Feasibility Study Report
for the
Buoy 212 Dredge Spoil Disposal Area
Fort Edward, New York

Site Number 558018

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List of Abbreviations and Acronyms

APEG	alkaline polyethylene glycol
ARAR	applicable or relevant and appropriate requirement
BCD	base-catalyzed decomposition
BEST	Basic Extractive Sludge Treatment
BGS	below ground surface
BUD	beneficial use determination
Buoy 212	Buoy 212 Dredge Spoil Disposal Area
C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeters per second
COC	contaminant of concern
COPC	chemical of potential concern
CY	cubic yards
DER	Department of Environmental Remediation
EEEPC	Ecology and Environment Engineering, P.C.
EPA	(United States) Environmental Protection Agency
ERA	ecological risk assessment
ESMI	Environmental Soil Management, Inc.
F	Fahrenheit
FS	feasibility study
HHRE	Human Health Risk Evaluation

List of Abbreviations and Acronyms (cont.)

HTTD	high-temperature thermal desorption
IC	institutional control
IRM	interim remedial measure
ISTD	in situ thermal desorption
ISV	in situ vitrification
KPEG	potassium polyethylene glycol
LTM	long-term monitoring
LTTD	low-temperature thermal desorption
mg/kg	milligrams per kilogram - a mass concentration of parts per million (ppm)
NCP	National Contingency Plan
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetland Inventory
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethylene
PPE	personal protective equipment
ppm	parts per million - a concentration equivalent to 1/1,000,000 of the whole
RAO	remedial action objective
RCC	Resource Conservation Company

List of Abbreviations and Acronyms (cont.)

RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
SCG	Standards, Criteria, and Guidance (used by the NYSDEC in the remedial program remedy selection process set forth in NYCRR 375-1.8)
SCO	soil cleanup objective
SITE	Superfund Innovative Technology Evaluation
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TAGM	Technical Administrative Guidance Memorandum
TBC	to be considered
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TerraTherm	TerraTherm, Inc.
TSCA	Toxic Substance Control Act
USGS	United States Geological Survey
VOC	volatile organic compound

1 Introduction

1.1 Purpose and Organization

Ecology and Environment Engineering, P.C. (EEEPC) completed a feasibility study (FS) at the Buoy 212 Dredge Spoil Disposal Area (Buoy 212) for the Division of Environmental Remediation (DER) in the New York State Department of Environmental Conservation (NYSDEC) under State Superfund Contract Work Assignment D004435-07. The Buoy 212 project site (NYSDEC Site 558018) is located along the eastern shore of the Hudson River in the town of Fort Edward, New York, in Washington County about 1.3 miles down-river (south) of Champlain Canal Lock 7 and near the floating red nun Buoy 212 that marks the eastern margin of the navigation channel of the Champlain Canal within the Hudson River (see Figure 1-1). The Buoy 212 site contains dredge spoil materials removed from the Champlain Canal/Hudson River navigation channel south of Canal Lock 7 in conjunction with routine and emergency maintenance dredging operations of the Canal System between 1970 and 1979. Some of these dredge spoil materials have been found to contain variable concentrations of polychlorinated biphenyls (PCBs). This FS was developed using information from: the United States Environmental Protection Agency's (EPA's) Guidance for conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA; EPA 540/G-89/004); NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 4030 - Selection of Remedial Actions at Inactive Hazardous Waste Sites; NYSDEC's Draft DER-10 - Technical Guidance for Site Investigation and Remediation; and 6 New York State Codes, Rules, and Regulations (NYCRR) Part 375 - Environmental Remediation Programs.

A remedial investigation (RI) was completed to characterize the nature and extent of contamination at the Buoy 212 site. The details and findings of the RI are described in the *Remedial Investigation Report for the Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York* (EEEPC 2011).

EEEPC completed RI/FS programs for NYSDEC at five other upland dredge spoil disposal sites located along the Upper Hudson River Valley. The results of these other investigations are presented in the RI/FS reports prepared for each project site. (Refer to Appendix A for a location map of these other project sites.)

This FS describes the technologies proposed and evaluated to address the contamination identified during the RI completed at the Buoy 212 site. The FS report is divided into six sections.

- Section 1 describes the purpose for the study and discusses site background information.
- Section 2 presents the process used to identify the appropriate standards, criteria and guidance (SCG) values applicable to the various contaminants found at the site and provides insight into the development of appropriate remedial action objectives (RAOs) for the protection of human health and the environment.
- Section 3 evaluates various remedial technologies that may be appropriate for the remediation of site contamination and the development of remedial alternatives to address that contamination.
- Section 4 discusses the combination of various remedial technologies to form appropriate remedial alternatives and provides a detailed description of each of the proposed alternatives.
- Section 5 presents a detailed and comparative analysis of proposed remedial alternatives along with some supporting rationale and preliminary cost estimates for each proposed remedy.
- Section 6 contains a listing of the references cited in this report.

1.2 Background Information

1.2.1 Site Description and Surrounding Land Uses

The Buoy 212 site is located along the eastern shore of the Hudson River in the Town of Fort Edward (Washington County), about 1.3 miles down-river (south) of Champlain Canal Lock 7 and near the floating red nun Buoy 212 that marks the eastern margin of the navigation channel of the Champlain Canal within the Hudson River (see Figure 1-1). The site consists of a closed and covered basin and earthen containment berm complex built by the Waterways Maintenance Division of the New York State Department of Transportation (NYSDOT) to dewater and hold sediment removed from the Champlain Canal/Hudson River navigation channel south of Canal Lock 7 - with emphasis on the navigation channel in the Hudson River between the Buoy 212 and Buoy 216 channel markers - in conjunction with routine and emergency maintenance dredging operations of the Canal System. The unlined settling basin system at this site was initially constructed by excavating the native soils on the property slightly and grading the displaced soils outward and upward to form the various containment berms. During subsequent maintenance operations, it is likely that some of the older dredge spoil materials were re-graded in order to deepen the settling basin and accommodate the disposal of additional dredge spoil materials. In its present closed and covered state, the dredge spoil disposal structure is about 200 feet wide and extends about 850 feet along the shore of the Hudson River with a footprint covering nearly 4.1 acres on a parcel owned by New York State. The adjoining property to the north is privately owned and occupied by a single dwelling and a few outbuildings. The residence on this property is connected to a public water supply. The adjoining property to the east is occupied by a single dwelling and several outbuildings and small service structures. There is a private well on this property that draws water from the overburden aquifer. The well is approximately 300 feet away from the eastern margin of the site. The adjoining property to the south is an open field and is used as a temporary support area and access point to the Hudson River for the Hudson River Dredging Project.

The dredge spoil disposal structure is fenced and surrounded by trees on the north, east, and west sides. Ground elevations across the site range between 125 feet and 140 feet above mean sea level. The western margin of the Buoy 212 disposal structure has stone riprap armoring near the base and out onto the Hudson River floodplain and along the shoreline in this area. The slopes of the disposal structure on the western and eastern sides of the site are relatively steep with an abrupt change in grade at the margins, while the slope at the southern end of the site tapers gradually and levels out to the surrounding grade near the perimeter fence and the extreme southern end of the disposal structure. The slope at the northern end of the site is relatively moderate and gradually blends with the surrounding grade in this area.

Stream gauge data collected for the Hudson River from gauges established by EEEPC on the opposite shore near this site for another project site shows that the river surface in this area fluctuated between 119 feet and 120 feet above mean sea level during the investigation activities at the Buoy 212 site.

Regional climate data obtained from the National Oceanic and Atmospheric Administration (NOAA) shows that the Buoy 212 site is located in a relatively humid area of the northeastern United States, characterized by mild summers and cold, but not commonly severe, winters. The majority of precipitation in the Fort Edward/Glens Falls area is derived from moisture-laden air that is transported northward by atmospheric processes from the Gulf of Mexico. According to NOAA's records for Albany County, (approximately 40 miles south of the site), the annual precipitation is evenly distributed over the year, with a 30-year average of 38.6 inches. The greatest average monthly amounts occur during the growing season, April through September. The average seasonal snowfall is 62.9 inches, while January and February account for approximately half of the seasonal snowfall.

This site is currently zoned as "Hudson River/Historic Canal Corridor," (LaBerge Group 2008).

1.2.2 Site History

Operational/Disposal History

As described above, a single unlined settling basin and baffle system was constructed at this site by the Waterways Maintenance Division of the NYSDOT and was used to dewater and hold dredge spoil material removed from the Champlain Canal/Hudson River navigation channel south of Champlain Canal Lock 7 - with emphasis on the navigation channel in the Hudson River between the Buoy 212 and Buoy 216 channel markers - in conjunction with routine and emergency maintenance dredging operations of the Canal System. Available NYSDOT records report that the Buoy 212 dredge spoil disposal area was used between 1970 and 1979. The records covering this period report the disposal of an unspecified volume of the 283,021 cubic yards (CY) of dredge spoil material processed in 1970 for the given stretch of River and the disposal of 28,725 CY in 1976 from the navigation channel between the Buoy 212 and Buoy 216 channel markers. Records also indicate that dredge spoils were also placed at Buoy 212 in 1979, but do not provide a specific volume out of the 66,930 CY processed that year for the given stretch of River. The Buoy 212 site was last used in 1979 and covered with 12-inches of sand and seeded. As described earlier, PCB contamination at the Buoy 212 site is attributable to the presence of PCB wastes (from activities at two upstream General Electric plant site sources) in some Hudson River sediments that were removed from the Champlain Canal/Hudson River navigation channel as dredge spoil material.

Remedial History/Previous Investigations

During an assessment of areas with possible PCB contamination in the Upper Hudson River Valley completed by Weston Environmental for NYSDEC in 1978, it was found that the soils/dredge spoil materials at this site were contaminated with PCBs at levels up to 264 parts per million (ppm) (Weston 1978). As mentioned previously, the Buoy 212 site was last used in 1979 and was covered with 12 inches of sand and seeded. Monitoring wells were also installed and a monitoring program was established. These actions were done in compliance with Toxic Substances Control Act (TSCA) requirements imposed by the EPA when they issued an approval for the temporary storage/disposal of PCB-laden material at this site in September 1979. Monitoring confirmed PCB contamination in the local groundwater and shallow soils at the site and a soil sampling program initiated in 1989 confirmed PCB contamination at the site within the limits of the closed dredge spoil disposal structure.

In May of 1989, NYSDEC listed the site as a Class 2 site in the Registry of Inactive Hazardous Waste Disposal Sites in New York State. A Class 2 site is a site where hazardous waste presents a significant threat to the public health or the environment and action is required.

In 1991, a TSCA-approved clay cover was added over the existing “standard turf” cover. The new cover was constructed by the NYSDOT and the earlier monitoring wells were replaced. Subsequent monitoring demonstrated that PCB levels in the local groundwater diminished such that PCBs were no longer detected in the groundwater following the installation of the TSCA-approved cover. A follow-up assessment completed by Malcolm Pirnie in 1992 for NYSDEC confirmed the presence of PCB contamination at the Buoy 212 site at levels greater than 50 ppm, the definition of hazardous waste, in five of the 21 samples that had reportable PCB detections. PCB concentrations for all samples ranged between non-detect (less than 2 ppm) and 180 ppm. Based on the results of the Malcolm Pirnie study, it was estimated that the Buoy 212 site contained 65,500 CY of contaminated soil with a PCB concentration greater than 2 ppm. The mass of PCBs at this site was also estimated to be 7,000 pounds in the Malcolm Pirnie report.

The site was removed from the New York State Registry of Inactive Hazardous Waste Disposal Sites in March 1998 because it was determined that TSCA facilities do not meet the definition of "inactive sites." Personnel from NYSDOT inspect and sample the groundwater monitoring wells and maintain the site under the TSCA program. The most recent TSCA program inspection occurred on May 20, 2010.

A series of 11 surface soil samples and two nearshore floodplain/sediment samples were collected from the adjoining residential property to the north of the Buoy 212 site in August of 1998 by NYSDEC. PCBs were detected at concentrations of 10.4 ppm and 19.94 ppm in two of the 11 surface soil samples - and at concentrations of 1 ppm and 6.5 ppm in the two nearshore floodplain/ sediment samples. These findings were included in NYSDEC's July 2001 Dredge Spoils Investigation Report.

In 2005, NYSDEC contracted EEEPC to perform the Buoy 212 RI/FS to characterize the nature and extent of contamination at the site and to develop remedial alternatives to address that contamination. Reports covering the details of the Buoy 212 RI/FS were finalized in February 2011. In these reports, it was estimated that the Buoy 212 site contains approximately 56,000 CY of contaminated material.

The most recent TSCA program inspection occurred on May 20, 2010.

An interim remedial measure (IRM) was completed in August of 2010 to address an area where PCB-contaminated soils/dredge spoil materials were identified on an adjacent property at concentrations above residential cleanup levels. Approximately 100 CY of PCB-contaminated soils/dredge spoil materials were excavated and removed to an off-site disposal facility during the IRM Soil Removal Program. Subsequent soil sampling confirmed that the remedial measure was effective. The causeway has been restored with clean materials.

1.2.3 Site Geology and Hydrology

The nature of the overburden at the Buoy 212 site was characterized by direct observation methods during the RI (EEEPC 2011). Soil samples that were recovered during the various borehole drilling and exploration programs were inspected and described.

The geologic setting for the Buoy 212 site has a varied mixture of silts, sands, gravel, and clay and that were placed over bedrock by natural processes and a varied mixture of sand, silt, shale fragments, and debris that were placed over the earlier lacustrine and alluvial deposits by unnatural processes a relatively short time ago.

The overburden materials in the natural setting are located in most areas outside of the basin and berm structure at the site. The overall thickness of these native soils at Buoy 212 is not known, but earlier work by others report similar undisturbed silts, sands, gravel, and clay to a depth about 40 feet lower than the bottom of the Buoy 212 dredge spoil disposal structure.

The overburden materials in the unnatural setting are best described as mechanically reworked native soil mixed with dredge spoil materials in the closed and covered dredge spoil disposal structure. The dredge spoils are typically dark gray to black, fine to medium sands with varying amounts of silt, black shale fragments, pebble gravel, brick fragments, coal fragments, fused slag, glass shards, and wood debris. Based on observations made during borehole drilling and sampling, materials that could be characterized as dredge spoils varied in thickness from a few inches to nearly 13 feet.

Bedrock was not encountered at any of the borehole locations advanced during the RI (EEEPC 2011).

The cover materials over the closed dredge spoil disposal structure at the Buoy 212 site consists of clay over sand. The clay cover varied in thickness from a few inches near the margins to approximately 2 feet over most of the disposal structure. The clay materials are typically light brown in color with occasional yellowish mottling. The clay cover material is directly over the earlier sand cover placed over the disposal structure to isolate the dredge spoils within. These sands are typically light brown to grayish-brown, fine-grained, and vary in thickness from a few inches to about 3 feet in some places over the site.

The entire closed and covered dredge spoil disposal structure, and the parcel of land occupied by it, is covered with grasses, trees, and other vegetation. Overland water flow at the Buoy 212 site occurs primarily during heavy precipitation events or spring snow melts as surface runoff. During heavy precipitation events, runoff is shed radially away from the higher areas of the closed and covered dredge spoil disposal area to the topographic low areas along the eastern and western margins. Along the eastern margin, runoff from Buoy 212 and nearby areas intermittently flows southward and collects in the southeastern part of the Buoy 212 property. Water that intermittently collects in this area has the potential to drain from the east side of the closed and covered former dredge spoil disposal structure to the west side through a steel culvert when the water level is high enough to spill through. Once on the west side of the dredge spoil disposal structure, the water drains across a narrow floodplain shelf to the adjacent Hudson River. When the volume of collected water is not great enough to spill through the steel culvert, the runoff either infiltrates and/or evaporates without reaching the Hudson River as direct runoff. Along the western margin, runoff accumulates in the lowest portions of the narrow floodplain shelf where it drains slowly into the Hudson River through breaks in the natural and armored bank levy or infiltrates and/or evaporates without reaching the Hudson River as direct runoff.

Groundwater elevations across the site ranged from approximately 118 feet to 123 feet above mean sea level during the investigation period. As expected, the lowest groundwater elevations were observed during the September monitoring event, when seasonal precipitation was relatively low.

Mapping shows that groundwater flow at this site typically moves away from the topographic rise on the eastern side and toward the Hudson River in a general west-southwest direction. Based on groundwater elevation measurements and other observations made during the RI (EEEPC 2011), lines of equal groundwater elevation are nearly parallel with the shore of the river and groundwater appears to flow through the native overburden soils just below the dredge spoil materials placed at the site most of the year.

1.2.4 Nature and Extent of Contamination

The placement and stockpiling of dredge spoil material associated with routine and emergency maintenance dredging operations of the New York State Champlain Canal/Hudson River navigation channel between Canal Lock 7 (Fort Edward) and the floating red nun channel marker Buoy 212 south of Lock 7, have resulted in the disposal of hazardous wastes, including PCBs and metals. These wastes, sporadically entrained within the sediment of the Hudson River and subsequently removed with some of the sediment from the Champlain Canal/ Hudson River navigation channel as dredge spoil material in the past, have contaminated the soil at the Buoy 212 site. Historical and reoccurring floodplain deposition of contaminated Hudson River sediments appear to have contaminated the soil upon the narrow floodplain shelf between the Hudson River and the western margin of the closed and covered Buoy 212 dredge spoil disposal site. Even though some environmental samples collected at the site contain metals that can be attributed to site activities at concentrations above the recommended soil cleanup objectives or alternative screening criteria, in general, the number of metal exceedances was less frequent than the number of PCB exceedances. Therefore, PCBs are the primary contaminants of concern at this site.

The following paragraphs summarize test results for drainage network soil, drainage water, surface soil, subsurface soil, and groundwater sampling as described in the RI (EEEPC 2011). Samples for each media were analyzed for PCBs and metals.

Drainage Network Soils

Drainage network soil samples were collected from eight locations. Two of the eight drainage network soil samples contained PCBs at concentrations of 2.9 ppm and 8.3 ppm. These results are at concentrations greater than the NYSDEC Part 375-6.8 soil cleanup objective (SCO) established for the unrestricted use of the site (0.1 ppm) and for the SCO applicable to the restricted-commercial use of the site (1.0 ppm). The sample with the higher PCB result was located in the Hudson River floodplain along the southwestern margin of the closed and covered dredge spoil disposal area. The other result was located along the margin of the cover on the eastern side of the site in the vicinity of an area where burrowing animals have brought dredge spoil materials to the surface.

Seventeen metals were detected in drainage network soil samples collected from the site. Chromium, lead, mercury, and zinc were present at concentrations exceeding applicable NYSDEC SCOs and aluminum, calcium, iron, magnesium, and potassium were found at concentrations exceeding alternative screening criteria (New York State background [95th percentile], Source-Distant Data Set from NYS Brownfield Cleanup Program, Technical Support Document, Appendix D, September 2006). In general, the highest concentrations of metals were found at a sample location in the Hudson River floodplain along the southwestern margin of the site. This location is also where the drainage network soil sample with the highest PCB result was collected.

Drainage Network Water

There are no sustained surface water bodies on this site. One area where precipitation intermittently drains along the eastern margin and collects intermittently in the southeastern part of the Buoy 212 property was identified and sampled once. Water that collects in this area has the potential to drain from the east side of the closed and covered former dredge spoil disposal structure to the west side through a steel culvert when the water level is high enough to spill through. Once on the west side of the dredge spoil disposal structure, the water drains across a narrow floodplain shelf to the adjacent Hudson River. At the time of sampling, water was flowing through the pass-through culvert and samples were collected along the water path on the west side of the disposal structure. None of the eight drainage water samples that were collected contained PCBs. A total of 10 metals were detected in the drainage water samples collected from the drainage network at the site. Of these, aluminum and iron were detected at concentrations above the NYSDEC Class D surface water standards they were compared to for assessment in nearly all of the eight samples, but the results appear to represent natural conditions of the native soil rather than contamination attributable to the disposal of dredge spoil materials at this site.

No site-related surface water contamination of concern was identified during the RI. Therefore, no remedial alternatives need to be evaluated for surface water.

Surface Soil

Surface soil samples (covering the 0 to 2-inch soil depth interval) were collected from 65 locations at this site to assess direct human exposures. Samples from the surface at some of the exploration boreholes advanced at this site also contributed to the overall surface soil assessment. All 65 samples were analyzed for PCBs. Results confirm PCBs at 42 surface soil sampling points with 21 samples reporting concentrations above 0.1 ppm (the unrestricted use SCO) and 12 samples reporting concentrations above 1.0 ppm (the Restricted Use-Commercial SCO applicable to this site, and the same value as the Restricted Use-Residential SCO). The highest PCB concentration in surface soil was 9.9 ppm in a sample collected from the Hudson River floodplain along the southwestern margin of the closed and covered dredge spoil disposal area. Nearly all of the other results found above the applicable SCOs were either located along the margins of the cover over the site or on top of the cover in the vicinity of areas where burrowing animals have brought dredge spoil materials to the surface. PCBs in soil are the risk drivers for human health and for wildlife.

The results also indicate that chromium and mercury (metals that may be attributable to the contaminated dredge spoil materials at the site or, in some cases, historical and reoccurring floodplain deposition of contaminated Hudson River sediments) were found at levels exceeding their respective unrestricted and commercial use SCO values in a few samples. These metals are not significant risk drivers for either human health or for wildlife in light of their low frequency.

Subsurface Soil

One hundred and twenty-seven subsurface soil samples (deeper than the 0 to 2-inch soil depth interval) were collected from 56 locations at this site and analyzed for PCBs and metals. Results confirm PCBs in 76 subsurface soil samples with 66 samples reporting concentrations above 0.1 ppm (the Unrestricted Use SCO) and 53 samples reporting concentrations above 1.0 ppm (the Restricted –Use-Commercial SCO applicable to this site). The highest PCB concentration in the soil under the existing isolation cover was 47 ppm. The highest PCB concentration in the subsurface soil outside of the existing isolation cover and in the vicinity of the closed and covered former dredge spoil disposal area was 2.4 ppm. Nearly all of the subsurface soil results found above the applicable SCOs outside of the existing isolation cover were either located in samples collected from the Hudson River floodplain or in the vicinity of areas where burrowing animals have disturbed dredge spoil materials along the margins of the closed and covered dredge spoil disposal area. PCBs in soil are the risk drivers for human health and for wildlife.

The results also indicate that cadmium and chromium (metals that may be attributable to the contaminated dredge spoil materials at the site or, in some cases, historical and reoccurring floodplain deposition of contaminated Hudson River sediments) were found at levels exceeding their respective unrestricted use SCO values in a few subsurface soil samples analyzed for these metals. These metals are not significant risk drivers for either human health or for wildlife at the site in light of their low frequency. The same rationale can be applied to the findings for iron although iron may also be naturally occurring as well.

