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Revised, Parking Lot Area Feasibility Study

Former Nepera Harriman Site

Site No. 336006

November 2014
Revised August 2016

Prepared for:
Nepera, Inc. and
Warner-Lambert Company
Corporate Defendants

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REPORT CERTIFICATION

Revised, Parking Lot Area Feasibility Study

Former Nepera Harriman Site (Site No. 336006)

Harriman, New York

I, Gary J. DiPippo, certify that I am currently a NYS registered professional engineer and that this Feasibility Study was prepared in accordance with applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

The material and data in this report were prepared under the supervision and direction of the undersigned.

Cornerstone Engineering and Land Surveying, PLLC

STATE OF NEW YORK
GARY J. DIPIPPO
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LICENSED PROFESSIONAL ENGINEER

8-22-16

Gary J. DiPippo, P.E. Date
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1 INTRODUCTION

This Feasibility Study (FS) has been prepared for the area known as the Parking Lot and also identified as Area B (the Site) at the former Nepera Harriman site pursuant to a Supplemental Remedial Investigation and Feasibility Study (RI/FS) Work Plan approved by the New York State Department of Environmental Conservation (NYSDEC) by letter dated June 3, 2014, and in accordance with a Stipulation and Order that was entered into by Nepera, Inc. and Warner-Lambert Company (Corporate Defendants) with the NYSDEC, entered on January 24, 2014. This FS was originally submitted to the NYSDEC in November 2014. In a letter dated April 6, 2015, the NYSDEC issued comments on the Supplemental Remedial Investigation required by the Stipulation and Order, which indicated the FS was still under review; however, the April 6 letter also included three comments on the FS. Since the April 6 letter, the NYSDEC has not indicated that its review of the FS is complete or provided additional comments. However, after receiving the results of additional sediment sampling voluntarily performed by the Corporate Defendants, the NYSDEC issued letters dated June 7, 2016 and June 24, 2016, directing the Corporate Defendants to revise the Supplemental RI Report and this FS. The Corporate Defendants responded in letters dated June 14, 2016 and July 8, 2016, and this revised FS reflects the Corporate Defendants June 14 and July 8 correspondence.

The former Nepera Harriman site has been the subject of both the NYSDEC Inactive Hazardous Waste Site Program (Corporate Defendants) and the RCRA Corrective Action Program (ELT-Harriman). Under the Inactive Hazardous Waste Site Program, investigations started at the site in 1986, culminating in completion of a Remedial Investigation (RI) and Feasibility Study (FS) in 1995/1996, which led to the NYSDEC's issuance of a Record of Decision (ROD) in 1997. The ROD included remediation decisions for potential mercury migration into the West Branch of the Ramapo River, which runs adjacent to the former Nepera Harriman site.

Under the RCRA program, the responsible party for which is ELT-Harriman, the site has been the subject of a RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) commencing in 2005 and continuing through today. The RCRA program includes various Solid Waste Management Units (SWMUs); Areas of Concern (AOCs); and Treatment, Storage or Disposal Facilities (TSDFs).

The purpose of this FS, in accordance with the Stipulation and Order, is to evaluate various alternatives for management of the calcium sulfate material in the Parking Lot area. The Statement of Work in the Stipulation and Order indicates that various alternatives may be considered including in-situ containment options (e.g., barrier wall), an on-site consolidation area, use of the adjacent lagoon as a consolidation area, or other alternatives. This FS presents a process by which alternatives are developed and evaluated consistent with the Stipulation and Order. Pursuant to the Stipulation and Order (paragraph 16), the inclusion of any remedial action for consideration in this FS shall not be cited or construed to mean that such remedial action is required or could be required to be implemented pursuant to the ROD.

The remainder of this FS has been organized as follows:

Section 2 – Site Description and History, provides information on the site history and location.

Section 3 – Summary of Site Investigations, summarizes the results of the site investigations relevant to the Parking Lot.

Section 4 – Remedial Goals and Remedial Action Objectives, presents both the overall and site-specific remediation goals.

Section 5 – General Response Actions, presents and screens the general response actions relevant to the Parking Lot.

Section 6 – Technology Identification and Screening, presents potentially applicable technologies, screens the technologies, and provides the basis for development of alternatives.

Section 7 – Development and Screening of Alternatives, discusses the combining of technologies to form alternatives and performs a preliminary screening to eliminate alternatives that are not applicable.

Section 8 – Evaluation of Alternatives, presents the detailed evaluation of the pre-screened alternatives against the eight evaluation criteria established by the NYSDEC.

Section 9 – Alternatives Comparison and Recommendation, provides the rationale for selecting and the recommended alternative.

