prevent damage to a capped area, while alternatives R5 and R6 would rely more on deeper contamination removal and cover to prevent failure. While preventative measures can be put in place to prevent human disturbance of this area, the only measure to address ice scour would be deeper removal and cover as provided in alternatives R5 and R6. In the case of R5 however, the time required for the natural sedimentary processes to fill in the excavated area is uncertain, and therefore we can not definitively say when the remedy will become fully protective.

For any of the remedial alternatives considered, background sediment contamination present throughout the Raritan River Estuary will result in the some recontamination of surface sediments over the long-term.

4. **Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment**

None of the alternatives involve treatment of the contaminated sediments. Alternatives R6 and R5 remove the most contaminated mass from the river, and therefore do reduce the most volume. However, treatment is not involved and these alternatives do not do more than the other alternatives to satisfy EPA's preference for treatment of wastes.

5. **Short-term Effectiveness**

All of the alternatives would be effective over the short term. Alternatives R3 through R6 involve at least some dredging and thus present minor short-term challenges. The risk of release during remedy implementation is principally limited to resuspension of sediments in the river, and to wind-blown transport or surface water runoff from stock piles. All potential environmental impacts associated with resuspension, dust and runoff can be minimized with proper engineering controls.

Risk to workers posed by normal dredging and materials-handling should be minimal and proper health and safety measures should mitigate this risk.

For the remaining alternatives with the exception of Alternative R5 (Deep Dredge and Natural Resedimentation), once the construction phase is complete, the remedy will be fully effective. The implementation time for Alternatives R3 and R4 is about two months, while Alternative R6 would require four months. Alternative R5 would require about four months to construct and at least 30 months before sedimentation would cover the sediments to a depth that is protective, resulting in an implementation time of about three years.

6. **Implementability**

Alternatives R3 through R6 are technically and administratively implementable, because they all utilize standard construction equipment and services, and require similar permit equivalencies.

7. **Cost**

As discussed above, cost estimates were developed jointly for the two sites without regard to the relative cost contribution of each site and, therefore, costs are divided equally between the Sites. EPA has not attempted to assess the actual contribution of each Site to river contamination. Actual allocations will be done at a future date when more information is available. Summing the per-site costs for each alternative provides the total cost for each alternative.

Horseshoe Road Site

The estimated present worth costs of Alternatives R2, R3, R4, R5, and R6 are $0.34 million, $1.4 million, $2.8 million, $5.45 million, and $6.75 million, respectively.

Atlantic Resources Site

The estimated present worth costs of Alternatives R2, R3, R4, R5, and R6 are $0.34 million, $1.4 million, $2.8 million, $5.45 million, and $6.75 million, respectively.

Dredging and off-site disposal of contaminated sediments is the primary cost variable across the remedial alternatives, with Alternative R3 dredging the least (1,290 cubic yards) and Alternatives R5 and R6 dredging the most (14,117 cubic yards).

The long-term monitoring costs for alternatives R2 through R5 are the highest, because they rely primarily on covering or MNR, and require additional on-site management to assure protectiveness or, in the case of MNR, monitoring to assure that the remedy is reaching the remedial goals for the river. Alternative R6 has the lowest long term monitoring cost, because it leaves only inaccessible deeper sediments in place at the conclusion of the remedial action. The potential for remedy failure (e.g., a substantial disruption of a cap following a catastrophic storm event) to a degree that would require a second cleanup effort to restore damage to a remedy is not accounted for in the estimated costs.

8. **State/Support Agency Acceptance**

The State of New Jersey concurs with EPA's preferred alternative in this Proposed Plan.

9. **Community Acceptance**

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for the sites.

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SUMMARY OF THE PREFERRED ALTERNATIVES

The Preferred Alternatives for the cleanup of OU3 marsh and river sediments are Alternative M7, Complete Removal, and Alternative R6, Extended Deep Dredge and Cover, hereafter referred to as the Preferred Sediment Alternatives. These alternatives include excavation, transportation and disposal of approximately 21,000 cubic yards of contaminated sediments from the Horseshoe/ARC marsh, and dredging approximately 14,120 cubic yards of contaminated sediments from the Raritan River. The excavated/dredged areas would be restored to approximately the current grades. Residual contaminated sediments remaining at depth would be capped in place. The accessible contaminated sediments would be removed in the marsh, and the cover layer would provide a substantial barrier to any residual deeper contaminants that might remain. A breach to the cover material appears highly unlikely under current and potential future scenarios. Because some contaminated material will be left on site, deed restrictions will be needed to manage the isolated sediments over the long term. This Remedy will require on-site restoration of approximately six acres of wetlands disturbed during implementation of the remedy.
The Preferred Sediment Alternative for the marsh was selected over other alternatives because it is expected to achieve substantial and long-term risk reduction through off-site disposal, and is expected to allow the property to be used for the reasonably anticipated future land use, which is open space/wetland. The Preferred Marsh Sediment Alternative reduces the risk within a reasonable time frame, at a cost comparable to other alternatives and is reliable over the long-term. Although M7 and M6 are very similar in most respects, M7 was chosen because it removes a higher mass of contaminants at only slightly higher cost than M6. Since the preferred alternative would achieve the remediation goals that are protective for the current expected human exposure scenarios (recreational land use), but are not expected to achieve levels that would allow for unrestricted use, institutional controls, such as a deed notice or covenant, may be needed to prevent a change in land use.

The river portion of the Preferred Sediment

Alternatives was selected over the other alternatives because it is expected to achieve substantial and long-term risk reduction through off-site disposal of dredged sediments, reducing contaminant levels in the river, and reducing the mudflat area as a source of contamination to the river. The Preferred River Sediment Alternative reduces the risk within a reasonable timeframe, at a cost comparable to the other alternatives and provides for long-term reliability of the remedy. Although Alternative R4 would provide protectiveness at the surface to a degree that would be similar to R6, EPA believes that the additional long-term effectiveness and permanence in a river setting, where conditions cannot be as easily controlled as on land, justifies the additional cost of removing a larger quantity of contaminated sediments.

The Preferred Sediment Alternatives are believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. EPA believes that the Preferred Sediment Alternatives would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected alternative can change in response to public comment or new information.

COMMUNITY PARTICIPATION

EPA provided information regarding the cleanup of the Horseshoe Road and Atlantic Resources Corporation sites to the public through public meetings, the Administrative Record file for the sites, and announcements published in the Suburban News. EPA encourages the public to gain a more comprehensive understanding of the sites and the Superfund activities that have been conducted there.

For further information on the Horseshoe Road and Atlantic Resources sites, please contact:

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The dates for the public comment period, the date, location and time of the public meeting, and the locations of the Administrative Record files, are provided on the front page of this Proposed Plan.