Groundwater

A total of 32 groundwater samples were collected from eight groundwater monitoring wells around the site in March, June, September, October, and December of 2006 to assess the overburden groundwater conditions at the site. All 32 samples were analyzed for PCBs and metals. PCBs were not detected in any of the groundwater samples and none of the primary metals of concern at this site (cadmium, chromium, lead, and mercury) were found at levels exceeding their respective groundwater quality standards. Other metals (iron, magnesium, manganese, and sodium) were found at levels that exceeded their respective groundwater quality standards or guidance values around the site, but these findings appear to represent natural conditions.

A single groundwater sample was collected from a residential well near the site in June of 2008. The well draws water from the overburden aquifer and did not show any impact attributable to the Buoy 212 site. The sample was analyzed for PCBs and metals. No PCBs were detected in this groundwater sample. Seven metals (barium, calcium, copper, magnesium, potassium, sodium, and zinc) were detected in the water sample, but none were present at concentrations exceeding the applicable groundwater standards or guidance values.

No site-related groundwater contamination of concern was identified during the RI. Therefore, no remedial alternatives need to be evaluated for groundwater.

1.2.5 Contamination Fate and Transport

PCBs in soil are the primary contaminants of concern at this site. The RI evaluated various natural and man-induced mechanisms that can result in the migration of contaminants from their source areas and concluded that PCBs in soil at this site might be transported by overland water flow, infiltration, and a few man-induce mechanisms including excavation, grading, and vehicular traffic. The impacts of these mechanisms vary by source area and specific site conditions.

Overland Water Flow

Overland water flow could result in the migration of site contaminants if those contaminants are exposed at or on the ground surface, present in soils at or near the surface, and/or are exposed to the influence of overland water flow.

Overland water flow at the Buoy 212 site occurs primarily during heavy precipitation events or spring snow melts as surface runoff. During heavy precipitation events, runoff is shed radially away from the higher areas of the closed and covered dredge spoil disposal area to the topographic low areas along the eastern and western margins. Along the eastern margin, runoff from Buoy 212 and nearby areas intermittently flows southward and collects in the southeastern part of the Buoy 212 property. Water that intermittently collects in this area has the potential to drain from the east side of the closed and covered former dredge spoil disposal structure to the west side through a steel culvert when the water level is high enough to spill through. Once on the west side of the dredge spoil disposal structure, the water drains across a narrow floodplain shelf to the adjacent Hudson River. When the volume of collected water is not great enough to spill through the steel culvert, the runoff either infiltrates and/or evaporates without reaching the Hudson River as direct runoff. Along the western margin, runoff accumulates in the lowest portions of the narrow floodplain shelf and drains slowly into the Hudson River through breaks in the natural and armored bank levy or infiltrates and/or evaporates without reaching the Hudson River as direct runoff.

Infiltration

Infiltration of precipitation would be expected in areas that are not covered by a relatively impermeable barrier, such as concrete, asphalt, or clay. At the Buoy 212 site, a clay cover that is up to 24 inches thick prevents the infiltration of precipitation into the closed disposal structure. However, recognizing that there are some areas of soil contamination that are not covered by the relatively impermeable barrier in place over the dredge spoil disposal structure, infiltration of precipitation and the subsequent flow/percolation of water through the unsaturated zone to groundwater, can cause water soluble contaminants on the surface or in the vadose zone to migrate downward to the water table. Considering that PCBs are relatively insoluble in water, they are not expected to appreciably leach into groundwater. The potential for PCB migration by water is further reduced by the presence of organic carbon in the soil between the surface and the top of the groundwater table, providing carbon sites where PCBs may bind.

Man-Induced Mechanisms

The Buoy 212 dredge spoil disposal structure is closed and covered with a relatively impermeable barrier and is fenced along its perimeter. Unauthorized access to the closed and covered disposal cell and the adjoining Hudson River floodplain area is limited. Considering the current setting of the Buoy 212 site, the migration of PCBs bound to surface soil is very limited.

1.2.6 Qualitative Human Health Risk Evaluation

PCBs, cadmium, chromium, lead, and mercury were identified as the chemicals of potential concern (COPCs) in some of environmental samples collected at this site and were evaluated along current and potential future exposure pathways in the RI (EEEPC 2011) to assess the potential for human exposure risks. The magnitude of exposure and likelihood of potential adverse health effects were assessed qualitatively through comparisons with appropriate risk-based concentrations that were available.

Current human users at and near the closed and covered dredge spoil disposal structure include adult NYSDOT workers involved in sample collections, site inspections, and/or site maintenance activities (like mowing and fence repair) as needed. NYSDOT workers were assumed to be exposed to soil/dredge spoil material at the surface and/or brought to the surface during earth moving activities, in all areas of the site, but primarily within the fenced area where the closed and covered dredge spoil disposal structure is situated. If the site is redeveloped in its current state, potential future site users could include site residents and temporary construction, utility, and maintenance workers. During this hypothetical redevelopment, subsurface soil/dredge spoil material could be brought to the surface as a result of grading and excavation activities associated with construction. Thus, potential future site residents and temporary construction, utility, and maintenance workers were assumed to be exposed to soils/dredge spoil materials to a depth of 10 feet.

The estimated excess cancer risks associated with exposure to the identified COPCs in soil for current site users (adult NYSDOT workers involved in sample collections, site inspections, and/or site maintenance activities as needed) are below the ranges generally considered acceptable by the EPA and NYSDEC/New York State Department of Health (NYSDOH), and the non-cancer hazard estimates for these receptors are below the level of potential concern - a non-cancer hazard index of 1. Therefore, no adverse health effects would be expected in these receptors as a result of exposure to COPCs at the site.

The estimated excess cancer risk calculated for potential future site users (construction workers and adult and child residents) exposed to the identified COPCs in soil are within or below the generally acceptable range. The non-cancer hazard estimates for potential future site construction workers and adult residents exposed to soil are at or below the maximum generally acceptable value of potential concern - a non-cancer hazard index of 1. The non-cancer hazard index estimate calculated for exposure to soil for the potential future child resident was 7, indicating that there may be the potential for adverse health effects due to exposure to PCB-contaminated soil/dredge spoil material. However, due to the uncertainly associated with reference doses and the conservative nature of this assessment, resident child exposure to PCB-contaminated soil/dredge spoil material is not likely to result in any adverse health effects. This potential hazard is attributable to presumed PCB exposure to soil at the surface in the Hudson River floodplain along the western margin of the Buoy 212 site outside of the Buoy 212 perimeter fence.

1.2.7 Screening Level Ecological Risk Assessment

The ecological risk assessment (ERA) completed in the RI (EEEPC 2011) evaluated the existing and potential impacts from the Buoy 212 site to fish and wildlife receptors. This assessment was limited to terrestrial and aquatic habitats that are within the Buoy 212 parcel and does not include the nearby Hudson River or the Champlain Canal. The Hudson River and the portions of the Champlain Canal that are within it are being addressed by the EPA Hudson River PCBs Superfund Site remedial program. The ERA results are summarized below.

- Chemicals detected in soil did not exceed the available phytotoxicity screening benchmarks. Considering this, soils at the site do not pose a risk to terrestrial plant communities.

- The mercury screening benchmark was marginally exceeded at four sampling locations on site; however, three of the exceedances occurred in samples collected between 4 and 6 feet below the ground surface, where the potential for exposure is limited. No other chemicals exceeded the available screening benchmarks. Overall, these results suggest that risks to soil invertebrates from chemicals in soil at the site are minimal.

- Based on food-chain modeling results, total PCB concentrations in soil are likely to pose a risk to song birds, such as the American robin, and small mammals, such as the short-tailed shrew, that feed extensively on soil invertebrates. Risks to carnivorous birds and mammals and other wildlife species with large home ranges appear to be minimal.

- Immature stages of amphibians in the area where precipitation intermittently drains along the eastern margin and collects intermittently in the southeastern part of the Buoy 212 property may be at risk from aluminum and iron based on comparison with surface water standards for these substances in the drainage water samples collected at the site.

- Benthic organisms in the intermittent drainage network along the eastern site margin and on the floodplain shelf adjacent to the Hudson River may be affected by several substances (total PCBs, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and vanadium) that were reported above established benchmarks for benthic-life protection in the drainage network soil samples collected at these areas. However, considering only low-level effect benchmarks were exceeded in a few of the samples, the likelihood of a community-level impact probably is low.

Overall, the current environmental conditions at the site pose little or no risk to communities of terrestrial plants and soil invertebrates, but may pose a risk to some wildlife species that use the site and perhaps also to aquatic life in the intermittent drainage network on the site and on the floodplain adjacent to the Hudson River.

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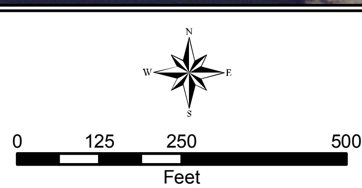


Figure 1-1
Site Location Map
Buoy 212 Dredge Spoil Disposal Area
Fort Edward, New York

2 Identification of Standards, Criteria, Guidelines, and Remedial Action Objectives

This section identifies the site contaminants of concern (COCs) and media of interest, and establishes proposed cleanup goals and specific RAOs for contaminated on-site media. Also presented are estimates of areas and volumes of contaminated on-site media.

2.1 Introduction

PCBs, cadmium, chromium, lead, and mercury were identified as the COCs in some of environmental samples collected at this site during the RI (EEEPC 2011). Based on screening of the analytical results, the RI further identified potential risks posed by site contamination by evaluating contaminant concentrations and identifying potential exposure routes. This evaluation was conducted for both human and environmental receptors.

The Human Health Risk Evaluation (HHRE; EEEPC 2011) assumed future residential uses at the Buoy 212 site for soil. Discussions with NYSDEC indicate the future use of the site would continue to be under the control of New York State and the Canal System. Thus, the current town zoning of Residential-Agricultural (Town of Fort Edward 1963) is not applicable. Furthermore, NYSDEC indicated the potential future resident exposure pathway is not plausible assuming environmental easements could be placed on the property where the closed and covered dredge spoil disposal structure is situated. Considering this scenario and the human health risk evaluation performed in the RI, current and future human health risks were within acceptable risk levels or below levels of potential concern. Thus, human health risks (current and future) are not a concern at this site.

Considering the above, the environmental receptor evaluation identified the following potential risks at the site:

- Direct contact and/or incidental ingestion exposure of site soils by birds, and small mammals; and
- Direct contact and/or ingestion exposure of surface water by amphibians.

RAOs were developed (see Section 2.3) to reduce or eliminate these potential risks by eliminating these routes of exposure or reducing the contaminant concentrations in impacted media to meet applicable chemical-specific standards at the site. Chemical-specific cleanup goals were developed for each media at the site to evaluate the area or volume of each medium that must be addressed to meet the RAOs.

SCGs are used at inactive hazardous waste sites to establish the locations where remedial actions are warranted and to establish cleanup goals. SCGs include state requirements. The following sections present potentially applicable SCGs and other standards and establish proposed cleanup goals and specific RAOs for contaminated on-site media.

2.2 Potentially Applicable Standards, Criteria, and Guidelines (SCGs) and Other Criteria

SCGs include applicable or relevant and appropriate requirements and other applicable requirements.

- **Applicable Requirements** are legally enforceable standards or regulations, such as groundwater standards for drinking water that have been promulgated under state law.

- **Applicable or Relevant and Appropriate Requirements (ARARs)** include those requirements that have been promulgated under state law that may not be "applicable" to the specific contaminant released or the remedial actions contemplated but are sufficiently similar to site conditions to be considered relevant and appropriate. If a relevant or appropriate requirement is well suited to a site, it carries the same weight as an applicable requirement during the evaluation of remedial alternatives.

- **To Be Considered Criteria (TBCs)** are non-promulgated advisories or guidance issued by state agencies that may be used to evaluate whether a remedial alternative is protective of human health and the environment in cases where there are no standards or regulations for a particular contaminant or site condition. These criteria may be considered with SCGs in establishing cleanup goals for protection of human health and the environment.

The following sections present the three categories of SCGs: chemical-specific, location-specific, and action-specific.

2.2.1 Chemical-Specific SCGs

Chemical-specific SCGs are typically technology or health-risk-based numerical limitations on the contaminant concentrations in the environment. They are used to assess the extent of remedial action required and to establish cleanup goals for a site. Chemical-specific SCGs may be directly used as actual cleanup goals or as a basis for establishing appropriate cleanup goals for the COCs at a site.

2.2.2 Location-Specific SCGs

Location-specific SCGs are site- or activity-specific. Examples of location-specific SCGs include building code requirements and zoning requirements. Location-specific SCGs are commonly associated with features such as wetlands, floodplains, sensitive ecosystems, or historic buildings that are located on or close to the site. Location-specific SCGs for the Buoy 212 site are presented in Table 2-1.

2.2.3 Action-Specific SCGs

Action-specific SCGs are usually administrative or activity-based limitations that guide how components of remedial actions are conducted. These may include record-keeping and reporting requirements; permitting requirements; design and performance standards for remedial actions; and treatment, storage, and disposal requirements. Action-specific SCGs for this site are presented in Table 2-2.

2.3 Remedial Action Objectives

The RAOs for on-site remedial actions were developed based on information contained in the RI (EEEPC 2011); including identified contaminants present in the study area and existing or potential exposure pathways in which the contaminants may affect human health and the environment.

The RAOs for this site are:

- Prevent migration of contaminants that would result in groundwater or surface water contamination; and

- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

2.4 Cleanup Objectives and Volume of Impacted Material

The following sections describe the process used to select numeric cleanup objectives and estimate the volume of impacted material.

2.4.1 Selection of Soil Cleanup Goals

Standards

Numeric cleanup goals identified for soils at the Buoy 212 Dredge Spoil Disposal Area are contained in NYCRR Part 375-6.8 (NYSDEC 2006). This regulation presents soil cleanup objectives for protection of ecological resources, groundwater, and public health. The soil cleanup objectives for the protection of public health are based on land use criteria, which include:

- **Unrestricted use** is a use without imposed restrictions, such as environmental easements or other land use controls; or

- **Restricted use** is a use with imposed restrictions, such as environmental easements, which as part of the remedy selected for the site require a site management plan that relies on institutional controls or engineering controls to manage exposure to contamination remaining at a site. Restricted use is separated into four different categories:

    1. **Residential use** is a land use category that allows a site to be used for any use other than raising livestock or producing animal products for human consumption. Restrictions on the use of groundwater are allowed, but no other institutional or engineering controls relative to the residential soil cleanup objectives, such as a site management plan, would be allowed. This land use category will be considered for single family housing;

    2. **Restricted-Residential use** is a land use category that shall only be considered when there is common ownership or a single owner/managing entity of the site. Restricted-residential use shall, at a minimum, include restrictions which prohibit any vegetable gardens on a site, although community vegetable gardens may be considered with NYSDEC's approval and single family housing. Active recreational uses, which are public uses with a reasonable potential for soil contact, such as parks, are also included under this category;

    3. **Restricted-Commercial use** is a land use category for the primary purpose of buying, selling, or trading of merchandise or services. Commercial use includes passive recreational uses, which are public uses with limited potential for soil contact; and

    4. **Restricted-Industrial use** is a land use category for the primary purpose of manufacturing, production, fabrication or assembly process and ancillary services. Industrial uses do not include any recreational component.

Based on the town of Fort Edward Zoning Map, (Town of Fort Edward 1963), the site is zoned Residential-Agricultural which means that it could be used to raise live stock or produce animal products for human consumption. Based on further discussions with NYSDEC regarding future activities at the site, it is anticipated that the site will not be used for residential or agricultural purposes as it will remain a closed and covered dredge spoil site disposal area. Considering this, the 6 NYCRR Part 375 - 6.8 SCO selected for the site is Restricted Use-Commercial and closely represents the manner in which NYSDEC anticipates the site to be used in the future. In addition, soil cleanup objectives presented in 6 NYCRR Subpart 375-6.8 for the protection of groundwater and ecological resources will be considered where applicable. Ecological receptors are potentially impacted by site contamination according to the risk assessment performed for this site, therefore, cleanup goals for the protection of ecological resources will be considered.

The cleanup goals for the contaminants detected at this site are presented in Table 2-3.

Criteria and Guidance Values

Guidance values identified for soils are contained in NYSDEC TAGM 4046 (January 1994). Criteria and guidance values for the contaminants detected at this site are presented in Table 2-3.

Background

Background soil sample data are used as cleanup objectives when standards and guidance values are not available. Site background samples were not collected. However, published soil background values from the New York State Brownfield cleanup program (NYSDEC 2006) and eastern United States background levels (Shacklette et. al 1984) were used as background values.

Selection Process

The selected cleanup goals for soils are presented in Table 2-3. These values will be used later in this report to calculate remedial volumes and subsequently cost estimates. The following logical basis was used to select the preliminary cleanup values:

- The most stringent 6 NYCRR Part 375-6.8 restricted use soil cleanup standards (Restricted-Commercial, ecological) were selected as the cleanup goals;
- Where cleanup standards were not available, NYSDEC TAGM 4046 values were selected as the cleanup goal;
- If neither cleanup standards nor guidance were available, New York State background values were used as the cleanup goals;
- The maximum observed concentration for each compound was then compared to the selected cleanup goal in order to determine which compounds may require cleanup; and
- Finally, the contaminants identified for cleanup were reviewed to determine whether they are site-related and whether cleanup is warranted.

2.4.2 Selection of Contaminants of Concern

Based on the cleanup objectives selected above and historical disposal of PCB-laden spoils, it was determined that PCBs are the primary soil contaminants of concern at the site. As stated above, some metals were detected above proposed cleanup goals. However, since soil removal/treatment remedy conducted at the site would remove other contaminants in the soil, PCBs will be considered the primary COCs at the site.

2.4.3 Determination of Contaminated Soil Volumes

The volume of contaminated dredge spoils at the site was estimated using the Autodesk Civil 3D, which is an add-on to AutoCAD. Two surfaces were created: the first surface was comprised of the ground elevations obtained from survey data and the second surface was the bottom of impacted material, which was estimated using analytical data and boring log information collected during the RI (EEEPC 2011). Using these two surfaces, the software produces a volume estimate. For soils, with the proposed cleanup goal of 1 ppm for PCBs, the volume was estimated to be 55,675 CY (including the existing cap). This volume considers sediment and surface soil contamination in addition to contaminated subsurface soils. The maximum contamination depth was estimated at 19 feet below ground surface (BGS) and is located in the middle of the site. The total area of contamination is approximately 4.1 acres.

Figure 2-1 provides the extent of contamination to be further addressed in this FS.

Table 2-1 Location-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Local Location-Specific SCGs					
Town Code	Noise	Chapter 61	Restricts unnecessary noise and construction equipment noise within the village during certain timeframes	Potentially Applicable	
	Vehicles and Traffic	Chapter 99	Weight limitations on certain town/village roads during portions of the year	Potentially Applicable	
	Street and Sidewalk Closure	Chapter 85	Street closure or alteration requirements	Potentially Applicable	
	Solid Waste	Chapter 82	Waste haulers local requirements; restrictions on construction of solid waste facilities	Potentially Applicable	
State Location-Specific SCGs					
Environmental Conservation Law	Endangered and Threatened Species	6 NYCRR 182	Lists endangered and threatened species and species of special interest	Potentially Applicable	Threatened/endangered birds/plants identified in the vicinity of the site.
	Freshwater Wetlands	6 NYCRR 663-665	Establishes permit requirement regulations, wetland maps and classifications	Potentially Applicable	
	Wild, Scenic, and Recreational Rivers	6 NYCRR 666	Regulations for administration and management	Potentially Applicable	
	Floodplains	6 NYCRR 502	Contains floodplain management criteria for state projects	Potentially Applicable	

Table 2-1 Location-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Federal Location-Specific SCGs					
National Historical Preservation Act 16 USC Section 469	Preservation of archaeological and historical data	36 CFR Part 65	Action to recover and preserve artifacts	Potentially Applicable	
National Historic Preservation Act Section 106 (16 USC 470)	Historic project owned or controlled by Federal agency	36 CFR Part 880	Preserve historic property, minimize harm to National Historic Landmarks	Potentially Applicable	
Endangered Species Act of 1973 16 USC 1531, 661	Endangered and Threatened species	50 CFR Part 200, 402 33 CFR Parts 320-330	Determine presence and conservation of endangered species	Potentially Applicable	Threatened/endangered birds/plants identified in the vicinity of the site.
Clean Water Act Section 404	Protect wetlands	40 CFR Parts 230 33 CFR Parts 320-330	Action to prohibit discharge into wetlands	Potentially Applicable	
Clean Water Act Part 6 Appendix A	Wetland Protection	40 CFR Part 6 Appendix A, section 4	Avoid adverse effects, minimize potential harm, preserve and enhance wetlands	Potentially Applicable	
Floodplain Management	Executive Order No. 11988	40 CFR 6.302 (b) (2005)	Regulates activities in a floodplain	Potentially Applicable	

Key:
CFR = Code of Federal Regulations.
NYCRR = New York Codes, Rules, and Regulations.
SCG = Standard, criteria, and guideline.