2 SITE DESCRIPTION AND HISTORY

2.1.1 Site Location and Description

The Parking Lot area (Area B or Site) is a part of the former Nepera Harriman site located in the Village of Harriman, Orange County, New York (Figure 1-1, Site Location Map). The boundaries of the former Nepera Harriman site include NYS Route 17 to the west, the West Branch of the Ramapo River to the north, Arden House Road to the south and the western berm of the State Pollutant Discharge Elimination System (SPDES) lagoon to the east. The Parking Lot Site encompasses approximately 3.5 acres and consists of the former administrative office building, a parking lot, and the stream bank of the West Branch of the Ramapo River.

2.1.2 Site Historical Information

The former Nepera Harriman site is currently owned by ELT-Harriman. The history of the site is detailed in the "Remedial Investigation - Harriman Site" (RI Report) (Conestoga-Rovers & Associates, July 1995), in the Record of Decision (ROD) issued by the NYSDEC in March 1997, and in the Site-Wide Characterization Summary Report (CSR) (Brown and Caldwell Associates and Cornerstone Engineering and Land Surveying, PLLC, March 2011). These documents may be consulted for additional details.

The former Nepera Harriman facility was previously used to manufacture fine and bulk pharmaceutical chemicals from 1942 to 2005. During the period 1945 through 2005 chemical by-products were incinerated on the site, initially through open pit burning and subsequently in a RCRA Part B permitted incinerator (shut down in 2005). Calcium sulfate material, used as part of the manufacturing processes, was disposed of in the area of the former administrative office building and the Parking Lot area.

The existing wastewater lagoon (adjacent to the eastern boundary of the Site) was constructed in the 1960s, southeast of the Parking Lot area. The lagoon had served as a settling pond for aluminum hydroxide and magnesium silicate precipitates generated during the manufacturing process. Additionally, wastewater consisting of boiler blowdown, non-contact cooling water, storm water runoff, and treated groundwater were also discharged to the lagoon prior to the plant shutdown. The lagoon currently stores stormwater runoff and discharges to the West Branch of the Ramapo River under a SPDES permit. ELT-Harriman currently operates a treatment and discharge system for the lagoon.

Following the issuance of the ROD, several remedial measures were conducted at the former Nepera site. Those remedial measures include source area excavations; operation of a groundwater Interim Remedial Measure (IRM) from 1990 through 2004; installation of erosion controls along the stream bank of the West Branch of the Ramapo River; operation of a biosparging system from 2001 to 2008; and monitored natural attenuation (MNA) of groundwater. Additional details regarding these remedial measures can be found in the

Site-Wide Characterization Summary Report (Brown and Caldwell Associates and Cornerstone Engineering and Land Surveying, PLLC, March 2011).

As noted in Section 1, in January 2014, Nepera, Inc. and Warner-Lambert Company (Corporate Defendants) entered into a Stipulation and Order with the NYSDEC. The Statement of Work within the Stipulation and Order included a Supplemental Remedial Investigation (RI) and a Feasibility Study (FS) for the Parking Lot (or Area B) as that area was defined in the 1997 Record of Decision. The Supplemental RI results are reported under separate cover and are summarized in Section 3.

3 SUMMARY OF SITE INVESTIGATIONS

A number of investigations have been undertaken at the former Nepera Harriman site under both the New York State Inactive Hazardous Waste Site program and the RCRA Corrective Action program. These include the Remedial Investigation under the Inactive Hazardous Waste Site program, the RCRA Facility Investigation, supplemental studies performed by the Corporate Defendants, and most recently the Supplemental RI. The relevant aspects of these various investigations are summarized below as they relate to this FS for the Parking Lot area.

3.1 Remedial Investigation

The RI (1995 Report) undertaken by Conestoga Rovers Associates, involved site characterization work related to groundwater, surface water, soil, sediments, and source areas. Related to the Parking Lot area the RI used the boring log data from monitoring well installations and test pit data to generally define the limits of the calcium sulfate material. This was not a very detailed delineation and additional work was performed to further characterize the nature and extent of the calcium sulfate material as described below. In addition, two samples of the calcium sulfate were collected during the RI for analysis and indicated mercury concentrations of 323 and 756 mg/kg.

3.2 Additional Investigations and Remediation

Additional investigatory work was undertaken of the Parking Lot area by the Corporate Defendants. In 2001, on behalf of the Corporate Defendants, Arcadis performed a test pit investigation along the stream bank of the West Branch of the Ramapo River. The purpose of the test pit investigation was to better define the limit of the calcium sulfate material along the stream bank. The results of the stream bank test pits were used to guide the installation of erosion controls as an interim remedial measure (IRM), voluntarily constructed by the Corporate Defendants, along the West Branch of the Ramapo River where the calcium sulfate material exists. The IRM erosion control cover consists of a geotextile secured with soil staples and a gravel cover. The IRM has been continuously inspected and maintained since its installation in 2005, and with continued inspection and maintenance has demonstrated its effectiveness as a long-term remedial measure (including after a number of extreme storm events) for containment of the calcium sulfate material so that it does not migrate via sediment transport to surface water.