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
State Action-Specific SCGs					
New York State Vehicle and Traffic Law, Article 386; Environmental Conservation Law Articles 3 and 19.	Noise from Heavy Motor Vehicles	6 NYCRR 450	Defines maximum acceptable noise levels	Potentially Applicable	Marginally applicable; appears to apply to over-the-road vehicles, not construction equipment
Environmental Conservation Law, Articles 3 and 19.	Prevention and Control of Air Contaminants and Air Pollution	6 NYCRR 200 - 202	Establishes general provisions and requires construction and operation permits for emission of air pollutants	Potentially Applicable	
Environmental Conservation Law, Article 15; also Public Health Law Articles 1271 and 1276 (Part 288 only)	Air Quality Classifications and Standards	6 NYCRR 256, 257	Part 256: New York Ambient Air quality Classification System Part 257: Air quality standards for various pollutants including particulates and non-methane hydrocarbons	Potentially Applicable	Applicable to remediation activities at the site that include a controlled air emission source
Environmental Conservation Law, Articles 1, 3, 8, 19, 23, 27, 52, 54, and 70.	Solid Waste Management Facilities	6 NYCRR 360	360-1: General provisions; includes identification of "beneficial use" potentially applicable to non-hazardous oily waste/soil (360-1.15). 360-2: Regulates construction and operation of landfills, including construction and demolition debris landfills	Potentially Applicable	May be applicable for establishing off-site treatment and disposal options for excavated contaminated non-hazardous soil and debris

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
New York Waste Transport Permit Regulations	Permitting Regulations, Requirements and Standards for Transport	6 NYCRR 364	The collection, transport and delivery of regulated waste, originating or terminating at a location with New York, will be governed in accordance with Part 364	Potentially Applicable	Applicable if site's wastes fall into regulated categories
Environmental Conservation Law, Articles 3, 19, 23, 27, and 70	Hazardous Waste Management System - General	6 NYCRR 370	Provides definition of terms and general standards applicable to 6 NYCRR 370 - 374, 376	Potentially Applicable	
	Identification and Listing of Hazardous Waste	6 NYCRR 371	Identifies characteristic hazardous waste (PCBs) and lists specific wastes	Potentially Applicable	Applies to transportation and all other hazardous waste management practices in New York State Applicable if hazardous waste (PCBs > 50 ppm) is generated during remediation
	Hazardous Waste Manifest System and Related Standards	6 NYCRR 372	Establishes manifest system and record keeping standards for generators and transporters of hazardous waste and for treatment, storage, and disposal facilities	Potentially Applicable	Relevant to transportation of hazardous material by bulk rail and water shipments for off-site treatment
	Hazardous Waste Treatment, Storage, and Disposal Facility Permitting Requirements	6 NYCRR 373	Regulates treatment, storage, and disposal of hazardous waste	Potentially Applicable	Relevant to off-site treatment/disposal of hazardous waste

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	6 NYCRR 374	Subpart 374-1 establishes standards for the management of specific hazardous wastes (Subpart 374-2 establishes standards for the management of used oil)	Potentially Applicable	
Environmental Conservation Law, Articles 1, 3, 27, and 52; Administrative Procedures Act Articles 301 and 305.	Inactive Hazardous Waste Disposal Site	6 NYCRR 375	Identifies process for investigation and remedial action at state funded Registry site; provides exception from NYSDEC permits. Part 375-6.8: Provides soil cleanup objectives used for this report	Applicable	
Environmental Conservation Law, Articles 3 and 27.	Land Disposal Restrictions	6 NYCRR 376	Identifies hazardous wastes that are restricted from land disposal. Defines treatment standards for hazardous waste.	Potentially Applicable	
New York Environmental Quality Review Regulations		6 NYCRR Part 617	Implements provisions of State Environmental Quality Review Act	Potentially Applicable	
Implementation of SPDES Program in New York	General permit for Stormwater	6 NYCRR 750 – 758	Regulates permitted releases into waters of the state	Potentially Applicable	
Primary and Principal Aquifer Determinations (5/87)		NYSDEC TOGS 2.1.3	Provides guidance on determining water supply aquifers in upstate New York	Not Applicable	Drinking Water supplied by the local drinking water supply system in the Town of Fort Edward, New York

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Environmental Justice and Permitting	Environmental Justice	Commissioner Policy 29	Policy incorporates environmental justice concerns into NYSDEC's public participation provisions	Potentially Applicable	Relevant to actions that involve discharges to surface water, solid/hazardous waste disposal or siting an industrial hazardous waste facility
Federal Action-Specific SCGs					
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986	National Contingency Plan	40 CFR 300, Subpart E	Outlines procedures for remedial actions and for planning and implementing off-site removal actions	Potentially Applicable	
Occupational Safety and Health Act	Worker Protection	29 CFR 1904, 1910, and 1926	Specifies minimum requirements to maintain worker health and safety during hazardous waste operations. Includes training requirements and construction safety requirements	Potentially Applicable	Under 40 CFR 300.38, requirements of OSHA apply to all activities that fall under jurisdiction of the National Contingency Plan
Executive Order	Delegation of Authority	Executive Order 12316 and Coordination with Other Agencies	Delegates authority over remedial actions to federal agencies	Potentially Applicable	

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Clean Air Act	National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes emission limits for six pollutants (SO_2, PM_{10}, CO, O_3, NO_2, and Pb)	Potentially Applicable	
	National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for 8 contaminants. Identifies 25 additional contaminants, including PCE and TCE, as having serious health effects but does not provide emission standards for these contaminants.	Potentially Applicable	
Toxic Substances Control Act	Rules for Controlling PCBs	40 CFR 761	Provides guidance on storage and disposal of PCB-contaminated materials	Potentially Applicable	
RCRA	Criteria for Municipal Solid Waste Landfills	40 CFR 258	Establishes minimum national criteria for management of non-hazardous waste	Potentially Applicable	Applicable to remedial alternatives that involve generation of non-hazardous waste. Non-hazardous waste must be hauled and disposed of in accordance with RCRA.
	Hazardous Waste Management System - General	40 CFR 260	Provides definition of terms and general standards applicable to 40 CFR 260 - 265, 268	Potentially Applicable	Applicable to remedial alternatives that involve generation of a hazardous waste (e.g., contaminated soil). Hazardous waste must be handled and disposed of in accordance with RCRA
	Identification and Listing of Hazardous Waste	40 CFR 261	Identifies solid wastes that are subject to regulation as hazardous wastes	Potentially Applicable	

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
	Standards Applicable to Generators of Hazardous Waste	40 CFR 262	Establishes requirements (e.g., EPA ID numbers and manifests) for generators of hazardous waste	Potentially Applicable	
	Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Establishes standards that apply to persons transporting manifested hazardous waste within the United States	Potentially Applicable	
	Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities	40 CFR 264	Establishes the minimum national standards that define acceptable management of hazardous waste	Potentially Applicable	
	Standards for owners of hazardous waste facilities	40 CFR 265	Establishes interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities	Potentially Applicable	
	Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes that are restricted from land disposal	Potentially Applicable	
	Hazardous Waste Permit Program	40 CFR 270, 124	EPA administers hazardous waste permit program for CERCLA/Superfund Sites. Covers basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Potentially Applicable	

Table 2-2 Action-Specific SCGs, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Act/Authority	Criteria/Issues	Citation	Brief Description	Status	Comments
Clean Water Act	EPA Pretreatment Standards	40 CFR 403	Establishes responsibilities of federal, state, and local government to implement National pretreatment standards to control pollutants that pass through to a POTW	May be Applicable	Applies if discharge is made to a POTW

Key:

CFR = Code of Federal Regulations.
EPA = (United States) Environmental Protection Agency.
NYCRR = New York Codes, Rules, and Regulations.
NYSDEC = New York State Department of Environmental Conservation.
OSHA = Occupational Safety and Health Administration.
PCB = Polychlorinated biphenyl.
PCE = Perchloroethylene.
POTW = Publicly owned treatment works.
ppm = Parts per million.
RCRA = Resource Conservation and Recovery Act.
SCG = Standard, criteria, and guidance.
SPDES = State Pollutant Discharge Elimination System.
TCE = Trichloroethylene.

Table 2-3 Selected Cleanup Goals for Soils, Buoy 212 Dredge Spoil Disposal Area

Analyte	NYSDEC Cleanup Goals[a]		NYSDEC TAGM 4046[b]	New York State Background[c]	Maximum Concentration[d]		Selected Cleanup Goal
	Protection of Public Health - Commercial	Protection of Ecological Resources[e]					
Total PCB by Method 8082 (mg/kg)							
Total PCBs	1	1	1 / 10	-	47		**1**
Metals by Method 6010/7471 (mg/kg)							
Cadmium	9.3	-	1	2.4	17.6		**9.3**
Chromium	1,500	-	10	20	71.6		**-**
Lead	1,000	-	SB	72	110		**-**
Mercury	2.8	-	0.1	0.2	0.249		**-**
Aluminum	-	-	SB	15,800	18,500	J	**15,800**
Antimony	-	-	SB	2.17	ND		**-**
Arsenic	16	-	7.5	12	3.8		**-**
Barium	400	-	300	165	140	J	**-**
Beryllium	590	-	0.16	1	ND		**-**
Calcium	-	-	SB	9,190	12,800	J	**9,190**
Cobalt	-	-	30	13.3	11.4		**-**
Copper	270	-	25	32	27.9		**-**
Iron	-	-	2,000	25,600	27,500	J	**2,000**
Magnesium	-	-	SB	5,130	7,250	J	**5,130**
Manganese	10,000	-	SB	1610	538		**-**
Nickel	310	-	13	25	29.6		**-**
Potassium	-	-	SB	1,890	3,160	J	**1,890**
Selenium	1,500	-	2	3.7	ND		**-**
Silver	1,500	-	SB	0.6	ND		**-**
Sodium	-	-	SB	211	190		**-**
Thallium	-	-	SB	16.3	ND		**-**

Table 2-3 Selected Cleanup Goals for Soils, Buoy 212 Dredge Spoil Disposal Area

Analyte	NYSDEC Cleanup Goals[a]		NYSDEC TAGM 4046[b]	New York State Background[c]	Maximum Concentration[d]	Selected Cleanup Goal
	Protection of Public Health - Commercial	Protection of Ecological Resources[e]				
Vanadium	-	-	150	31	31	-
Zinc	10,000	-	20	140	243	-

Notes:

[a] Cleanup goals obtained from 6 NYCRR Part 375-6.8 Soil Cleanup Objective Tables (NYSDEC December 14, 2006).

[b] NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (Jan 1994) Soil Cleanup Objectives. PCB value in surface soil is 1 ppm and 10 ppm in subsurface soils.

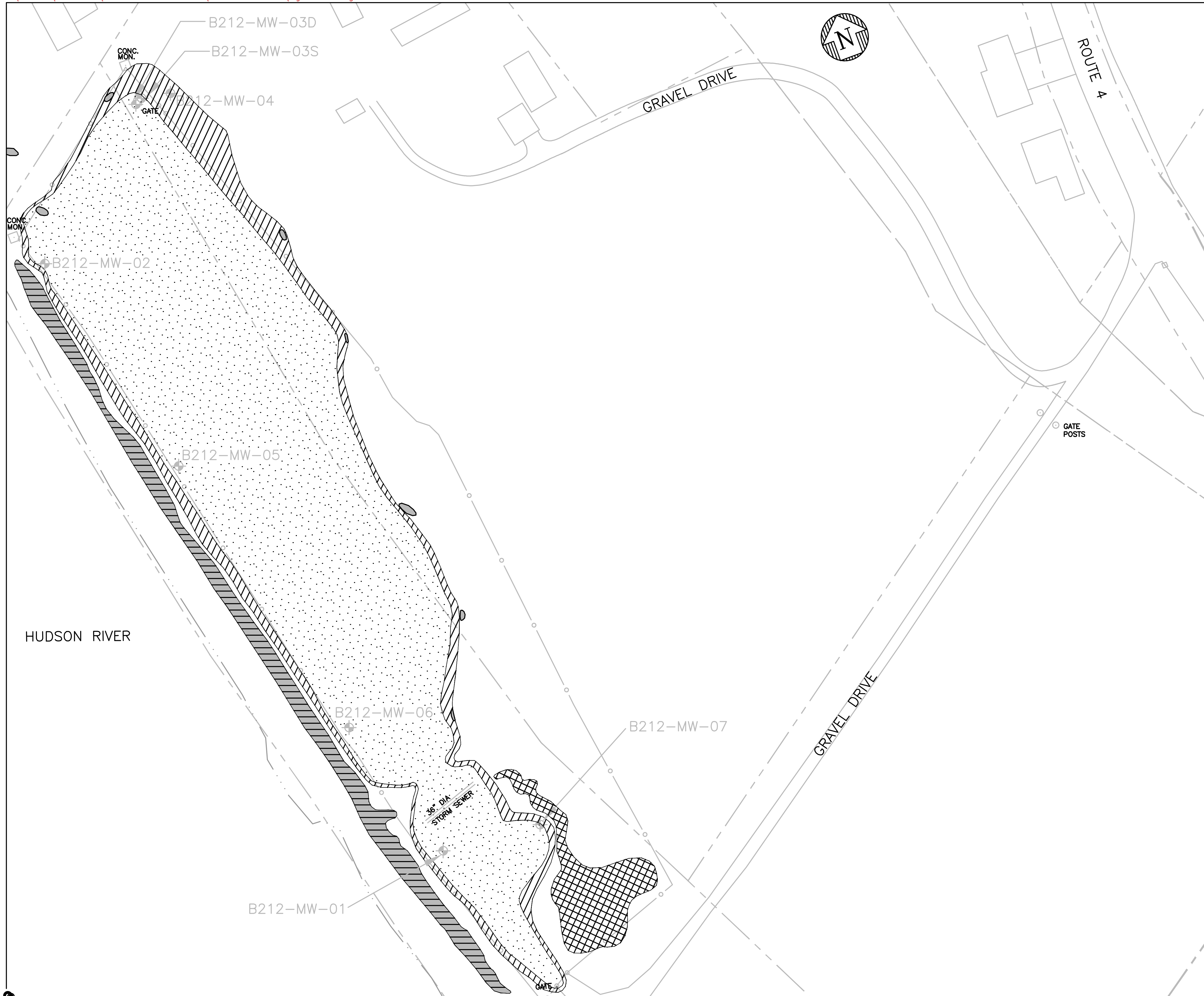
[c] Background values obtained from NYS background (95th percentile), Source-Distant Data Set from NYS Brownfield Cleanup Program, Technical Support Document, Appendix D, (NYSDEC September 2006) for metals presented except thallium and antimony for which background values were obtained from Eastern United States background (95th percentile) (Shacklette and Boerngen 1984).

[d] Concentration listed is the maximum detected value from surface soil, subsurface soil or sediment sediment samples collected during the Buoy 212 RI (EEEPC 2011).

[e] According to the Ecological Risk Assessment conducted for this site, metals in soils do not present an ecological risk and hence are not considered for cleanup goals.

Key:

J = Estimated value ("-" is biased low and "+" is biased high)
mg/kg = milligrams per kilogram
ND = non-detect
NYSDEC = New York State Department of Environmental Conservation
PCB = Polychlorinated biphenyl
TAGM = Technical Administrative Guidance Memorandum



LEGEND:

- APPROXIMATE EDGE OF WATER BOUNDARY
- APPROXIMATE LOCATION OF PROPERTY BOUNDARY (SEE NOTE 2)
- FENCE
- B212-MW-04 MONITORING WELL
- APPROXIMATE LOCATION OF STRUCTURE
- APPROXIMATE WETLAND AREA
- APPROXIMATE EXTENT OF COVERED DREDGE SPOIL MATERIALS
- APPROXIMATE EXTENT OF COVER MATERIALS
- APPROXIMATE EXTENT OF SOILS WITH PCB CONCENTRATIONS ≥ 0.1 PPM ON OR OUTSIDE OF COVER
- APPROXIMATE EXTENT OF SOILS WITH PCB CONCENTRATIONS ≥ 0.1 PPM IN THE FLOODPLAIN

NOTES:

1. SITE FEATURE LOCATIONS BASED ON 2003 AERIAL PHOTOGRAPHY.
2. PROPERTY LINE LOCATIONS ARE APPROXIMATE AND ARE BASED ON WASHINGTON COUNTY PARCEL DATA, 2006.
3. STORM SEWER DATA TAKEN FROM LU ENGINEERS DRAWING 10623-09 BUOY 212.DWG DATED 3/21/06.

APPROXIMATE SCALE IN FEET

0 100 200 300

ecology and environment

FIGURE 2-1 EXTENT OF CONTAMINATION
BUOY 212 DREDGE SPOIL DISPOSAL AREA
FORT EDWARD, NEW YORK

3 Identification and Screening of Remedial Technologies

3.1 Introduction

This section presents the results of the preliminary screening of remedial actions that may be used to achieve the RAOs. Potential remedial actions, including general response actions and remedial technologies are evaluated during the preliminary screening on the basis of effectiveness, implementability, and relative cost. Past performance (e.g., demonstrated technology) and operating reliability were also considered in identifying and screening applicable technologies. Technologies that were not initially considered effective and/or technically or administratively feasible were eliminated from further consideration.

The purpose of the preliminary screening is to eliminate remedial actions that may not be effective based on anticipated on-site conditions, or cannot be implemented at the site. The general response actions considered herein are intended to include those actions that are most appropriate for the site and, therefore, are not exhaustive.

3.2 General Response Actions

Based on the information presented in the RI (EEEPC 2011) and the RAOs established in Section 2, this section identifies general response actions, or classes of responses for contaminated soils. General response actions describe classes of technologies that can be used to meet the remediation objectives for contaminated site soils. As previously discussed, PCB contamination in soil will be the focus of remedial actions addressed by this FS.

General response actions identified for the contaminated soils are as follows:

- No action;
- Institutional controls;
- Containment;
- In situ treatment;
- Ex situ treatment; and

- On- and off-site disposal.

3.2.1 Criteria for Preliminary Screening

In accordance with guidance documents issued by NYSDEC (TAGM 4030) and the EPA (Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA [October 1988]), the criteria used for preliminary screening of general response actions and remedial technologies include the following.

- **Effectiveness**. The effectiveness evaluation focuses on the degree to which a remedial action is protective of human health and the environment. An assessment is made of the extent to which an action: (1) reduces the mobility, toxicity, and volume of contamination at the site; (2) meets the remediation goals identified in the RAOs; (3) effectively handles the estimated areas and volumes of contaminated media; (4) reduces impacts to human health and the environment in the short-term during the construction and implementation phase; and (5) has been proven or shown to be reliable in the long-term with respect to the contaminants and conditions at the site. Alternatives that do not provide adequate protection of human health and the environment are eliminated from further consideration.

- **Implementability.** The implementability evaluation focuses on the technical and administrative feasibility of a remedial action. Technical feasibility refers to the ability to construct and operate a remedial action for the specific conditions at the site and the availability of necessary equipment and technical specialists. Technical feasibility also includes the future maintenance, replacement, and monitoring that may be required for a remedial action. Administrative feasibility refers to compliance with applicable rules, regulations, statutes, and the ability to obtain permits or approvals from other government agencies or offices and the availability of adequate capacity at permitted treatment, storage, and disposal facilities and related services. Remedial actions that do not appear to be technically or administratively feasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time are eliminated from further consideration.

- **Relative Cost.** In the preliminary screening of remedial actions, relative costs are considered rather than detailed cost estimates. The capital costs and operation and maintenance (O&M) costs of the remedial actions are compared on the basis of engineering judgment, where each action is evaluated as to whether the costs are high, moderate, or low relative to other remedial actions based on knowledge of site conditions. A remedial action is eliminated during preliminary screening on the basis of cost if other remedial actions are comparably effective and implementable at a much lower cost.

The results of the preliminary screening are summarized below.

3.3 Identification of Remedial Technologies

This section identifies the potential remedial action technologies that may be applicable to remediation of soils at the Buoy 212 Site. Table 3-1 shows a summary of results from the screening of remedial technologies.

3.3.1 No Action

The no action alternative involves taking no further action to remedy the condition of contaminated soils. NYSDEC and EPA guidance set forth in the CERCLA National Contingency Plan (NCP) requires that the no action alternative automatically pass through the preliminary screening and be compared to other alternatives in the detailed analysis of alternatives.

3.3.2 Institutional Controls and Long-Term Monitoring (LTM)

Institutional controls (ICs) are non-engineered instruments, such as administrative and/or legal controls, that limit the potential for human exposure to a contaminant by restricting land or resource use (EPA-OSWER 2000). ICs are meant to supplement engineering controls during all phases of cleanup and may be a necessary component of the completed remedy. They typically include easements, deed restrictions, covenants, well drilling prohibitions, zoning restrictions, building or excavation permits. Physical barriers like fences that restrict access to sites should also be considered in addition to the ICs.

ICs are not generally expected to be the sole remedial action unless active response measures are determined to be impracticable. However for this site, ICs will be evaluated independently and will also be considered in conjunction with other engineering alternatives to achieve RAOs.

Long-term monitoring (LTM) can be performed in multiple environmental media, but is most applicable in groundwater at this site. LTM in groundwater generally uses an array of monitoring wells that are regularly sampled and tested by an analytical laboratory for COC. These wells are placed such that they would detect migration toward potential receptors. LTM will not actively reduce contamination levels; it can be useful in demonstrating that exposures do not occur. LTM of groundwater will be further considered.

3.3.3 Containment

3.3.3.1 Capping

Containment of impacted soils can be achieved by capping contaminated materials in place, consolidating and capping, excavating selective areas, and capping or surface sealing. Capping is a means to limit direct contact with impacted material and reduce the potential for rainfall infiltration into groundwater, thus limiting contaminant mobility and exposure. Capping systems use materials, such as soil, synthetic membranes, asphalt, concrete, and chemical sealants.

Capping of the entire affected area is generally performed when subsurface contamination at a site precludes excavation and removal of contaminated materials because of potential hazards and/or prohibitive costs. Capping also may be performed as an interim remedial measure to reduce infiltration of precipitation and to control air releases. The main disadvantages of capping are uncertain design life and the need for long-term maintenance and monitoring.

Capping systems (single and multi-layered) considered applicable and represent the range of available options include asphalt cover (single-layered cap), a clay cap, and cover systems described in 6 NYCRR Part 360, and 6 NYCRR Part 373 (Resource Conservation Recovery Act [RCRA] cap). These cover systems would be effective in limiting infiltration of surface water.

- **Bituminous Concrete Cover (Asphalt):** A standard asphalt cover system typically includes a layer of stone (6 to 8 inches), followed by an asphalt binder course (typically 4 inches), and a final wearing course (typically 2 inches). Site grading is typically required to achieve an adequate slope for drainage. Although asphalt covers serve to limit infiltration into groundwater, they are more permeable than 6 NYCRR Part 360 composite cap and 6 NYCRR Part 373 RCRA cap. Furthermore, asphalt is susceptible to cracking and settlement, and thus would require more O&M in the long term.

- **Clay Cap:** A clay cap consists of a layer of low permeability clay over the contaminated material. Typically, the thickness of this layer is between one and 5 feet. This type of cap is designed to prevent the infiltration of water and needs to be graded for proper drainage. Clay caps are not as protective as an asphalt, 6 NYCRR Part 360, or 6 NYCRR Part 373 cap as they are more susceptible to cracking thus would require more O&M in the long term. Based on current knowledge of the site, a clay cap exists over the contaminated material.

- **6 NYCRR Part 360 Cover System:** A 6 NYCRR Part 360 cover system is commonly used in New York State to close municipal solid waste landfills. The system consists of the following components:

    1. A 12-inch gas venting layer with a hydraulic conductivity equal or greater than 1×10^{-3} centimeters per second (cm/sec) directly overlying the waste material. A filter fabric is typically directly below and above the venting layer to limit the migration of fines into the venting layer. This layer is intended to transmit methane from high organic waste material. This layer might not be required for the Buoy 212 site, because the PCB-containing waste material does not readily decompose.

    2. An 18-inch layer of compacted low permeability barrier soil overlying the gas venting layer with a hydraulic conductivity equal to or less than 1×10^{-6} cm/sec.

    3. A synthetic 40-mil or thicker geomembrane overlying the low permeability soil barrier.

4. A 24-inch compacted soil layer to protect the low-permeability layer and geomembrane from root penetration, desiccation, and freezing.

5. A final 6-inch layer of topsoil placed on top of the protective layer to promote vegetative growth for erosion control.

- **6 NYCRR Part 373 (RCRA) Cover System:** A RCRA cover system is typically required at hazardous waste sites. A RCRA cover system is most applicable when a significant potential for leaching of contaminants from the unsaturated zone to the saturated zone exists. Basic requirements for cover systems are described in 6 NYCRR Part 373. These requirements are also consistent with Subparts G, K, and N of RCRA of Subtitle C regulations (for hazardous waste). The recommended design for a RCRA Subtitle C cover system consists of the following (from bottom to top):

1. A low hydraulic conductivity geomembrane/soil layer consisting of a 24-inch thick layer of compacted natural or amended soil with a hydraulic conductivity of 1×10^{-7} cm/sec, and a minimum 20-mil (0.5 mm) geomembrane liner.

2. A minimum 12-inch thick soil layer having a minimum hydraulic conductivity of 1×10^{-2} cm/sec, or a layer of geosynthetic material having the same characteristics.

3. Minimum 24-inch thick top vegetative soil layer.

The following presents the preliminary screening of containment technology:

- **Effectiveness.** Placement of a cover over the contaminated soils would be effective in helping to achieve the RAOs for soil, since it would reduce the potential for direct contact with the contaminated soils and limit erosion and transport of contaminated materials.

- **Implementability.** The materials, equipment, and labor for construction of a cover are available and can be readily implemented.

- **Cost.** Capital costs for installing a NYCRR Part 360 cover system are expected to be around $165,000 per acre, while it is $225,000 per acre for a RCRA Subtitle C cover system (FRTR 2002). Capital costs may include materials, labor, and equipment to construct the system. O&M costs would be minimal.

Although capping is effective in protecting human health and the environment, readily implementable, and relatively cost-effective as a containment technology, on-site consolidation of contaminated material to the existing landfill is assumed to not be acceptable as addition of contaminated material to the existing landfill is understood to contradict conditions set forth by the landfill's approval letter from EPA (EPA 1979). Therefore, capping will not be retained for further analysis.

3.3.4 In Situ Treatment

In situ treatment technologies for soil remediation typically fall in the following three major categories:

- Thermal treatment;
- Physical/chemical treatment; and
- Biological treatment.

The following sections present a discussion of applicable soil remediation technologies under each general response category described above.

3.3.4.1 Thermal Treatment

Thermal treatment processes generally involve applying heat to contaminated material to vaporize the contaminants into a gas stream (i.e., physically separate from the host medium), and then treating the gas stream prior to discharge into the atmosphere. Various gas treatment technologies can be used to collect, condense, or destroy the volatilized gases. The three common types of in situ thermal treatment technologies are: in situ thermal desorption using thermal blankets and thermal wells, vitrification using electrodes, and enhanced soil vapor extraction (SVE).

Thermally enhanced SVE is a full-scale technology that uses electrical resistance/ electromagnetic/radio frequency heating, or hot-air steam injection to facilitate volatilization and extraction of the contaminant vapors. The process is otherwise similar to SVE. However, since SVE does not remove PCBs and heavy hydrocarbons (only applicable to volatile organic compounds [VOCs] and semivolatile organic compounds [SVOCs] with a Henry's law constant greater than 0.01), it will not be retained for further consideration.

In Situ Thermal Desorption (ISTD) – Thermal Blankets and Thermal Wells

This type of technology was developed in Shell Research labs over the last 25 years as part of its enhanced oil recovery efforts, and has been one of the few in-situ forms of thermal desorption technologies that has been demonstrated to work effectively on a commercial scale. At the present time, thermal blankets and thermal wells are proprietary technologies of TerraTherm, Inc. (TerraTherm), an affiliate of Shell Oil Company. The thermal blanket system consists of electric heating "blankets" approximately 8 by 20 feet that are placed on top of the contaminated ground surface. The blankets can be heated to 1,800° Fahrenheit (F), and by thermal conduction are able to vaporize most contaminants down to a depth of approximately 3 feet BGS. Vapors are drawn out of the soil and through the blanket system by means of a vacuum system. The contaminated vapors are then oxidized at high temperature in a thermal oxidizer near the treatment area, and finally cooled and passed through activated carbon beds to collect any trace levels of organics not oxidized prior to discharge to the atmosphere.

Thermal wells use the same process as thermal blankets, except that heating elements are placed in well boreholes drilled at an average spacing of 7 to 10 feet. Similar to the blanket modules, the vacuum is drawn on the manifold so that extracted vapors are collected and destroyed. Estimated ISTD treatment costs obtained from TerraTherm range from $100 per CY for a 100,000-CY site to $600/CY for a 1,000-CY site (TerraTherm, Inc. 2007).

ISTD using thermal wells and blankets have been successfully demonstrated by TerraTherm at several PCB-contaminated sites. PCB reduction of 99.9% was achieved from initial concentrations of as high as 20,000 milligrams per kilogram (mg/kg) at a contamination site in Missouri. Contamination depth varied between 6 to 18 inches for blankets, and down to 12 feet BGS with thermal wells for these demonstrations. ISTD is a more appropriate technology for volumes of contamination up to 10,000 CY (Naval Facilities Engineering Service Center 1998). A treatability study is generally recommended to determine the effectiveness of thermal treatment as a remediation technology at a site.

- **Effectiveness.** Thermal treatment has not been demonstrated in treating PCB-contaminated soil at depths of greater than 12 feet, while the Buoy 212 site has contamination at depths greater than 12 feet.

- **Implementability.** Contractors and treatment facilities are available to implement this technology. Treatability studies may be necessary to evaluate the effectiveness of the type of thermal treatment needed to treat the soil down to site acceptable concentrations.

- **Cost.** The cost of an in-situ treatment is high but may be comparable to other in-situ treatment technologies considering the lifetime for treatment and O&M costs of other technologies.

In summary, due to contaminated soil volumes greater than 10,000 CY, other in-situ technologies may be more feasible based on implementability and cost. Therefore, this technology will not be retained for further analysis.

In Situ Vitrification

In situ vitrification (ISV) is a process which uses electrical power to heat and melt soil contaminated with organics, inorganics, and metal-bearing wastes. The molten material cools to form a hard, monolithic, chemically inert, stable glass, and crystalline product that incorporates the inorganic compounds and heavy metals present in the waste. The organic contaminants within the waste are vaporized or pyrolyzed and migrate to the surface of the vitrified zone where they are oxidized under a collection hood. Residual emissions are captured in an off-gas treatment system.

ISV uses electrodes that are inserted into the ground to the desired treatment depth. Electrical power is charged to the electrodes, which heat the surrounding soil to 2,000 degrees Celsius (°C), which is above the initial melting temperature of typical soils. With favorable site conditions, it is estimated that a processing depth down to 30 feet BGS can be achieved.

Although ISV has been tested for a range of organic and inorganic contaminants, including PCBs, and has been operated for demonstration purposes at the pilot scale, few full-scale applications of this technology exist. Treatability studies are generally required to determine the effectiveness of ISV as a remediation technology at a site. Once vitrified, the original volume of soil would decrease by approximately 20 to 50%, requiring backfilling with clean material, grading, and restoring.

- **Effectiveness.** ISV processing requires that sufficient glass-forming materials (e.g., silicon and aluminum oxides) be present within the contaminated soil to form and support a high-temperature melt. If the natural soil does not contain enough of these materials, then a fluxing agent, such as sodium carbonate, can be added. If metals of high concentrations and/or large dimensions are present in the soil to be treated, the electrodes may short circuit.

  ISV can treat soils saturated with water; however, additional power is required to dry the soil prior to melting. The presence of large inclusions in the area to be treated can limit the effectiveness of the ISV process. Inclusions are highly concentrated contaminant layers, void volumes, containers, metal scrap, general refuse, demolition debris, rock, or other heterogeneous materials within the treatment volume.

- **Implementability**. ISV is considered an emerging technology. The only vendor currently supplying commercial systems for in situ vitrification of hazardous wastes is Geosafe Corporation. Four units are in operation ranging from bench-scale to commercial-scale. A large-scale test was conducted at Hanford, Washington, on mixed radioactive and chemical wastes that contained chromium. A fire involving the protective hooding occurred. Materials of construction (e.g., for the collection hood) and electrode-feeding mechanisms are still being tested and developed.

- **Cost**. Two studies conducted on the West Coast and Midwest estimated ISV costs between $1,320 and $2,900 per CY of contaminated soil (EPA 2007). Factors that influence the cost of remediation by ISV are the moisture content of the soil, the amount of additives required to create the required "recipe," the amount of site preparation required, the specific properties of the waste soil, the depth of processing, and the unit price of electricity.

In summary, since few full-scale applications of this technology exist and this technology has relatively high implementation costs, in situ vitrification will not be further considered.

3.3.4.2 Physical/Chemical Treatment

A number of in-situ physical/chemical treatment processes for soil have been developed to chemically convert, separate, or contain waste constituents. These include solidification/stabilization and soil flushing.

In-Situ Solidification/Stabilization

Solidification/stabilization treatment systems, sometimes referred to as fixation systems, seek to trap or immobilize contaminants within their “host” medium instead of removing them through chemical or physical treatment. Solidification is a process whereby contaminants are physically bound or enclosed within a stabilized mass. Stabilization is a process where chemical reactions are induced between the stabilizing agent and contaminants to either neutralize or detoxify the wastes, thus reducing their mobility.

Solidification/stabilization methods used for chemical soil consolidation can immobilize contaminants. Most techniques involve a thorough mixing of the solidifying agent and the waste. Solidification of wastes produces a monolithic block. The contaminants do not necessarily interact chemically with the solidification reagents but are mechanically locked within the solidified matrix. Solidification/stabilization systems have generally targeted inorganics (i.e., heavy metals) and radionuclides, not PCBs. Stabilization methods usually involve the addition of materials, such as molten bitumen, asphalt emulsion, and portland cement, that limit the solubility or mobility of waste constituents even though the physical handling characteristics of the waste may not be improved. Remedial actions involving combinations of solidification and stabilization techniques are often used to yield a product or material for land disposal, or in other cases, that can be applied to beneficial use. Auger/caisson systems and injector head systems are techniques used in soil solidification/stabilization systems.

- **Effectiveness.** In situ solidification/stabilization systems have generally targeted inorganics (i.e., heavy metals) and radionuclides. The auger/caisson and reagent/injector head systems have limited effectiveness in treating organics, although systems are currently being developed and tested for treatment of PCBs.

- **Implementability.** Treatability studies are generally required to assess compatibility of waste material and reagent used.

- **Cost.** In situ solidification/stabilization costs around $150 to $250 per CY for deeper applications (FRTR 2002). However, based on the extent of the contamination and depth of the contaminated soil, we believe the cost of this treatment alternative would be moderate at best. Treatability studies would be required to better determine the cost of this alternative in a full-scale operation.

In summary, since this technology has not been successfully demonstrated on a full-scale basis for treating organics and because the solidified material may hinder future site use, this technology will not be retained for further consideration.

In-Situ Soil Flushing

Soil flushing is an extraction process by which organic and inorganic contaminants are washed from contaminated soils. An aqueous solution is injected into the area of contamination, and the contaminant elutriate is pumped to the surface for removal, re-circulation, or on-site treatment, and re-injection. During elutriation, sorbed contaminants are mobilized into solution because of solubility, and form an emulsion, or chemical reaction with the flushing solution. An in situ soil-flushing system includes extraction wells installed in the area of contamination, injection wells installed upgradient of the contaminated soil areas, and a wastewater treatment system for treatment of recovered fluids. Similar to solidification/stabilization systems, in situ soil flushing generally targets inorganics (i.e., heavy metals) and radionuclides, not PCBs.

Co-solvent flushing is another type of soil flushing that involves injecting a solvent mixture (e.g., water plus a miscible organic solvent such as alcohol) into the vadose zone, saturated zone, or both to extract organic contaminants. Co-solvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it.

- **Effectiveness.** The effectiveness of this technology decreases in heterogeneous soils similar to those found at the Buoy 212 site. The tendency of PCBs to adsorb to soil particles also reduces the effectiveness.

- **Implementability.** In-situ soil flushing has had very limited commercial success. This technology can be used only in areas where flushed contaminants and soil flushing fluid can be contained or recaptured. Typically treatability studies must be performed under site-specific conditions before this technology can be selected.

- **Cost.** In-situ soil flushing is a low cost technology with costs ranging from $25 to $250 per CY (FRTR 2002). Treatability studies would need to be performed to estimate the cost for installing a full-scale system. Also, the aboveground separation and treatment of recovered fluids can drive the cost of the whole process.

In summary, it is believed that in-situ soil flushing is not effective in heterogeneous soils found at this site. Due to its limited success and difficulty in ensuring effectiveness in-situ, this technology will, therefore, not be considered further.

3.3.4.3 Biological Treatment

Biological treatment processes use indigenous or selectively cultured microorganisms to reduce hazardous organic compounds into water, carbon dioxide, and chlorinated hydrogen chloride. Available in situ biological treatment technologies include bioventing, enhanced biodegradation (aerobic and anaerobic), natural attenuation, and phytoremediation. Factors that affect the rate of biodegradation include the type of contaminants present and their concentrations, oxygen, nutrients, moisture, pH, and temperature. Treatability studies are typically conducted to determine the effectiveness of bioremediation in a given situation. A review of completed remediation projects and demonstration projects where biological treatment technologies were used for soil remediation indicates that these technologies have primarily been used for soils contaminated with petroleum hydrocarbons, VOCs (e.g., trichloroethylene [TCE] and perchloroethylene [PCE]), pesticides, and wood preservatives. Because PCBs have relatively higher chlorine content, they are more persistent in the environment and are less susceptible to biodegradation.

- **Effectiveness.** Bioremediation of PCB contaminated soil is not known to be effective.

- **Implementability.** Vendors and organisms to biologically treat contaminated soil are readily available.

- **Cost.** Costs vary based on the type of technology used and can range from $20 to $80 per CY (FRTR 2002).

Since biological treatment technologies are not well demonstrated for PCBs, and due to the relatively longer remediation periods, these technologies were not retained for further consideration.

3.3.5 Ex Situ Treatment

Ex situ treatment requires soil to be excavated before treatment. Ex situ treatment allows for greater flexibility in establishing the physical, chemical, or biological conditions; or any combination of these conditions that are required to remove or destroy the contaminant. Available ex situ treatment technologies that would be applicable at the site include thermal desorption, incineration vitrification (thermal treatment processes), dehalogenation, solvent extraction (chemical processes), and soil washing (physical process).

3.3.5.1 Thermal Treatment

Thermal treatment processes generally involve the application of heat to physically separate, destroy, or immobilize the contaminant. A number of ex situ thermal treatment technologies exist to treat a range of contaminants including high-temperature and low-temperature thermal desorption, hot gas decontamination, open burning/open detonation, pyrolysis, and incineration. This section will focus on high-temperature thermal desorption, incineration, and vitrification, because the other technologies are either not applicable to PCB contamination (hot gas decontamination, open burning/open detonation, low-temperature thermal desorption), or have not been successfully demonstrated on a full-scale basis for sites contaminated with PCBs (pyrolysis). High-temperature thermal desorption, incineration, and vitrification are described below.

High-Temperature Thermal Desorption

Thermal desorption is a physical separation process that uses heat to volatilize organic wastes, which are subsequently collected and treated in a gas treatment system. Thermal desorption differs from incineration because the decomposition or destruction of organic material is not the desired result, although some decomposition may occur. Varieties of gas treatment technologies are used to collect, condense, or destroy the volatilized gases. A vacuum system is typically used to transport volatilized water and organics to the treatment system. As described above, thermal desorption technologies can be grouped into high-temperature thermal desorption (HTTD) and low-temperature thermal desorption (LTTD) systems. LTTD is primarily used for non-halogenated VOCs and SVOCs with low boiling points (i.e., below 600° F), and is not considered as an applicable technology for PCB contamination.

HTTD systems are able to heat materials to temperatures in the range of 600°F to 1,200°F, and can target SVOCs, polycyclic aromatic hydrocarbon (PAH), and PCBs. In general, thermal systems can be differentiated by the method used to transfer heat to the contaminated material and by the gas treatment system. Direct-contact or direct-fired systems (i.e., rotary dryer) apply heat directly by radiation from a combustion flame. Indirect-contact or indirect-fired systems (i.e., thermal screw conveyor) apply heat indirectly by transferring it from the source (combustion or hot oil) through a physical barrier that separates the heat source from the contaminated material.

Of the several vendors working in the thermal treatment industry, Environmental Soil Management Inc. (ESMI) currently owns and operates three fixed-location thermal treatment facilities in the northeast region, one each in New York, New Jersey, and New Hampshire. In addition, ESMI owns a portable thermal treatment unit that can be transported as needed based on site-specific conditions. Depending on the material volume to be treated and chemical concentrations, material may be more appropriately sent to one facility versus another.

HTTD is a full-scale technology that has been successfully demonstrated in the field for treatment of PCB-contaminated soils. Typically, systems that have been used for PCB contamination consist of a rotary dryer (primary chamber) to volatilize the contaminated material, and an afterburner (secondary chamber) where the off-gas is oxidized at temperatures in the range of 1,400°F to 1,800°F. The off-gas is then cooled, or quenched, and passed through a baghouse to remove any trace organics not oxidized prior to discharge into the atmosphere. HTTD units are considered to be incinerators, and must meet RCRA incinerator emission requirements (40 CFR Parts 264 and 265, Subpart O).

- **Effectiveness.** HTTD technology is effective in treating PCB contamination and the treated soils can be returned to the site as backfill.

- **Implementability.** This technology can be implemented fairly quickly. The equipment can be set up on site or it may be mobilized, so that it could potentially be moved from site to site.

- **Cost.** HTTD is a moderate cost technology with costs typically ranging from $300 to $500 per CY depending on the volume of contaminated soils (FRTR 2002).

In summary, HTTD is a demonstrated technology which could be implemented effectively at this site and, therefore, will be retained for further consideration.

Incineration

Incineration uses high temperatures (1,600° to 2,200°F) to volatilize and destroy organic contaminants and wastes. A typical incineration system consists of the primary combustion chamber into which contaminated material is fed and initial destruction takes place, and a secondary combustion chamber where combustion byproducts (products of incomplete combustion) are oxidized and destroyed. From the secondary chamber, the off-gases are drawn under negative pressure into an air pollution control system which may include a variety of units depending on the contaminants and site-specific requirements.

The two primary types of incinerators are rotary kiln and liquid injection incinerators. The rotary kiln is a refractory-lined, slightly inclined, rotating cylinder that serves as the primary combustion chamber operating at temperatures up to 1,800°F. The kilns can range in size from 6 to 14 feet in diameter. The liquid injection incinerators are used to treat combustible liquid, sludge, and slurries. Liquid injectors would not be applicable for the contamination at Buoy 212, since liquid waste is not present at the site.

Ex situ on-site incineration is a demonstrated treatment technology for PCB-contaminated soils. Incineration is considered an effective technology, achieving a greater than 99% reduction requirement of PCBs and dioxins concentrations in soil, thus providing long-term protection. Incinerators burning hazardous wastes must meet the RCRA incinerator regulations (40 CFR Parts 264 and 265, Subpart O) as well as state and local regulations. Furthermore, on-site incinerators used to treat PCB-contaminated material with concentrations greater than 50 mg/kg may also be subject to the requirements under TSCA set forth in 40 CFR Part 761.

- **Effectiveness.** Incineration is an effective, demonstrated technology that can treat PCB-contaminated soils.

- **Implementability.** Incineration can be readily implemented at this site.

- **Cost.** Ex situ incineration is a high cost technology with costs ranging from $600 to $1,100 per CY (FRTR 2002).

In summary, because the effectiveness of incineration to remediate site contaminated soil would be similar to HTTD, however at much higher costs. Therefore, incineration will not be retained for further consideration.

Ex Situ Vitrification

Thermal vitrification of contaminated material uses a natural gas and oxygen-enhanced power source or an electrical power source to treat PCB-impacted soil and produce a glass-like material. Natural gas-fired vitrification is less costly than the electric-powered system. For thermal vitrification, soils must be excavated, segregated, and stockpiled prior to treatment using an on-site glass furnace. This alternative may require the soils to be "dried" so that the soils entering the system contain less than 15% moisture.

The glass furnace is a "melter" constructed of refractory brick. A series of oxy-fuel burners combine natural gas and oxygen, which raise the temperature of the melter to 2,900°F. PCBs are destroyed and the soil melts and flows out of the system as molten glass. Molten glass then flows into a water-filled quench tank that hardens the molten glass into glass aggregate that makes it inert to the environment. Water is continuously added to the quench tank as the molten glass causes the water to evaporate. The glass aggregate can be beneficially reused as backfill in the original excavation, or can be sold for use as a loose-grain abrasive, as highway aggregate, or in a number of other applications.

A pilot-scale ex situ vitrification process using glass furnace technology was demonstrated to treat PCB-contaminated river sediment at Minergy Glass Pack Test Center, Wisconsin and is documented in the EPA's Superfund Innovative Technology Evaluation (SITE) Program in *Minergy Corporation Glass Furnace Technology Evaluation* (EPA 2004). The process attained greater than 99% total PCBs removal or destruction, and the glass aggregate met the state of Wisconsin's requirements for beneficial reuse. Other vitrification technologies that historically converted waste materials to glass aggregate have been applied in New York State, and the resulting materials met the NYSDEC Beneficial Use Determination (BUD) requirements.

In October 2005, soil samples from a nearby dredge spoil disposal area (the Old Moreau Site [see Appendix A for location]), were submitted to Minergy for initial screening tests to determine the feasibility of this technology (Minergy Corporation 2006). The results concluded that the mineral content of site soils is similar to those seen in other full-scale vitrification projects that were able to produce a glass aggregate end product and vitrification is an applicable technology for this site. Additional bench-scale testing would be required to establish design parameters for full-scale implementation.

- **Effectiveness.** Ex-situ vitrification of soils is an effective method of treating PCB-contaminated soils. In addition, this action reduces/eliminates the potential for future contamination of groundwater from soil contamination.

- **Implementability.** Contractors are available to implement this technology. The system would be set up at a location central to the site and the soil would be transported to it. A bench-scale study would be necessary prior to implementation of this technology.

- **Cost.** Estimated costs for ex situ vitrification obtained from Minergy range from $50 to $475 per CY (Minergy Corporation 2007 and 2003). Compared with other ex situ treatment technologies, ex situ vitrification has a much greater up-front capital cost. There are some financial risks associated with this technology as a major cost-factor is the price of natural gas, which can fluctuate significantly over the life of the operation.

In summary, ex situ vitrification is a medium-to-high cost technology with proven effectiveness to remediate PCB contamination. However, the volume of soil to be treated does not warrant the capital costs associated with the construction of the system. For this reason, ex situ vitrification will not be retained for further consideration

3.3.5.2 Physical/Chemical Treatment

Several ex situ physical/chemical treatment processes for soils have been developed to chemically convert, separate, or contain waste constituents. These include dehalogenation (or dechlorination), soil washing, and solvent extraction as discussed below.

Dehalogenation

Dehalogenation is a chemical process that is achieved either by replacement of the halogen molecule of the organic compound or decomposition and partial volatilization of the contaminant through adding and mixing specific reagents. This technology typically consists of excavating, screening, and crushing the contaminated soils; mixing the soils with the reagent in a heated reactor; and then treating the wastewater or the volatilized contaminants. Two types of dehalogenation technologies exist: base-catalyzed decomposition (BCD) and glycolate/alkaline polyethylene glycol (APEG).

Glycolate technology involves the replacement of halogen molecules in the organic contaminant by mixing the contaminant with an APEG-type reagent (commonly potassium polyethylene glycol [KPEG]) in a heated reactor. The byproducts of the reaction include glycol ether and/or hydroxylated compound and an alkali metal, which are all water soluble. Typically, treatment and disposal of wastewater generated by the process is required. The APEG process has been successfully used and demonstrated for cleanup of contaminated soils containing PCBs ranging between 2 and 45,000 mg/kg.

- **Effectiveness.** This technology has been approved by EPA's Office of Toxic Substances under TSCA for PCB treatment, and has been selected for cleanup at three Superfund sites.

- **Implementability.** EPA has been developing the BCD technology since 1990, in cooperation with the Naval Facilities Engineering Service Center (NFESC), as a remedial technology specifically for soils contaminated with chlorinated organic compounds such as PCBs. Although this technology has been approved by EPA's Office of Toxic Substances under the TSCA for PCB treatment, and one successful test run in 1994 was completed, BCD has had no commercial application to date.

- **Cost.** Ex situ dehalogenation is a high-cost technology with costs ranging from $440 to $1,100 per CY (FRTR 2002). Excavation and material handling cost would be higher with this alternative compared with more established technologies.

In summary, since dehalogenation was not commercially implemented on a large scale and is moderately expensive, this technology will not be retained for further consideration.

Solvent Extraction

Solvent extraction is a chemical process whereby the target contaminant is physically separated from its medium (soil) using an appropriate organic solvent. This technology does not destroy the waste, but reduces the volume of material that must be treated. Solvent extraction is typically accomplished by homogeneously mixing the soil, flooding it with the solvent, then mixing thoroughly again to allow the waste to come in contact with the solution. Once mixing is complete, the solvent is drawn off by gravity, vacuum filtration, or some other conventional dewatering process. The solids are then rinsed with a neutralizing agent (if needed), dried, and placed back on site or otherwise treated/ disposed of. Solvents and rinse water are processed through an on-site treatment system and recycled for further use. Solvent extraction has been shown to be effective in treating sediments, sludges, and soils containing primarily organic contaminants such as PCBs, VOCs, halogenated solvents, and petroleum wastes.

- **Effectiveness.** An on-site demonstration of the solvent extraction technology was completed in 2000 at a similar site contaminated with PCBs. Although analytical results from the demonstration showed on average a greater than 99% total PCB removal, operational problems were encountered during start-up, and multiple extractions were needed to achieve the required cleanup criteria.

- **Implementability.** This technology was demonstrated successfully at a number of Superfund sites for PCB-contaminated soils and sediments. The performance data currently available are mostly from the Resource Conservation Company's (RCC's) full-scale Basic Extractive Sludge

Treatment (BEST) process. However, full-scale application of the technology has been limited, especially with large volumes of soil as is the case at the Buoy 212 site. Additional concerns with this technology include the potential for presence of solvent in the treated soil, and regeneration and reuse of the spent solvent.

- **Cost.** The costs involved in the implementation of this technology would typically range between $275 to $1,300 per CY depending on site-specific conditions and volume of treated material (FRTR 2002).

In summary, solvent extraction has not been commercially implemented and is costly compared to other ex situ treatment technologies. For these reasons, solvent extraction is not being retained for further consideration.

Soil Washing

Soil washing segregates the fine solid fractions from the coarser soils through an aqueous washing process and uses a wash water treatment system. Typically, soil washing has been used to remediate SVOCs, fuels, and heavy metals in soils, with limited success in remediating PCB-contaminated soils. This technology is based on the observation that the majority of contaminants are found adsorbed into the fine soils (typically silt and clay-size particles) due to their greater specific surface area. The finer, contaminated fraction of soils would require further treatment/ disposal. The coarser soils (expected to be relatively free of contamination) would be backfilled on site once site cleanup goals have been achieved, which might require the soil to pass through the soil washing process multiple times. This alternative, on average, returns 80 to 90% of the treated soil or sediment back to its source. Commercially available surfactants are commonly used in the aqueous washing solution to transfer contaminants from the soil matrix to the liquid phase. Bench-scale studies are generally required prior to implementation of a full-scale soil washing operation to determine site-specific parameters and selection of surfactant(s).

- **Effectiveness.** Soil washing offers the ability to clean a wide range of contaminants from coarse-grained soils. However, the effectiveness of the technology decreases with complex waste mixtures, which make choosing the washing fluid difficult. However, because contaminated site soils are primarily glacial deposits that consist of unsorted glacial till and lacustrine deposits of gravel, sand, silt, and clay as opposed to exclusively finer soils, soil washing is expected to be effective in reducing the volume of contaminated on-site soils.

- **Implementability.** Bench-scale studies are generally required prior to implementation of a full-scale soil washing operation to determine site-specific parameters and selection of surfactant(s). The equipment for this process would be fairly inexpensive, readily available, and mobile.

- **Cost.** Ex situ soil washing is a moderate cost technology with costs ranging between $333 to $444 per CY depending on the site conditions, target waste quantity, and concentration (FRTR 2002).

In summary, there is not a high degree of confidence in the effectiveness of soil washing of PCB contaminated soil. Furthermore, since the cost to construct an on-site processing facility and the cost to operate the facility for the contaminated volume are high, ex situ soil washing is not feasible at this site. Therefore, ex situ soil washing will not be retained for further consideration.

3.3.6 On- and Off-Site Disposal

Land disposal of contaminated wastes has historically been the most common remedial action for hazardous waste sites. The two disposal options: on-site disposal in a constructed landfill, or off-site disposal in a commercial facility.

3.3.6.1 On-Site Disposal

On-site disposal of material classified as hazardous waste by New York State Hazardous Waste Regulations and TSCA, requires construction of a secure landfill that meets RCRA and state requirements. These requirements include the following:

1. The landfill must be designed so that the local groundwater table will not be in contact with the landfill;

2. The landfill must be lined with, natural and synthetic material of low permeability to inhibit leachate migration;

3. A low-permeability cover must be employed to limit infiltration and leachate production; and

4. Periodic monitoring of surface water, groundwater, and soils adjacent to the facility must be conducted to confirm the integrity of the liner and leachate collection system.

- **Effectiveness.** Construction of an on-site landfill would be an effective technology because it would limit the direct contact with and mobility of the contaminated material.

- **Implementability.** The implementability of this option is limited by the shallow groundwater table, the high volume of contaminated soil at the site, and the anticipated difficulty in meeting permit requirements.

- **Cost.** The costs involved in a construction of an on-site landfill are high.

In summary, migration of soil contamination into groundwater is not a significant transport mechanism and containment of the waste material could be achieved by capping. Therefore, construction of an on-site landfill is not warranted. On-site disposal of contaminated materials was not retained as an applicable technology.

3.3.6.2 Off-Site Disposal

Off-site disposal of contaminated soils and sediments involves hauling excavated materials to an appropriate commercially licensed disposal facility. The type of disposal facility depends on whether the waste is considered hazardous or non-hazardous. Waste material classified as hazardous waste may only be disposed of in an RCRA-permitted facility. In accordance with New York State Hazardous Waste Regulations and TSCA, materials containing PCBs at or above 50 ppm (if excavated and removed from the site), are subject to regulation as both hazardous waste and TSCA waste. Contaminated waste materials containing less than 50 ppm of PCBs are considered non-hazardous waste, and can be disposed of in a non-hazardous/solid waste facility.

- **Effectiveness.** Excavation and disposal of contaminated soil at a permitted landfill is an effective method of reducing potential for direct contact with contaminated soils. In addition, this action reduces the potential for future contamination of groundwater.

- **Implementability.** Contractors and disposal facilities are available to implement both disposal options.

- **Cost.** The cost for disposal of contaminated soils ranges between $100 and $150 per CY for non-hazardous soils and $200 to $300 per CY for hazardous soils (Waste Management 2007).

In summary, off-site disposal of contaminated materials in an off-site permitted disposal facility is a demonstrated alternative which effectively reduces exposure risks and provides long-term protection of human health and the environment. For these reasons, off-site disposal will be retained as an applicable alternative.

Table 3-1 Summary of Soil Remedial Technologies, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

General Response Actions and Remedial Technology	Brief Description	Preliminary Screening Evaluation	Screening
No Action			
	No further action to remedy soil conditions at the site.	Ineffective for the protection of human health and the environment.	Yes
Institutional Controls			
	Include public notification, deed restrictions, fencing, and signs.	Does not reduce contamination concentrations but can reduce potential exposure to the contaminated media.	Yes
Containment			
Capping			
Bituminous Concrete Cover (Asphalt)	Selective excavation and/or standard asphalt cover system including layer of stone, asphalt binder course, and final wearing course.	Does not reduce contamination concentrations but can reduce potential exposure to the contaminated media.	No
Clay Cap	Selective excavation and/or clap cap system	Does not reduce contamination concentrations but can reduce potential exposure to the contaminated media.	No
6 NYCRR Part 360 Cap	Selective excavation and/or non-RCRA cap typically used to close Municipal Solid Waste Landfills.	Does not reduce contamination concentrations but can reduce potential exposure to the contaminated media.	No
6 NYCRR Part 373 (RCRA) Cap	Selective excavation and/or RCRA cap typically required at Hazardous Waste Sites.	Does not reduce contamination concentrations but can reduce potential exposure to the contaminated media.	No
In-Situ Treatment			
Thermal			
Thermally Enhanced Soil Vapor Extraction (SVE)	Uses electrical resistance/electromagnetic/ radio frequency heating, or hot-air steam injection to facilitate volatilization and extraction of the contaminant vapors.	SVE is not effective in removing non-volatile organics such as PCBs.	No

Table 3-1 Summary of Soil Remedial Technologies, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

General Response Actions and Remedial Technology	Brief Description	Preliminary Screening Evaluation	Screening
Thermal Desorption (thermal blankets and wells)	Thermal blankets and thermal wells are placed on contaminated ground surface. A majority of contaminants are vaporized out by thermal conduction. Vapors are drawn out by vacuum system, oxidized, cooled, and passed through activated carbon beds.	More expensive than other established remedial technologies.	No
Vitrification	Contaminated soils are melted at extremely high temperatures using probes inserted into the ground delivering an electric current. The soil is heated to extremely high temperatures, and is cooled to form a stable, glassy crystalline mass.	Only a few commercial applications of this technology exist. Treatability studies are generally required to determine the effectiveness of ISV as a remediation technology at a given site. End product of the technology may hinder future site use, and there is relatively high implementation cost.	No
Physical/Chemical			
Solidification/Stabilization	Solidification/stabilization treatment systems, sometimes referred to as fixation systems, seek to trap or immobilize contaminants within their "host" medium using chemical reactions instead of removing them through chemical or physical treatment.	Stabilization technologies have not been successfully demonstrated on a full-scale basis for treating organics. Solidified material may hinder future site use. Treatability studies would be required prior to implementing this technology.	No
Soil Flushing	An extraction process by which organic and inorganic contaminants are washed from contaminated soils through the injection of an aqueous solution into the area of contamination, and the contaminant elutriate is pumped to the surface and removed from the site.	Capture of the impacted solution is critical to the effectiveness of this technology. Contamination depths and PCBs strong tendency to adhere to soil particles may limit this technology's effectiveness.	No

Table 3-1 Summary of Soil Remedial Technologies, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

General Response Actions and Remedial Technology	Brief Description	Preliminary Screening Evaluation	Screening
Biological			
Biological Treatment	Uses indigenous or selectively cultured microorganisms to reduce hazardous organic compounds into water, carbon dioxide, and chlorinated hydrogen chloride.	Biological treatment technologies are not well-demonstrated for PCBs. This technology also involves a relatively longer remediation period compared to other treatment technologies.	No
Ex-Situ Treatment			
Thermal			
High Temperature Thermal Desorption	A physical separation process that uses heat to volatilize organic wastes, which are collected and treated in a gas treatment system.	Moderate cost, full-scale technology that has been successfully demonstrated in the field for treatment of PCB contaminated soils. HTTDs are permitted as incinerators.	Yes
Incineration	Uses high temperatures to volatilize and destroy organic contaminants and wastes.	A moderate cost technology that has a demonstrated success.	No
Vitrification	Thermally vitrifies and destroys PCBs at high temperatures using a gas/oxygen power source. Soils are excavated and stockpiled, and a fluxing agent is introduced to aide in the melting process.	Medium-to-high cost technology that is successful in destroying PCBs.	No
Physical/Chemical			
Dehalogenation	A chemical process that is achieved either by replacement of the halogen molecule of the organic compound or decomposition and partial volatilization of the contaminant through adding and mixing specific reagents.	Although EPA has been developing this technology since 1990, it has not yet been successfully demonstrated in a commercial application.	No
Solvent Extraction	A chemical extraction process whereby the target contaminant is physically separated from the soil using an appropriate organic solvent to dissolve PCBs.	This technology has not been commercially implemented, and may require multiple extractions so that solvent-contaminated soils are not returned to the site.	No

Table 3-1 Summary of Soil Remedial Technologies, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

General Response Actions and Remedial Technology	Brief Description	Preliminary Screening Evaluation	Screening
Soil Washing	A volume reduction technology that segregates the fine solid fractions from the coarser soils through an aqueous washing process and washing water treatment system.	There is not a high level of confidence in the effectiveness of soil washing of PCB contaminated soil and the costs to construct and operate an on-site processing facility are high.	No
On- and Off-Site Disposal			
On-Site Disposal	Requires construction of a secure landfill that meets RCRA and state requirements.	Migration of soil contamination into groundwater is not a significant transport mechanism and containment of the waste material in an on site landfill is not necessary.	No
Off-Site Disposal	Involves the excavation and hauling of contaminated material to appropriate commercially licensed disposal facilities. The non-hazardous spoils would go to a non-hazardous/solid waste facility, while the hazardous spoils would go to a RCRA-permitted facility.	Excavation and disposal of contaminated soil at a permitted landfill is an effective method of reducing potential for direct contact with contaminated soils and future contamination of the groundwater. Backfill materials would need to be imported to fill the site.	Yes

Key:

HTTD = High Temperature Thermal Desorption.
NYCRR = New York Codes, Rules, and Regulations.
PCB = Polychlorinated biphenyl.
RCRA = Resource Conservation and Recovery Act.
SVE = Soil vapor extraction.

4 Identification of Alternatives

This section combines the technologies selected in Section 3 into alternatives. In collaboration with NYSDEC, four alternatives were identified for the soil contamination at the Buoy 212 site and are briefly described below. Note that contaminated soil outside of the existing isolation cover and located in the Hudson River floodplain will be addressed by a comprehensive RI/FS evaluation for the floodplain under the EPA Hudson River PCBs Superfund Site remedial program. A detailed description and evaluation of the alternatives is presented in Section 5.

4.1 Alternative No. 1: No Action

The no-action alternative was carried through the FS for comparison purposes as required by the NCP. This alternative would be acceptable only if it is demonstrated that the contamination at the site is below the RAOs, or that natural processes will reduce the contamination to acceptable levels. This alternative does not include institutional controls.

4.2 Alternative No. 2: No Further Action with Institutional Controls and Monitoring

The no further action with institutional controls alternative recognizes the existing isolation cover placed over the former dredge spoil disposal structure at the Buoy 212 site by NYSDOT in 1991 to satisfy TSCA requirements imposed by the EPA at that time and implements an environmental easement on the property to limit the potential for human exposure to contaminated site soils. Another element of this alternative involves a program to monitor the existing groundwater wells located around the Buoy 212 site to verify that PCBs are not moving into the waters of the Hudson River and Champlain Canal from the site.

4.3 Alternative No. 3: Excavation and Off-Site Treatment by High Temperature Thermal Desorption

This alternative consists of excavation and thermal treatment of contaminated soils that exceed site cleanup goals. An off-site HTTD system was selected to thermally treat the contaminated soils. This process applies heat to the contaminated material and volatilizes the contaminants (i.e., physical separation process). The resulting gas stream is then collected and treated separately.

4.4 Alternative No. 4: Excavation and Off-Site Disposal

This alternative consists of excavation and off-site disposal of contaminated soils that exceed the site cleanup goals. The excavated material will be stockpiled, sampled, and disposed of accordingly. As maximum PCB concentrations in soil at the site were detected below 50 ppm, contaminated soils are considered non-hazardous waste and are anticipated to be disposed of in a non-hazardous/solid waste facility.

5 Detailed Analysis of Alternatives

5.1 Introduction

The purpose of the detailed analysis of remedial action alternatives is to present the relevant information for selecting a remedy for the site. In the detailed analysis, the alternatives established in Sections 4 are described in detail and evaluated on the basis of environmental benefits and costs using criteria established by NYSDEC in TAGM 4030, Draft DER-10, and 6 NYCRR Part 375. This approach is intended to provide needed information to compare the merits of each alternative and select an appropriate remedy that satisfies the remedial action objectives for the site.

5.1.1 Detailed Evaluation of Criteria

This section first presents a summary of ten evaluation criteria that were used to evaluate the alternatives.

Overall Protection of Human Health and the Environment

This criterion provides an overall assessment of protection of human health and the environment and is based on a composite of factors assessed under the evaluation criteria, especially short-term effectiveness, long-term effectiveness and performance, and compliance with cleanup goals.

Compliance with SCGs

This criterion is used to evaluate the extent to which each alternative may achieve the proposed cleanup goals. The proposed cleanup goals were developed based on SCGs presented in Section 2.

Short-Term Impacts and Effectiveness

This criterion addresses the impacts of the alternative during the construction and implementation phase until the RAOs are met. Factors to be evaluated include protection of the community during the remedial actions; protection of workers during the remedial actions; and the time required to achieve the RAOs. Several alternatives described within the following sections may not be effective in meeting RAOs in less than 30 years. Therefore, references to short-term impacts and effectiveness may include discussions of impacts/effectiveness over a period of 30 years.

Long-Term Effectiveness and Permanence

This criterion addresses the long-term protection of human health and the environment after completion of the remedial action. An assessment is made of the effectiveness of the remedial action in managing the risk posed by untreated wastes and/or the residual contamination remaining after treatment and the long-term reliability of the remedial action.

Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion addresses NYSDEC's preference for selecting "remedial technologies that permanently and significantly reduce the toxicity, mobility, and volume" of the contaminants of concern at the site. This evaluation consists of assessing the extent to which the treatment technology destroys toxic contaminants, reduces mobility of the contaminants using irreversible treatment processes, and/or reduces the total volume of contaminated media.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of services and materials required during implementation. Technical feasibility refers to the ability to construct and operate a remedial action for the specific conditions at the site and the availability of necessary equipment and technical specialists. Technical feasibility also considers construction and O&M difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor effectiveness. Administrative feasibility refers to compliance with applicable rules, regulations, and statutes and the ability to obtain permits or approvals from government agencies or offices.

Cost

The estimated capital costs, long-term O&M costs, and environmental monitoring costs are evaluated. The estimates included herein (unless otherwise noted) assume engineering and administrative costs would equal 10% of the capital costs and contingency costs would equal 15% of the capital costs. A present-worth analysis is made to compare the remedial alternatives on the basis of a single dollar amount for the base year. For the present-worth analysis, assumptions are made regarding the interest rate applicable to borrowed funds and the average inflation rate. According to the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, the Superfund program recommends that a discount rate of 5% before taxes and after inflation be assumed. Also, the CERLA guidance states that in general, the period of performance for costing purposes should not exceed 30 years for the purpose of the detailed analysis. Therefore, the following detailed analysis of remedial alternatives will follow this guidance. The comparative cost estimates are intended to reflect actual costs with an accuracy of +50% to –30%.

State Acceptance

This assessment evaluates the technical and administrative issues and concerns the state may have regarding each alternative. This criterion will be addressed in the record of decision (ROD) once comments are received on the proposed plan. Therefore, state acceptance will not be discussed further in this report.

Community Acceptance
This assessment evaluates the issues and concerns the public may have regarding each alternative. This criterion will be addressed in the ROD once comments on the proposed plan have been received. Therefore, community acceptance will not be discussed further in this report.

Land Use
The land use criterion evaluates the issues and concerns regarding the current, intended, and reasonably anticipated future land uses of the site. Other considerations include the sites' surroundings, compatibility with applicable zoning laws, compatibility with comprehensive community master plans and Local Waterfront Revitalization plans, proximity to incompatible property in proximity to the site, accessibility to existing infrastructure, and a number of other concerns as identified in 6 NYCRR Part 375-1.

A detailed description of the alternatives listed in Section 4 and evaluation criteria are described below. Cost estimates for each alternative are presented in Tables 5-1 through 5-3. Table 5-4 presents a summary of these costs.

5.2 Remedial Alternatives

5.2.1 Alternative No. 1: No Action

5.2.1.1 Description

The No Action alternative involves taking no further action to remedy site conditions. The NCP at 40 CFR §300.430(e) (6) provides that the No Action alternative be considered at every site as a baseline for comparison with other alternatives. This alternative does not include remedial action, institutional or engineering controls, or long-term monitoring.

5.2.1.2 Detailed Evaluation of Criteria

Overall Protection of Human Health and the Environment
This alternative is not protective of human health and the environment, because the site would remain in its present condition. Soils contamination exceeding target risk levels and regulatory levels will continue to exist at the site and will be available for potential future exposure. Uncontrolled excavations could lead to PCB exposure and, therefore, risk to human health. In addition, direct contact and ingestion exposure of contaminated soil by certain wildlife may be a risk.

Compliance with SCGs
Site contaminants (PCBs) are resistant compounds by nature and are not expected to decrease appreciably over time. Therefore, this alternative would not comply with the chemical-specific SCGs for the site.

Short-Term Impacts and Effectiveness

No short-term impacts (other than those existing) are anticipated during the implementation of this alternative since there are no remedial activities involved.

This alternative does not include source removal or treatment and would not meet the RAOs (as defined in Section 2.3) in a reasonable or predictable timeframe.

Long-Term Effectiveness and Permanence

Because this alternative does not involve removal or treatment of the contaminated soil, the volume of contamination, risks associated with direct contact and ingestion with the soil, and migration of contaminants to groundwater will essentially remain the same. This alternative is, therefore, not effective in the long-term.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not involve removal or treatment of contaminated soil, and, therefore, the toxicity, mobility, and volume of contamination will not be reduced.

Implementability

There are no actions to implement under this alternative.

Cost

There are no costs associated with this alternative.

Land Use

The Buoy 212 site is a closed and covered dredge spoil disposal area located on the eastern bank of the Hudson River near channel marker 212. The site is bounded by private property on the east, north, and south. The site consists of two adjoining mounded drainage areas containing dredge spoils and separated by a drainage culvert located near the southern end of the site. The collective dredge spoil area measures approximately 850 feet long by 150 feet wide. The site is inactive, fenced, and surrounded by trees on the north, east, and west sides. The parcel is state-owned and undeveloped and best fits into a marine commercial classification. Personnel from the NYSDOT inspect and sample the groundwater monitoring wells and maintain the site under the TSCA program. Town of Fort Edward zoning maps (Town of Fort Edward 1963) indicate that the site is zoned Residential-Agricultural. In discussions with NYSDEC regarding future activities at the site, it is anticipated that the site will not be used for residential or agricultural purposes as it will remain a closed and covered dredge spoil site disposal area. Implementation of this alternative may limit future uses at this site as contaminated material would remain on site.

5.2.2 Alternative No. 2: No Further Action with Institutional Controls and Monitoring

5.2.2.1 Description

This alternative recognizes the existing isolation cover placed over the former dredge spoil disposal structure at the Buoy 212 site by NYSDOT in 1991 to satisfy TSCA requirements imposed by the EPA at that time.

The No Further Action with Institutional Controls and Monitoring alternative implements an environmental easement on the property to limit the potential for human exposure to contaminated soil/dredge spoil material. This institutional control specifies a set of limits relative to the use and development of the property and requires a site management plan to control activities at the site to minimize the potential for creating exposure pathways to the known site contamination.

Another element of this alternative involves a program to monitor the existing groundwater wells located around the Buoy 212 site to verify that PCBs are not moving into the waters of the Hudson River and Champlain Canal from the site (see Figure 5-1). The existing series of seven groundwater monitoring wells are currently sampled twice a year by the NYSDOT to satisfy TSCA requirements imposed by the EPA. As part of the remedy monitoring program, the results would be evaluated to determine if any modifications to the remedy or monitoring program are warranted.

5.2.2.2 Detailed Evaluation of Criteria

Overall Protection of Human Health and the Environment

Placement of institutional controls, such as access and deed restrictions (that would control future use/activities at the site), would provide some long-term protection of human health. Fencing and signs alone may not be adequate to prevent unauthorized access to the site by trespassers (who could potentially directly contact contaminants). In addition, fencing would provide limited protection for certain ecological receptors from direct contact and/or ingestion of site contaminants.

Compliance with SCGs

The contaminant levels in soil are not expected to decrease appreciably over time. Therefore, this alternative would not comply with the chemical-specific SCGs for the site. Action-specific and location-specific SCGs (e.g., safety regulations) would be included in the institutional controls and complied with for site activities.

Short-Term Impacts and Effectiveness

No short-term impacts (other than those existing) are anticipated during the implementation of this alternative since there are no remedial activities involved. Controlling future use and activities on site would protect workers' health. This alternative would provide some protection to the community by notifying the public and limiting site access. This alternative will achieve site RAOs through limiting direct ecological contact with impacted material.

Long-Term Effectiveness and Permanence

This alternative would not be effective in the long term (in terms of protecting human health and the environment) because this alternative does not involve removal or treatment of contaminated soil. The risks involved with direct contact with on-site contaminants would be limited to some extent with this alternative. In addition, the potential for erosion to occur would remain. Deed or other restrictions would be effective in the long term as long as they are interpreted correctly and not modified by future site users, and are enforced.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not involve the removal or treatment of contaminated soil. Therefore, neither the toxicity, nor mobility, nor volume of contamination is expected to be reduced.

Implementability

This alternative can be readily implemented on a technical and administrative basis using typical institutional control practices and procedures. However, it may be difficult to ensure long-term enforcement. Note that contaminated soil outside of the existing isolation cover and located in the Hudson River floodplain will be addressed by a comprehensive RI/FS evaluation for the floodplain under the EPA Hudson River PCBs Superfund Site remedial program.

Cost

The 2011 total present-worth cost of this alternative based on a 30-year period is $66,000. Table 5-1 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Cost estimating information was obtained from RS Means Cost Data series and engineering judgment. Groundwater sampling and renewal of institutional controls are assumed with this alternative.

Land Use

The Buoy 212 site is a closed and covered dredge spoil disposal area located on the eastern bank of the Hudson River near channel marker 212. The site is bounded by private property on the east, north, and south. The site consists of two adjoining mounded drainage areas containing dredge spoils and separated by a drainage culvert located near the southern end of the site. The collective dredge spoil area measures approximately 850 feet long by 150 feet wide. The site is inactive, fenced, and surrounded by trees on the north, east, and west sides. The parcel is state-owned and undeveloped and best fits into a marine commercial classification. Personnel from the NYSDOT inspect and sample the groundwater monitoring wells and maintain the site under the TSCA program. Town of Fort Edward zoning maps (Town of Fort Edward 1963) indicate that the site is zoned Residential-Agricultural. In discussions with NYSDEC regarding future activities at the site, it is anticipated that the site will not be used for residential or agricultural purposes as it will remain a closed and covered dredge spoil site agricultural purposes as it will remain a closed and covered dredge spoil site disposal area. Implementation of this alternative may limit future uses at this site as contaminated material would remain on site.

5.2.3 Alternative No. 3: Excavation and Off-Site Treatment by High Temperature Thermal Desorption

5.2.3.1 Detailed Description

This alternative involves excavation, off-site thermal treatment of contaminated soils, and backfill of treated soils at the site. Figure 5-2 presents the extent of excavation while Figure 5-3 presents a conceptual process for this alternative. As indicated in Section 2.4.3, a total of approximately 55,675 CY of soil will be excavated from the site and hauled to an off-site HTTD facility for treatment. It is assumed that the existing monitoring wells will be decommissioned, without replacement, in the excavated areas as groundwater monitoring is not included in this alternative (see Figure 5-2).

Excavation of the contaminated soil will be performed using conventional construction equipment such as a hydraulic excavator and bulldozers. As shown in Figure 5-2, the excavation area extends outside the existing fenced area. The maximum depth of excavation is approximately 19 feet BGS. As the cap thickness ranged from approximately 1 to 3 feet, the top 9 inches of soil used as cover material over the existing landfill is considered uncontaminated material and will be excavated and set aside for later use as backfill. To ensure safe working conditions in the excavation at all times, cutback of the excavation will be required. Based on a cutback slope of 3:1, EEEPC estimated that approximately 3,300 CY of clean soil will need to be excavated from the site. In addition, excavation at this site may require a permit as portions of excavation are located in existing wetlands (small area to the south) (see Figure 2-1).

During the excavation process, PCB field screening tests will be used in accordance with 40 CFR 761.61, analytical sampling for metals, and the approval of NYSDEC to verify contamination levels. The goal will be to determine if the remaining soil has PCB or metals concentrations exceeding cleanup criteria, thus requiring additional excavation, or providing documentation that additional excavation is not necessary if the results indicate that PCB and metals levels are less than the respective clean up goals. A sampling grid will be developed over the soil area for the NYSDEC's approval.

Based on groundwater elevations collected during the RI (EEEPC 2011), it does not appear that the excavation at this site will extend into the groundwater table. Therefore, excavation dewatering is not assumed at this site.

After each dump truck unloads the contaminated soil at the treatment facility, the dump truck will then load soil that has been treated and return to the site to be used as backfill. The off-site treatment facility requires a week to process soils and there will be a one-week lag period between the initial unloading of contaminated soils and receiving treated soils. The reuse of treated site soils versus new backfill was preferred as a cost-saving and resource saving alternative. Instead of trucks returning to the site (from the treatment facility) empty, they can return with the backfill needed for the site. Furthermore, reuse of treated soil eliminates the need for the treatment facility to dispose of the material and reduces the need to use natural resources (soil).

Negligible soil loss is anticipated through the treatment process, and it was assumed no additional backfill will be imported to the site. Six inches of topsoil will be placed and graded to the final surface elevation. Once backfill operations are completed, the site will be restored to preconstruction conditions to include seeding and tree planting.

Under CERCLA 121 (c) five-year reviews should be conducted for sites that implement remedial actions that, upon completion, will leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure. Since the implementation of this alternative will result in PCB concentrations above the 6 NYCRR Part 375 unrestricted use cleanup objective of 0.1 ppm, five-year reviews may be required at the site.

5.2.3.2 Detailed Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is considered protective of human health and the environment since the contaminated material is excavated and thermally treated off site to meet site cleanup levels. Because the contaminants will be treated and destroyed, exposure risks associated with soil contamination will be eliminated.

Compliance with SCGs

This alternative will meet SCGs since the PCB contamination in site soils will be effectively treated to meet cleanup goals at the site. Applicable action- and location-specific SCGs including air discharge permits and requirements, noise limitations, wetland permits (as required), and Occupational Safety and Health Administration (OSHA) regulations will be met during implementation of the alternative.

Short-Term Impacts and Effectiveness

Several short-term impacts to the community and workers may arise during excavation of contaminated soil from the site. With this alternative, an increased risk to workers is imposed due to the equipment required to excavate the soil. Furthermore, a portion of the excavation will occur on private property. Community impacts include dust and noise from equipment operation. Construction equipment may increase noise impacts on the surrounding community. Transportation of materials by dump trucks may increase the traffic in the surrounding community. To minimize short-term impacts, site access will be restricted during excavation and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment (PPE), and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels for the site will be set prior to any intrusive activities, and an appropriate corrective action will be implemented if these action levels are exceeded.

Off-site transportation of contaminated soil to and from the treatment facility will be performed by a licensed hauler. Based on anticipated excavation rates and 22-ton per load dump trucks, it is estimated that up to 50 trucks will be needed on a daily basis to transport contaminated soil on a continuous basis. While there is a risk of spills due to accidents, this risk will be limited by using closed and lined containers for transport.

This alternative involves treatment of contaminated soil off-site, so the preliminary remediation goals will be achieved at the completion of this work. Excavation and thermal treatment of the contaminated soil is estimated to be complete in approximately one to three years. Additional time would be needed for engineering, design, mobilization/demobilization, etc.

Long-Term Effectiveness and Permanence

This alternative is considered to be an effective remedy in the long term, since contaminants in site soils will be destroyed using thermal treatment. Treated soil will meet site cleanup criteria; therefore, environmental risks will be eliminated.

Reduction in Toxicity, Mobility, or Volume through Treatment

The volume of contamination will be reduced at the site because this alternative actively treats PCB contamination in site soils. Consequently, the toxicity and mobility of the contaminants will also be reduced.

Implementability

This alternative can be readily implemented using standard construction means and methods. Thermal treatment could reliably meet cleanup goals. Due to variability of the PCB and other parameter concentrations (e.g., presence of metals, debris) adjustment in operational parameters may be required to treat this material. This however should not affect the performance or implementability of the alternative. Monitoring and sampling of the HTTD system will be conducted during the treatment phase to ensure that site cleanup criteria are met and air discharge standards are not exceeded.

Cost

The 2011 total present-worth cost of this alternative is $10,773,000. Table 5-2 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Technology-specific costs were obtained from ESMI in 2007, while other cost estimating information was obtained from RS Means Cost Data series and engineering judgment. No long-term O&M costs are anticipated with this alternative.

Land Use

The Buoy 212 site is a closed and covered dredge spoil disposal area located on the eastern bank of the Hudson River near channel marker 212. The site is bounded by private property on the east, north, and south. The site consists of two adjoining mounded drainage areas containing dredge spoils and separated by a drainage culvert located near the southern end of the site. The collective dredge spoil area measures approximately 850 feet long by 150 feet wide. The site is inactive, fenced, and surrounded by trees on the north, east, and west sides. The parcel is state-owned and undeveloped and best fits into a marine commercial classification. Personnel from the NYSDOT inspect and sample the groundwater monitoring wells and maintain the site under the TSCA program. Town of Fort Edward zoning maps (Town of Fort Edward 1963) indicate that the site is zoned Residential-Agricultural. In discussions with NYSDEC regarding future activities at the site, it is anticipated that the site will not be used for residential or agricultural purposes as it will remain a closed and covered dredge spoil site disposal area. Implementation of this alternative may limit future uses at this site as contaminated material would remain on site.

5.2.4 Alternative No. 4: Excavation and Off-Site Disposal

5.2.4.1 Detailed Description

This alternative involves the excavation and off-site disposal of contaminated soils at the Buoy 212 site (see Figure 5-4). A portion of the existing cap will be removed and stockpiled for use in restoring the site as this soil is considered uncontaminated. The contaminated soil below will be characterized and properly disposed of off site. Clean fill and stockpiled cap material will be used to backfill the excavated areas to bring final grades above the groundwater table.

The top 9 inches of soil of the existing landfill will be excavated and stockpiled on site for future use. Excavation of the contaminated soil and analytical testing will be performed as described in Alternative 3. Excavated soils that are contaminated will be stockpiled on plastic-lined areas on site for characterization in accordance with disposal facility requirements. The contractor will be responsible for the characterization sampling, which will be conducted at a NYSDOH-certified laboratory.

After the results of the characterization sampling are received, the soil will be cleared for disposal by NYSDEC. For this alternative, lined and covered dump trucks were assumed at $45 per ton for transportation of the non-hazardous soil. Trucks will be weighed with an empty load. The soil will be loaded onto the trucks then weighed again to determine the loaded weight of the vehicle. The trucks will then transport the soil to the appropriate disposal facility.

Excavated soils with PCB concentrations less than 50 mg/kg are considered non-hazardous. These soils can be disposed of in a permitted NYSDEC-approved non-hazardous/solid waste landfill. Several disposal locations are available for non-hazardous soils. For example, Waste Management, Inc. accepts soil containing PCBs less than 50 mg/kg at a landfill in Fairport, New York. For costing purposes, unit costs from this Waste Management facility with the understanding that a landfill closer to the site may be identified at the design stage. The contractor will be responsible for characterization sampling in accordance with disposal facility requirements. At a minimum, EEEPC assumed that toxicity characteristic leaching procedure (TCLP), pesticides/PCB, PAH, RCRA ignitability, RCRA corrosivity, and RCRA reactivity analyses will be performed on samples collected every 1,000 CY. It is estimated that the contaminated soil, approximately 55,675 CY, will be excavated and disposed of as non-hazardous material.

Following excavation and removal of designated soil from the site, a 5-foot layer of imported clean fill will be placed and compacted in the excavation area to restore the final site grades to approximate original and surrounding grades, above the groundwater table. Six inches of topsoil will be placed and graded to the final surface elevation. Once backfill operations are completed, the site will be restored to preconstruction conditions to include seeding and tree planting.

Under CERCLA 121 (c) five-year reviews should be conducted for sites that implement remedial actions that, upon completion, will leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure. Since the implementation of this alternative will result in PCB concentrations above the 6 NYCRR Part 375 unrestricted use cleanup objective of 0.1 ppm, five-year reviews may be required at the site.

5.2.4.2 Detailed Evaluation of Criteria

Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment since contaminated soils will be removed from the site and properly disposed of in an environmentally acceptable facility. The contaminated soil will no longer present an exposure risk.

Compliance with SCGs

This alternative complies with SCGs since contaminated soils will be removed from the site and properly disposed of in an environmentally acceptable facility. Off-site disposal will comply with all applicable land disposal restrictions and analytical requirements. Action- and location-specific SCGs including noise limitations, wetlands permits (as required), and OSHA regulations will be in compliance with during implementation of this alternative.

Short-Term Impacts and Effectiveness

Several short-term impacts to the community and workers may arise during excavation of contaminated soil at the site. These include dust, noise, and potential spills during handling and transportation of contaminants. To minimize short-term impacts, site access will be restricted during construction and remediation activities. Furthermore, a portion of the excavation will occur on private property. Health and safety measures, including air monitoring, use of appropriate PPE, and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community. Action levels will be set prior to any intrusive activities, and an appropriate correction action will be implemented if these action levels are exceeded.

Off-site transportation of contaminated soil to the disposal facility will be performed by a licensed hauler. Based on anticipated excavation rates and 22-ton per load dump trucks, it is estimated that up to 50 trucks will be needed on a daily basis to dispose of contaminated soil on a continuous basis. While there is a risk of spills due to accidents, this risk will be limited by using closed and lined containers for transport.

Because this alternative involves removal of the contaminated soil from the site and replacement with clean fill, site RAOs will be achieved at the completion of this work. The time to complete this alternative is estimated to be approximately 1 to 3 years.

Long-Term Effectiveness and Permanence

Removal and off-site disposal is considered to be an adequate and effective remedy in the long-term since the contaminated soil will no longer represent an environmental risk.

Reduction in Toxicity, Mobility, or Volume through Treatment

This alternative does not reduce the toxicity, mobility, or volume of contaminated soil through treatment. However, excavation and off-site disposal of contaminated soils will eliminate concerns associated with toxicity and mobility of the contaminants at the site. Since the non-hazardous soil will be disposed of in an engineered permitted facility, the mobility of the contaminants will be within acceptable limits and would be practically reduced.

Implementability

This alternative is readily implemented using standard construction means and methods. Contaminated soil will be excavated, tested, and segregated for disposal disposed of at a non-hazardous waste facility. Several facilities have been identified which can accept the contaminated soil from the site. No capacity or availability problems have been identified. Finally, no delay is anticipated in obtaining the necessary approvals from the state and local agencies for implementation of this alternative.

Cost

The 2011 total present-worth cost of this alternative is $10,712,000. Table 5-3 presents the quantities, unit costs, and subtotal costs for the various work items in this alternative. Disposal costs were obtained from Waste Management, Inc. of New York in 2007, while other cost estimating information was obtained from RS Means Cost Data series and engineering judgment. No long-term O&M costs are anticipated with this alternative.

Land Use

The Buoy 212 site is a closed and covered dredge spoil disposal area located on the eastern bank of the Hudson River near channel marker 212. The site is bounded by private property on the east, north, and south. The site consists of two adjoining mounded drainage areas containing dredge spoils and separated by a drainage culvert located near the southern end of the site. The collective dredge spoil area measures approximately 850 feet long by 150 feet wide. The site is inactive, fenced, and surrounded by trees on the north, east, and west sides. The parcel is state-owned and undeveloped and best fits into a marine commercial classification. Personnel from the NYSDOT inspect and sample the groundwater monitoring wells and maintain the site under the TSCA program. Town of Fort Edward zoning maps (Town of Fort Edward 1963) indicate that the site is zoned Residential-Agricultural. In discussions with NYSDEC regarding future activities at the site, it is anticipated that the site will not be used for residential or agricultural purposes as it will remain a closed and covered dredge spoil site disposal area. Implementation of this alternative may limit future uses at this site as contaminated material would remain on site.

5.3 Comparative Evaluation of Alternatives

Overall Protection of Human Health and the Environment

Since Alternative 1 employs no action, contaminated site soils will remain on site providing no protection for potential future exposure. Alternatives 2, 3, and 4 are more protective of human health and the environment; each at a different level. By only using institutional controls in Alternative 2, inadequate enforcement could lead to potential health risks. Wildlife may also not be properly protected with this alternative. Alternatives 3 and 4 provide a higher level of protection than Alternative 2 because the site-wide contaminated soils will be excavated and either treated or properly disposed of off site.

Compliance with SCGs

PCBs are recalcitrant compounds by nature and, therefore, their levels in the soil are not expected to decrease over time. Alternatives 1 and 2 do not comply with SCGs because the contaminated soils will remain on site. Alternatives 3 and 4 comply with SCGs since soil contamination will be either treated or properly disposed of off site.

Short-Term Impacts and Effectiveness

Short-term impacts are not anticipated for Alternatives 1 and 2 since no remediation activities will take place. Several similar short-term impacts may affect the community during remedial activities for Alternatives 3 and 4, such as dust and noise due to excavation of the contaminated soil. A continuous influx of dump trucks would be needed on a daily basis, accompanied by the potential for spills of contaminated soils during the off-site transport of soils by trucks with Alternatives 3 and 4. Noise impacts are inherent of excavation activities, therefore, affecting Alternatives 3 and 4.

Long-Term Effectiveness and Permanence

Since Alternative 1 employs no action, contaminated soil will remain on site providing no protection for potential future exposure. Alternative 2 is effective in the long term provided proper enforcement is performed. Alternatives 3 and 4 have a higher level of long-term effectiveness and permanence than Alternative 2, because sitewide contaminated soils will be either treated to eliminate on-site PCB contamination or properly disposed of.

Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction in toxicity, mobility, or volume through treatment will be achieved through treatment in Alternative 3. Alternatives 1 and 2 will not treat contaminated soils, therefore reduction in, toxicity, mobility, or volume will not take place. Alternative 4 will essentially eliminate concerns of toxicity, mobility, and volume of contaminated soil at the site through off-site disposal at a permitted disposal facility.

Implementability

There are no actions to implement for Alternative 1. Alternatives 2 through 4 are readily implemented using standard construction means and methods. Note that contaminated soil outside of the existing isolation cover and located in the Hudson River floodplain will be addressed by a comprehensive RI/FS evaluation for the floodplain under the EPA Hudson River PCBs Superfund Site remedial program.

Cost

Alternative 1 calls for no action, and thus incurs no costs. Alternative 2 has a lower total present worth and O&M cost than Alternatives 3 through 4 because no soil excavation is required for this alternative.

Land Use

As contaminated soil will be left in place for Alternatives 1 and 2, anticipated future uses at the site may be limited as contaminated material would remain on-site. For Alternatives 3 and 4 contaminated soil will be either removed or treated, thus, future uses at the site would not be limited based on anticipated future uses.

Table 5-1 Cost Estimate for Alternative 2 - No Further Action with Institutional Controls and Monitoring
Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Not Applicable				$0.00	$0
				Subtotal	$0
Capital Cost Subtotal in 2007 Dollars:					$0
Adjusted Capital Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):					$0
10% Legal, administrative, engineering fees:					$0
15% Contingencies:					$0
Adjusted Capital Cost Subtotal in 2011 Dollars (1.092):					$0
Total Capital Cost:					**$0**
Annual Costs					
Not Applicable				$0.00	$0
				Subtotal	$0
Annual Cost Subtotal in 2007 Dollars:					$0
Adjusted Annual Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):					$0
10% Legal, administrative, engineering fees:					$0
15% Contingencies:					$0
Adjusted Annual Cost Subtotal in 2011 Dollars (1.092):					$0
Annual Cost Total:					**$0**
30-Year Present Worth of Annual Costs:					**$0**
5-Year Costs					
Groundwater Sampling (Labor)	2-people @ $100/hr; 8 hr/day; total of 5 wells; assume 3 wells/day	Day	2	$1,600.00	$3,200
Parameter Analysis	Includes TCL PCBs	Each	5	$100.00	$500
Data Evaluation and Reporting		HR	32	$100.00	$3,200
10% of Fence Replaced	Chain link industrial, 6' High, 6 gauge wire with 3 strands barb wire	LF	230	$29.00	$6,670
Institutional Controls	Maintain/update documentation	Each	1	$5,000.00	$5,000
				Subtotal	$18,570
5-Year Cost Subtotal in 2007 Dollars:					$18,570
Adjusted 5-Year Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):					$17,084
10% Legal, administrative, engineering fees:					$1,708
15% Contingencies:					$2,819
Adjusted 5-Year Cost Subtotal in 2011 Dollars (1.092):					$23,602
5-Year Total:					**$23,602**
30-Year Present Worth of 5-Year Costs:					**$66,000**

2011 Total Present Worth Cost: $66,000

Assumptions:

1. Length of fencing obtained from Figure 5-1: No Further Action with Institutional Controls and Monitoring, Buoy 212.				
2. Wooded area assumed to be =	0.7	acres		
3. Present worth of costs assumes 5% annual interest rate.				
4. Unit costs listed were obtained from 2007 RS Means Cost Data and engineering judgement.				
5. Costs listed are expressed in 2007 dollars unless otherwise noted.				
6. RSMeans Historical Cost Index used to escalate 2007 costs to 2011 costs.		Year	Index #	
		2011	185.0	
		2007	169.4	

Key:
HR = Hour.
LF = Linear foot.

Table 5-2 Cost Estimate for Alternative 3 - Excavation and Treatment by Off-Site High Temperature Thermal Desorption
Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	$237,660.56	$237,661
				Subtotal	$237,661
Site Preparation					
Surveying Crew	2-person crew @ $100/hr, 8hr/day; assume 50% of project duration	Day	93	$1,600.00	$148,467
Cut and Chip Trees	Trees to 12" diameter	Acre	0.7	$4,950.00	$3,465
Grub Stumps and Remove		Acre	0.7	$3,225.00	$2,258
Install Construction Fence	Chain link fence rental, 6' high, encompass treatment facility	LF	2,300	$9.55	$21,965
				Subtotal	$176,154
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$3,000.00	$6,000
Community/Exclusion Zone Air Monitoring	Particulate meter purchase (Qty 4)	Each	4	$7,500.00	$30,000
Site Safety Officer	10 hrs/day, 5days/wk, $100/hr; 100% of project duration	manweeks	26	$5,000.00	$132,196
				Subtotal	$168,196
Excavation					
Excavation	Backhoe, hydraulic, 2 CY bucket = 130 CY/hr	BCY	55,675	$1.86	$103,556
Transport contaminated soil to Stockpile	Front End Loader, 5 CY bucket	BCY	51,517	$1.48	$76,246
Stockpiling (prior to treatment)	300 Horsepower Bulldozer w/ 50' haul	BCY	51,517	$1.26	$64,912
Transport clean soil (cap) to Stockpile	Front End Loader, 5 CY bucket	BCY	4,158	$1.48	$6,153
Stockpiling clean soil (cap)	300 Horsepower Bulldozer w/ 50' haul	BCY	4,158	$1.26	$5,238
Confirmation Sampling (PCB Screening)	Immunoassay testing; includes bottom and sidewall testing	Each	423	$75.00	$31,739
Confirmation Sampling (PCB)	10% samples collected by PCB screening	Each	42	$100.00	$4,232
Confirmation Sampling (Metals)	TAL metals	Each	423	$200.00	$84,636
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	3	$200.00	$600
				Subtotal	$377,312
High Temperature Thermal Desorption					
HTTD (Treatment)	Includes off-site equipment, labor, maintenance, utilities, testing of effluent at ESMI facility in New Hampshire	Ton	77,276	$43.00	$3,322,877
Soil Testing (Characterization)	Includes TPH, VOCs, PAHs, RCRA 8 metals, PCBs	Each	167	$560.00	$93,269
Transporting Soil to HTTD Facility (off site)	Includes trucks, labor, gas	Ton	77,276	$32.00	$2,472,839
Transporting Soil from HTTD Facility (back to site)	Includes trucks, labor, gas, handling fees	Ton	77,276	$18.00	$1,390,972
				Subtotal	$7,279,957
Backfilling					
Placement of Backfill	300 Horsepower Bulldozer w/ 50' haul	BCY	55,675	$1.26	$70,151
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	BCY	55,675	$0.44	$24,497
				Subtotal	$94,648
Site Restoration					
Topsoil (Material only)	0.5 ft thick layer	LCY	3,697	$12.50	$46,210
Placement of Topsoil	300 Horsepower Bulldozer w/ 50' haul	BCY	3,301	$1.26	$4,159
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; add 10% for disturbed areas outside of excavation area	MSF	200	$49.50	$9,900
Tree Planting (Material)	Conifer trees, assume Douglas Fir in pre-construction wooded area	Each	77	$95.50	$7,354
Tree Planting (Labor & Equipment)	Up to 24" ball	Each	77	$59.00	$4,543
				Subtotal	$72,166
				Capital Cost Subtotal in 2007 Dollars:	$8,406,094
				Adjusted Capital Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):	$7,733,606
				10% Legal, administrative, engineering fees:	$773,361
				15% Contingencies:	$1,276,045
				Adjusted Capital Cost Subtotal for 2011 Dollars (1.092):	$10,683,927
				Total Capital Cost:	**$10,684,000**
Annual Costs					
Not Applicable				$0.00	$0
				Subtotal	$0
				Annual Cost Subtotal in 2007 Dollars:	$0
				Adjusted Annual Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):	$0
				10% Legal, administrative, engineering fees:	$0
				15% Contingencies:	$0
				Adjusted Annual Cost Subtotal for 2011 Dollars (1.092):	$0
				Annual Cost Total:	**$0**
				Present Worth of Annual Costs	**$0**

Table 5-2 Cost Estimate for Alternative 3 - Excavation and Treatment by Off-Site High Temperature Thermal Desorption
Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
5-Year Costs					
5-year CERCLA reviews		Each	1	$25,000.00	$25,000
				Subtotal	$25,000
				5-Year Cost Subtotal in 2007 Dollars:	$25,000
				Adjusted 5-Year Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):	$23,000
				10% Legal, administrative, engineering fees:	$2,300
				15% Contingencies:	$3,795
				Adjusted 5-Year Cost Subtotal in 2011 Dollars (1.092):	$31,774
				5-Year Total:	**$31,774**
				30-Year Present Worth of 5-Year Costs:	**$89,000**

2011 Total Present Worth Cost: $10,773,000

Assumptions:

1. Total cap area at the site (assumed to be the	4.1	acres, as obtained from EEEPC CAD department October 2007, or		
extent of contamination shown on Figure 2-1 of this report) =	178,239	SF		
2. Thickness of the existing clay cap layer to be used as backfill =	9	inches		
3. Volume of cap soil to be reused on site =	4,158	BCY		
4. Contaminated soil volume =	51,517	BCY		
Total excavation volume =	55,675	BCY		
5. Contaminated soil excavation area =	178,239	SF		
Total excavation area =	4.1	acres, as obtained from EEEPC CAD department October 2007, or		
	178,239	SF		
6. Wooded area assumed to be =	0.7	acres		
7. Assume confirmation sampling spacing =	25	foot grid spacing (per 40 CFR 761.280)		
8. Maximum excavation depth =	19	ft BGS		
9. Assumed production rate of excavation =	130	BCY/hr		
	75%	assumed effective production rate		
	98	BCY/hr, effective production rate		
	780	BCY/day, effective production rate		
	284,700	BCY/year, effective production rate		
10. Assuming effective production rate, time to excavate soil =	2	months, or	0.20	years
11. HTTD facility can accept up to =	450	tons/day		
12. Assuming effective production rate, time to treat excavated soil =	6.1	months, or	0.51	years
13. Mob/demob assumed to be =	4	months, or	0.33	years
Volume of soil to be treated by HTTD unit =	51,517	BCY		
14. Assume % of treated soil to be used as backfill =	100%			
15. Assume % reduction by volume of soil from Thermal Treatment proces =	0%			
16. Backfill volume for site restoration =	55,675	BCY, or		
	62,356	LCY		
17. Topsoil volume for site restoration (0.5ft thick) =	3,301	BCY, or		
	3,697	LCY		
18. Assume tree planting grid spacing every	20	ft		
19. No storage facilities are assumed for treated or untreated soil. However, these facilities may be added at a later time.				
20. Effluent sampling for PCBs (after treatment) included in HTTD treatment cost.				
21. No additional backfill will be imported to the site. Final elevations will be graded to drain to existing catch basins or adjacent grassy areas.				
22. Soil testing for off-site HTTD unit assumes:				
Characterization - 1 sample for every	200	Tons, up to 4,000 tons, then 1 sample every		
	500	Tons		
23. Based on geotechnical data from the RI (EEEPC 2007) , in-situ bulk density of site soils =				
	1.5	Tons/BCY		
24. For loose soil assume sandy, dry soil with swell factor =	12%			
(Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).				
25. Topsoil density assumed to be	1.2	Tons/LCY		
26. The excavated cap volume will be used as backfill.				
27. Dewatering is not required during excavation.				
28. Present worth of costs assumes 5% annual interest rate.				
29. HTTD costs supplied by vendor, Environmental Soil Management, Inc. (ESMI), June 2007. Other unit costs listed were obtained from 2007 RS Means Cost Data and engineering judgement.				
30. Costs listed are expressed in 2007 dollars unless otherwise noted.				
31. RSMeans Historical Cost Index used to escalate 2007 costs to 2011 costs.		Year	Index #	
		2011	185.0	
		2007	169.4	

Key:
BCY = Bank cubic yards.
BGS = Below ground surface.
CLF = Current limiting fuse.
ft = Feet.
LCY = Loose cubic yards.
LF = Linear foot.
LS = Lump sum.
MSF = Thousand square feet.
SF = Square feet.

Table 5-3 Cost Estimate for Alternative 4 - Excavation and Off-Site Disposal, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Capital Costs					
Construction Management (2.5% of total capital cost)	Includes submittals, reporting, meetings	LS	1	$236,292.34	$236,292
				Subtotal	$236,292
Site Preparation					
Surveying Crew	2-person crew @ $100/hr, 8hr/day; assume 50% of project duration	Day	36	$1,600.00	$57,103
Cut and Chip Trees	Trees to 12" diameter	Acre	0.7	$4,950.00	$3,465
Grub Stumps and Remove		Acre	0.7	$3,225.00	$2,258
Install Construction Fence	Chain link fence rental, 6' high, encompass treatment facility	LF	2,300	$9.55	$21,965
				Subtotal	$84,790
Health and Safety					
Construct Decontamination Pad & Containment	For equipment & personnel	Setups	2	$3,000.00	$6,000
Community/Exclusion Zone Air Monitoring	Particulate meter purchase (Qty 4)	Each	4	$7,500.00	$30,000
Site Safety Officer	10 hrs/day, 5days/wk, $100/hr; 100% of project duration	manweeks	10	$5,000.00	$50,845
				Subtotal	$86,845
Excavation					
Excavation	Backhoe, hydraulic, 2 CY bucket = 130 CY/hr	BCY	55,675	$1.86	$103,556
Transport contaminated soil to Stockpile	Front End Loader, 5 CY bucket	BCY	51,517	$1.48	$76,246
Stockpiling contaminated soil	300 Horsepower Bulldozer w/ 50' haul	BCY	51,517	$1.26	$64,912
Transport clean soil (cap) to Stockpile	Front End Loader, 5 CY bucket	BCY	4,158	$1.48	$6,153
Stockpiling clean soil (cap)	300 Horsepower Bulldozer w/ 50' haul	BCY	4,158	$1.26	$5,238
Stockpile Liner		LS	1	$5,000.00	$5,000
Confirmation Sampling (PCB Screening)	Immunoassay testing; includes bottom and sidewall testing	Each	423	$75.00	$31,739
Confirmation Sampling (PCB)	10% samples collected by PCB screening	Each	42	$100.00	$4,232
Confirmation Sampling (Metals)	TAL metals	Each	423	$200.00	$84,636
Off-Site Disposal (Drums)	Waste decon water (<500 mg/kg PCB, <1% solids); price per 55 gal drum including transportation	Drum	3	$200.00	$600
				Subtotal	$382,312
Off Site Disposal					
Off-Site Disposal of Non-Hazardous Soil (PCB concentration < 50 ppm)					
Characterization Sampling	Includes TCLP, Pesticides/PCB, PAH, RCRA ignitability, RCRA corrosivity, RCRA reactivity analyses; Assume 24-hr turnaround; one sample for first 500 LCY, and one sample for each additional 1000 LCY	Each	59	$1,440.00	$84,960
Loading Trucks	Front End Loader, 5 CY bucket	BCY	51,517	$1.48	$76,246
Transportation	Dump truck transport from the Buoy 212 site to Fairport, NY; incl taxes and fees	Ton	77,276	$45.00	$3,477,429
Off-Site Disposal (Soil)	Disposal at High Acres Landfill (Fairport, NY); incl taxes and fees	Ton	77,276	$45.00	$3,477,429
				Subtotal	$7,116,065
Backfilling					
Backfill (Material)	Includes material and transportation to site; assume average of 5' layer of backfill over contaminated soil excavation area	LCY	32,312	$10.00	$323,117
Placement of Backfill	300 Horsepower Bulldozer w/ 50' haul	BCY	33,007	$1.26	$41,589
Compaction	Vibrating roller, 12" compacted lifts, 4 passes	BCY	33,007	$0.44	$14,523
				Subtotal	$379,229
Site Restoration					
Topsoil (Material only)	0.5 ft thick layer	LCY	3,697	$12.50	$46,210
Placement of Topsoil	300 Horsepower Bulldozer w/ 50' haul	BCY	3,301	$1.26	$4,159
Seeding (w/ mulch and fertilizer)	Bluegrass 4#/MSF w/ mulch and fertilizer, hydroseeding; add 10% for disturbed areas outside of excavation area	MSF	200	$49.50	$9,900
Tree Planting (Material)	Conifer trees, assume Douglas Fir in pre-construction wooded area	Each	77	$95.50	$7,354
Tree Planting (Labor & Equipment)	Up to 24" ball	Each	77	$59.00	$4,543
				Subtotal	$72,166
				Capital Cost Subtotal in 2007 Dollars:	$8,357,699
				Adjusted Capital Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):	$7,689,083
				10% Legal, administrative, engineering fees:	$768,908
				15% Contingencies:	$1,268,699
				Adjusted Capital Cost Subtotal in 2011 Dollars (1.092):	$10,622,418
				Total Capital Cost:	**$10,623,000**

Table 5-3 Cost Estimate for Alternative 4 - Excavation and Off-Site Disposal, Buoy 212 Dredge Spoil Disposal Area, Fort Edward, New York

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
Annual Costs					
Not Applicable				$0.00	$0
				Subtotal	$0
Annual Cost Subtotal in 2007 Dollars:					$0
Adjusted Annual Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):					$0
10% Legal, administrative, engineering fees:					$0
15% Contingencies:					$0
Adjusted Annual Cost Subtotal in 2011 Dollars (1.092):					$0
Annual Cost Total:					**$0**
Present Worth of Annual Costs:					**$0**

Item Description	Comment	Unit	Quantity	Unit Cost	Cost
5-Year Costs					
5-year CERCLA reviews		Each	1	$25,000.00	$25,000
				Subtotal	$25,000
5-Year Cost Subtotal in 2007 Dollars:					$25,000
Adjusted 5-Year Cost Subtotal in 2007 Dollars for Glens Falls, New York Location Factor (0.92):					$23,000
10% Legal, administrative, engineering fees:					$2,300
15% Contingencies:					$3,795
Adjusted 5-Year Cost Subtotal in 2011 Dollars (1.092):					$31,774
5-Year Total:					**$31,774**
30-Year Present Worth of 5-Year Costs:					**$89,000**

2011 Total Present Worth Cost: $10,712,000

Assumptions:

1. Total cap area at the site (assumed to be the	4.1	acres, as obtained from EEEPC CAD department October 2007, or		
extent of contamination shown on Figure 2-1 of this report) =	178,239	SF		
2. Thickness of the existing clay cap layer to be used as backfill =	9	inches		
3. Volume of cap soil to be reused on site =	4,158	BCY		
4. Contaminated soil volume =	51,517	BCY		
Total excavated volume =	55,675	BCY		
5. Contaminated soil excavation area =	178,239	SF		
Total excavation area =	4.1	acres, as obtained from EEEPC CAD department October 2007, or		
	178,239	SF		
6. Wooded area assumed to be =	0.7	acres		
7. Assume confirmation sampling spacing =	25	foot grid spacing (per 40 CFR 761.280)		
8. Maximum excavation depth =	19	ft BGS		
9. Assumed production rate of excavation =	130	BCY/hr		
	75%	assumed effective production rate		
	98	BCY/hr, effective production rate		
	780	BCY/day, effective production rate		
	284,700	BCY/year, effective production rate		
10. Assuming effective production rate, time to excavate soil =	2	months, or	0.20	years
11. Mob/demob assumed to be =	4	months, or	0.33	years
12. Volume of soil estimated as < 50ppb PCBs =	51,517	BCY		
13. Taxes and fees for non-haz landfill transportation	26%			
14. Taxes and fees for non-haz landfill disposal	12%			
15. Volume of backfill needed =	33,007	BCY		
Volume of backfill needed for purchase (excluding cap material to be reused) =	28,850	BCY		
16. Topsoil volume for site restoration (0.5ft thick) =	3,301	BCY, or		
	3,697	LCY		
17. Assume tree planting grid spacing every	20	ft		
18. Based on geotechnical data from the RI (EEEPC 2007), in-situ bulk density of site soils =				
	1.5	Tons/BCY		
19. For loose soil assume sandy, dry soil with swell factor =	12%			
(Means Estimating Handbook. United States of America : Means Southern Construction Information Network, 1990).				
20. Topsoil density assumed to be	1.2	Tons/LCY		
21. The excavated cap volume will be used as backfill.				
22. Dewatering is not required during excavation.				
23. Present worth of costs assumes 5% annual interest rate.				
24. Disposal costs supplied by vendor, Waste Management, Inc., February 2007. Other unit costs listed were obtained from 2007 RS Means Cost Data and engineering judgement.				
25. Costs listed are expressed in 2007 dollars unless otherwise noted.				
26. RSMeans Historical Cost Index used to escalate 2007 costs to 2011 costs.		Year	Index #	
		2011	185.0	
		2007	169.4	

Key:
BCY = Bank cubic yards.
BGS = Below ground surface.
ft = Feet.
LCY = Loose cubic yards.
LF = Linear foot.
LS = Lump sum.
MSF = Thousand square feet.
SF = Square feet.

Table 5-4 Summary of Total Present Values of Remedial Alternatives at the Buoy 212 Dredge Spoil Disposal Area

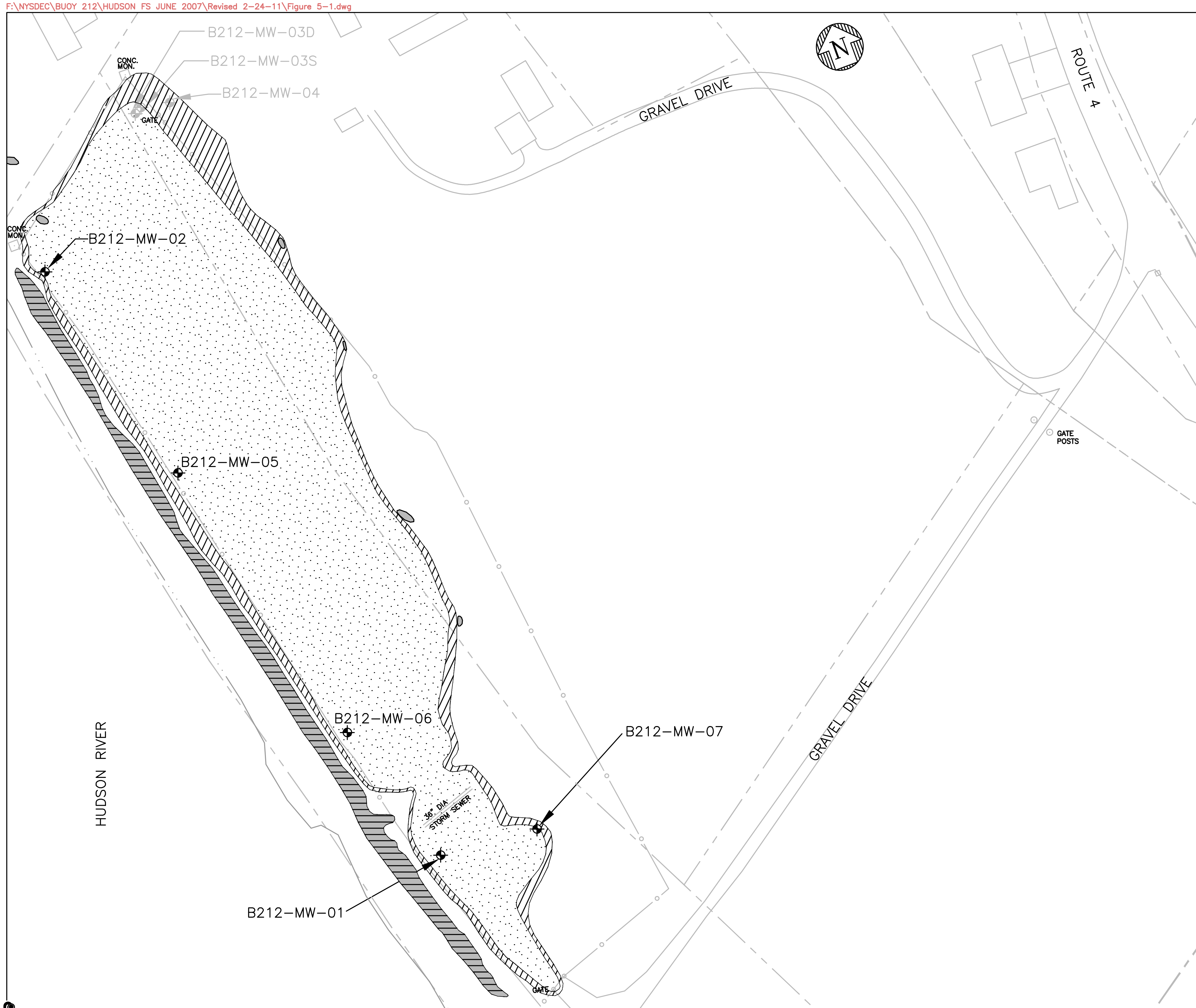
Description	Alternative 1 No Action	Alternative 2 No Further Action with Institutional Controls & Monitoring	Alternative 3 Excavation and Treatment by Off-Site HTTD	Alternative 4 Excavation and Off-Site Disposal
Estimated Total Project Duration (Years)	0	30	1 to 3	1 to 3
Capital Cost	$0	$0	$10,684,000	$10,623,000
Annual O&M	$0	$0	$0	$0
Periodic O&M	$0	$23,602	$31,774	$31,774
2011 Total Present Value of Alternative	**$0**	**$66,000**	**$10,773,000**	**$10,712,000**

Key:

HTTD = High temperature thermal desorption.

O & M = Operations and Maintenance.

F:\NYSDEC\BUOY 212\HUDSON FS JUNE 2007\Revised 2-24-11\Figure 5-1.dwg



LEGEND:

APPROXIMATE EDGE OF WATER BOUNDARY

FENCE

APPROXIMATE LOCATION OF STRUCTURE

B212–MW–04 MONITORING WELL

B212–MW–01 MONITORING WELL IN LTM PROGRAM

APPROXIMATE LOCATION OF PROPERTY BOUNDARY (SEE NOTE 2)

APPROXIMATE EXTENT OF COVERED DREDGE SPOIL MATERIALS

APPROXIMATE EXTENT OF COVER MATERIALS

APPROXIMATE EXTENT OF SOILS WITH PCB CONCENTRATIONS ≥ 0.1 PPM ON OR OUTSIDE OF COVER

APPROXIMATE EXTENT OF SOILS WITH PCB CONCENTRATIONS ≥ 0.1 PPM IN THE FLOODPLAIN

NOTES:

1. SITE FEATURE LOCATIONS BASED ON 2003 AERIAL PHOTOGRAPHY.
2. PROPERTY LINE LOCATIONS ARE APPROXIMATE AND ARE BASED ON WASHINGTON COUNTY PARCEL DATA, 2006.
3. STORM SEWER DATA TAKEN FROM LU ENGINEERS DRAWING 10623–09 BUOY 212.DWG DATED 3/21/06.

APPROXIMATE SCALE IN FEET

0 100 200 300

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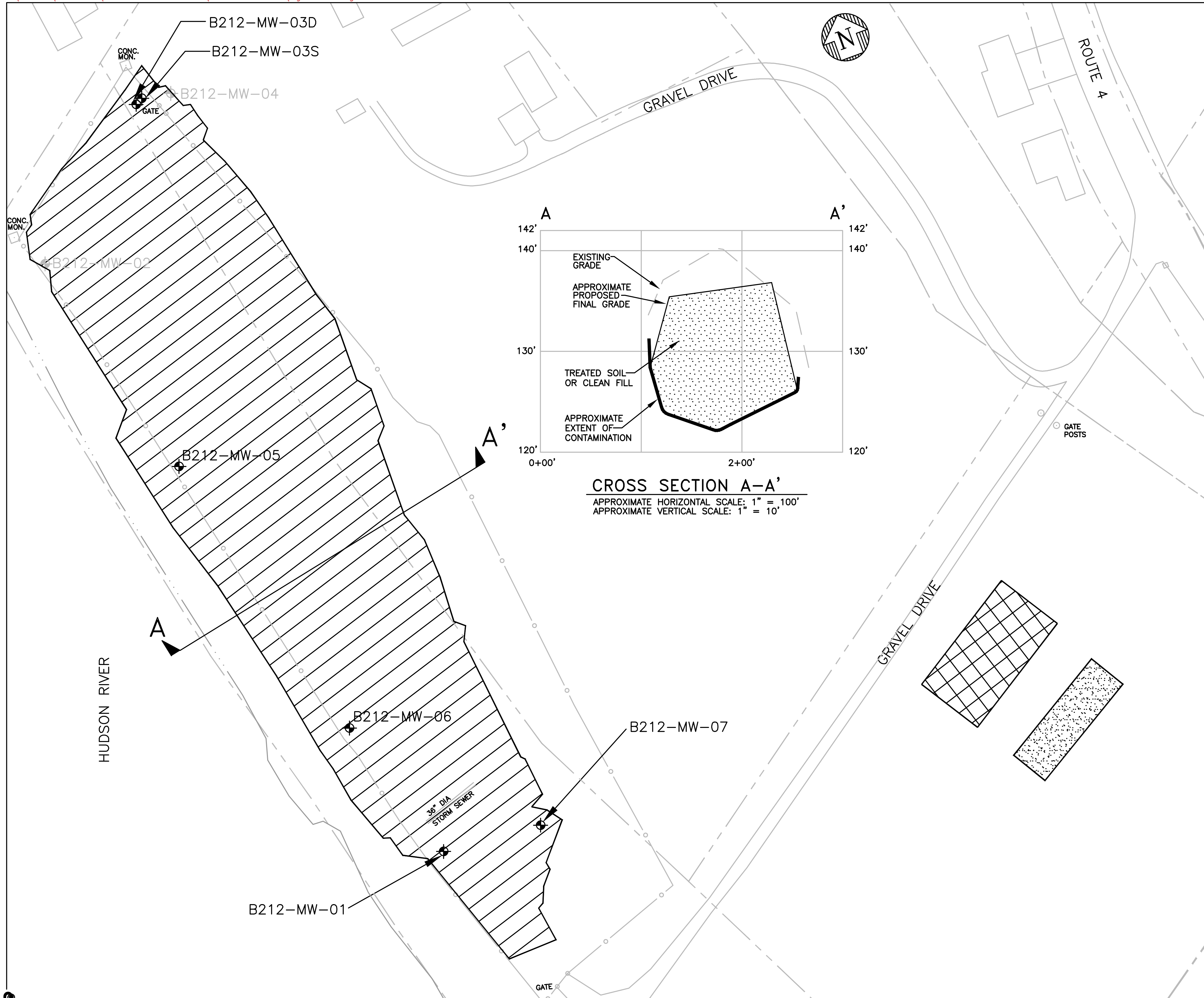
FIGURE 5–1 ALTERNATIVE 2:
NO FURTHER ACTION WITH INSTITUTIONAL CONTROLS AND MONITORING
BUOY 212 DREDGE SPOIL DISPOSAL AREA
FORT EDWARD, NEW YORK



LEGEND:

- APPROXIMATE EDGE OF WATER BOUNDARY
- APPROXIMATE LOCATION OF PROPERTY BOUNDARY (SEE NOTE 2)
- FENCE
- APPROXIMATE LOCATION OF STRUCTURE
- B212–MW–04 — MONITORING WELL
- B212–MW–01 — MONITORING WELL TO BE DECOMMISSIONED
- PROPOSED SOIL AREAS TO BE EXCAVATED AND TREATED OFF–SITE
- PROPOSED STOCKPILE AREA FOR CONTAMINATED SOIL
- TREATED SOIL (OR) CLEAN FILL
- PROPOSED STOCKPILE AREA FOR TREATED SOIL (OR) CLEAN FILL

NOTES:

1. SITE FEATURE LOCATIONS BASED ON 2003 AERIAL PHOTOGRAPHY.
2. PROPERTY LINE LOCATIONS ARE APPROXIMATE AND ARE BASED ON WASHINGTON COUNTY PARCEL DATA, 2006.
3. STORM SEWER DATA TAKEN FROM LU ENGINEERS DRAWING 10623–09 BUOY 212.DWG DATED 3/21/06.
4. MAXIMUM DEPTH OF CONTAMINATION EXTENDS TO APPROXIMATELY 19 FEET BELOW GROUND SURFACE.
5. LIMITS OF EXCAVATION ARE SHOWN AT GRADE AND INCLUDE A CUTBACK OF 3:1 ON SIDESLOPES.

APPROXIMATE SCALE IN FEET

0 100 200 300

ecology and environment

FIGURE 5–2 ALTERNATIVE 3: EXCAVATION AND OFF–SITE HIGH TEMPATURE THERMAL DESORPTION
BUOY 212 DREDGE SPOIL DISPOSAL AREA
FORT EDWARD, NEW YORK

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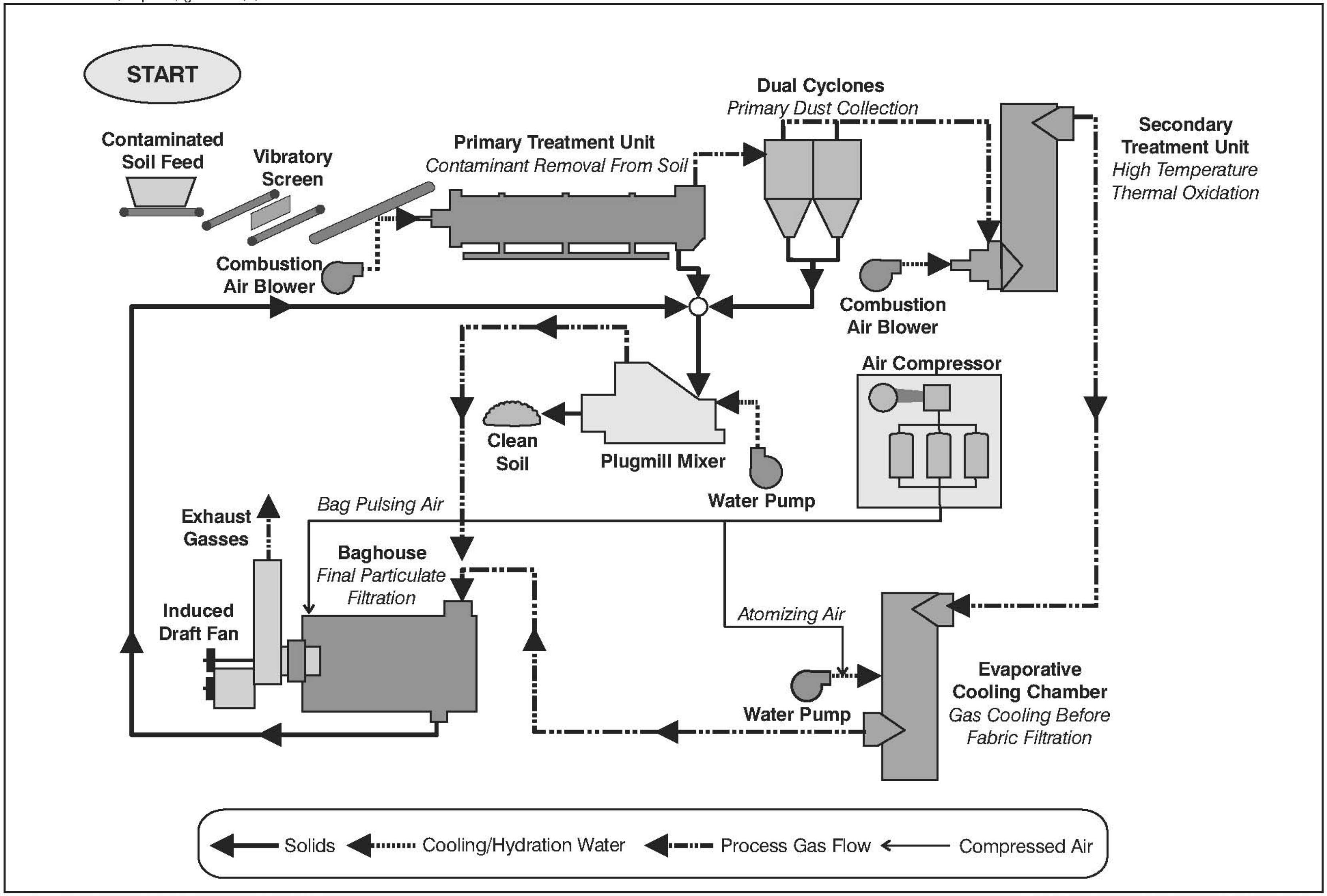

SOURCE: Environmental Soil Management Inc., 2007

Figure 5-3 High Temperature Thermal Desorption System Process Flow Diagram

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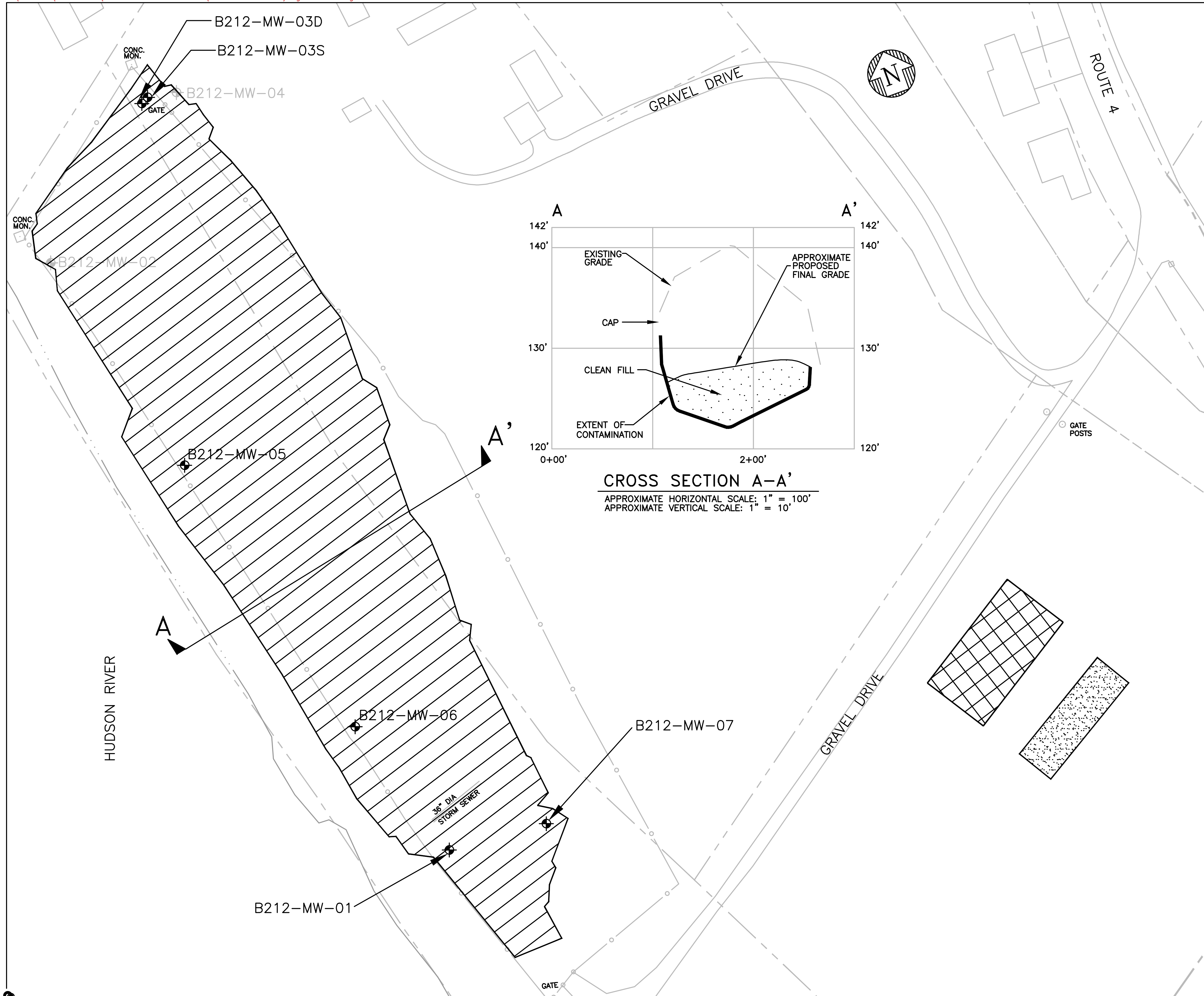

LEGEND:

- APPROXIMATE EDGE OF WATER BOUNDARY
- APPROXIMATE LOCATION OF PROPERTY BOUNDARY (SEE NOTE 2)
- FENCE
- APPROXIMATE LOCATION OF EXISTING STRUCTURE
- B212-MW-04 MONITORING WELL
- B212-MW-01 MONITORING WELL TO BE DECOMMISSIONED
- PROPOSED SOIL AREAS TO BE EXCAVATED AND DISPOSED OFF-SITE
- PROPOSED STOCKPILE AREA FOR CONTAMINATED SOIL
- PROPOSED STOCKPILE AREA FOR CLEAN SOIL
- CLEAN FILL

NOTES:

1. SITE FEATURE LOCATIONS BASED ON 2003 AERIAL PHOTOGRAPHY.
2. PROPERTY LINE LOCATIONS ARE APPROXIMATE AND ARE BASED ON WASHINGTON COUNTY PARCEL DATA, 2006.
3. STORM SEWER DATA TAKEN FROM LU ENGINEERS DRAWING 10623-09 BUOY 212.DWG DATED 3/21/06.
4. MAXIMUM DEPTH OF CONTAMINATION EXTENDS TO APPROXIMATELY 19 FEET BELOW GROUND SURFACE.
5. LIMITS OF EXCAVATION ARE SHOWN AT GRADE AND INCLUDE A CUTBACK OF 3:1 ON SIDESLOPES.

APPROXIMATE SCALE IN FEET

0 100 200 300

ecology and environment

FIGURE 5-4 ALTERNATIVE 4: EXCAVATION AND OFF-SITE DISPOSAL
BUOY 212 DREDGE SPOIL DISPOSAL AREA
FORT EDWARD, NEW YORK

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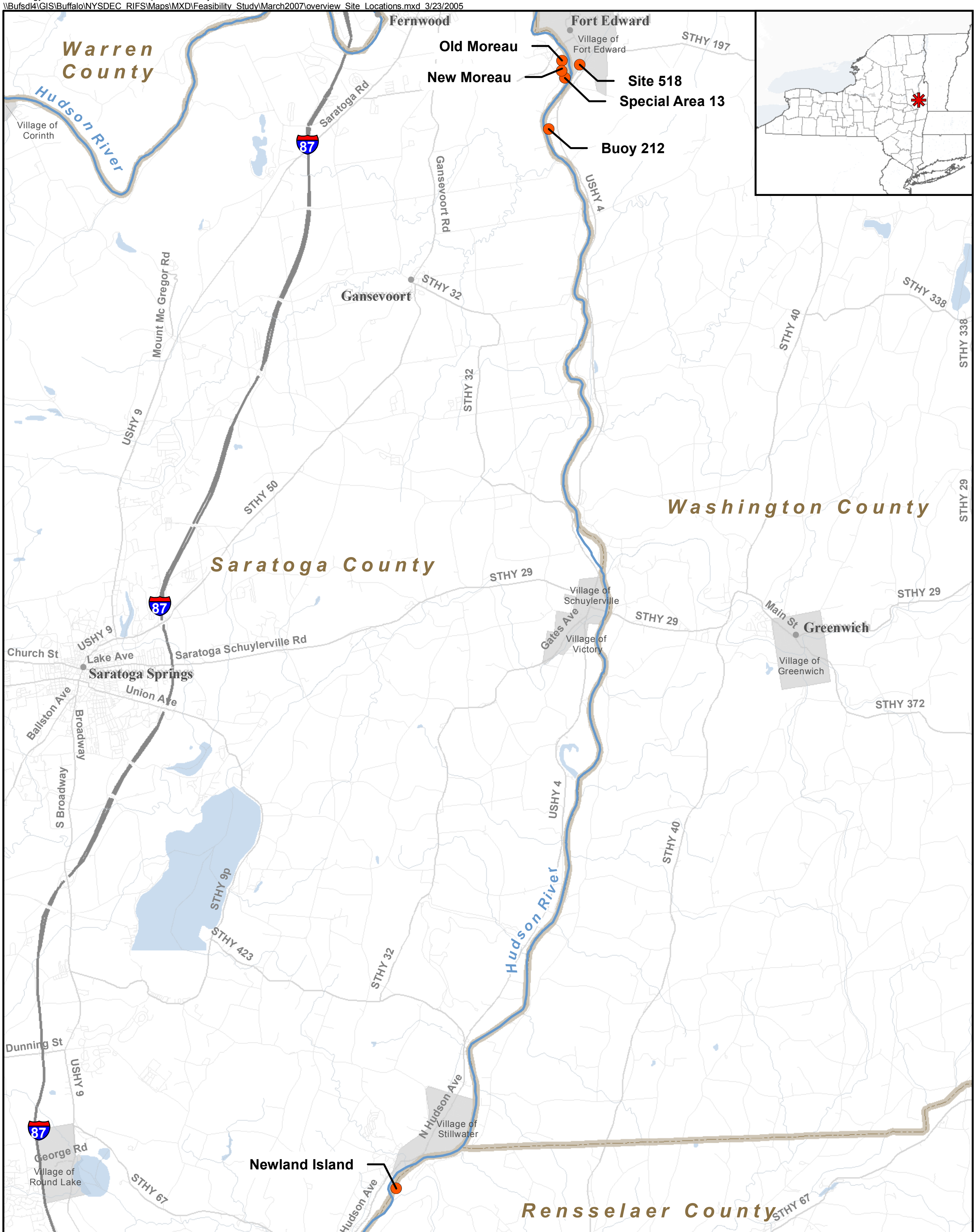
A

Overview Map of Hudson River Dredge Spoil Disposal Sites located in Saratoga, Washington and Rensselaer Counties



Hudson Dredge Spoil Site Locations

County Boundary

0 1 2 4
Miles

Site Location Map for Hudson Dredge Spoil Sites Saratoga and Washington Counties, New York