In November 2009 the NYSDEC requested that additional sampling and delineation be conducted for the material in the Parking Lot area. A field investigation, reported in an "Area B Parking Lot Investigation" letter report (Cornerstone Engineering and Land Surveying, PLLC, April 16, 2010), was implemented in January 2010 on behalf of the Corporate Defendants, with the objective of delineating the vertical and horizontal extent of the calcium sulfate material and to further characterize this material relative to the presence of mercury and volatile organic compounds (VOCs). This investigation included 55 GeoProbe borings and collection of a total of 12 samples for mercury and VOC testing.

The VOC testing indicated only one constituent, benzene, found at a depth of 8 - 8.5 feet (in natural materials) below ground surface, exhibited site related concentrations greater than the Part 375 groundwater protection standard. Acetone was also reported above the Part 375 groundwater protection standard in two samples. However, acetone is a typical laboratory artifact and is not associated with the site historical operations. These data indicate that the calcium sulfate layer is not a source of VOCs and that the presence of VOCs in the natural soils underlying the Parking Lot area is not wide spread or associated with the material. Rather, it appears that the reported concentrations are attributable to an isolated and more than likely unrelated historical release.

The Parking Lot investigation testing for mercury included six discrete and six composite samples. Total mercury concentrations within individual samples ranged from 1.1 to 1900 mg/kg, and total mercury concentrations in composite samples ranged from 356 to 598 mg/kg. Discrete samples were collected from intervals registering the highest mercury vapor readings. In addition, representative portions of the calcium sulfate material observed in each of the borings were composited for total mercury analysis.

Mercury has only been detected intermittently at concentrations above the Class GA groundwater quality criterion of 0.7 ug/l, in MW-24S. Of note is that the sulfate concentrations in MW-24S are consistently representative of groundwater flow paths originating from the calcium sulfate material. However, with the exception of three reported concentrations of 0.73, 0.76, and 1.1 ug/l, mercury is consistently below the Class GA groundwater quality standard. These data, along with mercury speciation data presented in the RCRA Facility Investigation Report (Brown and Caldwell, 2007) indicate that the mercury is present principally in the insoluble mercuric sulfide form.

The collective data indicate that the mercury is present primarily in an insoluble form and is not a source of dissolved mercury to surrounding soils, groundwater, or surface water.

The approximate limit of the calcium sulfate material resulting from the above-described investigation is illustrated on Figures 8-1 through 8-6.

In addition, a fish study conducted by NYSDEC concluded that fish in the West Branch of the Ramapo River do not contain elevated levels of mercury and that a fish advisory was not necessary (See NYSDEC Fact Sheet June/July 2001). Further evaluation of the fish study data performed as a part of the Supplemental RI supports the conclusion that mercury in fish tissue is not elevated at the Site by comparison to other local and regional areas. Collectively, these data indicate that mercury is not leaching from the calcium sulfate layer and is in a form that has low environmental mobility. This confirms the ROD statement that the mercury present at the Site exists in a highly immobile form. This determination was based on the data generated during the RIs, sampling events at other locations within the Village of Harriman, and a review of the process chemistry in which mercury was used.

A removal action was undertaken in an off-site trailer park area where the calcium sulfate material was found. The removal action included characterization of the material for disposal purposes. The USEPA subjected the calcium sulfate to TCLP testing to assess how it would be classified for off-site disposal purposes. The calcium sulfate was classified as a non-hazardous waste by characteristic (and it is not a listed waste).

3.3 Summary of the Supplemental Remedial Investigation

The Supplementary RI was performed in 2014 and 2015 in accordance with the Statement of Work within the Stipulation and Order. The investigation included surface water, sediment, and soils testing for further characterization of the areas at and in proximity to the Parking Lot area. The results of the RI are reported in the November 2014 Supplemental RI report (Cornerstone) as revised in August 2016, presented under separate cover and are summarized below.

3.3.1 Surface Water

Surface water samples were collected from 7 locations along the West Branch of the Ramapo River starting with an up-gradient location near the north-west corner of the Site and ending with a location about 1,000 feet downstream. Analytical results for TCL VOCs, SVOCs, and TAL Metals, including mercury, were below the Part 703 surface water quality standards. These data are consistent with prior and current site characterization data that indicate the calcium sulfate material is not a source of organic contamination and that the mercury is present principally in an insoluble form, and as a result migration via the dissolved phase in groundwater is not occurring.

3.3.2 Sediment

Sediment samples were collected from 7 locations (along the transects with the surface water sample locations) along the West Branch of the Ramapo River. Analytical results of the sediment sampling were compared to Class A, B and C sediment guidance values (SGVs) published in the draft NYSDEC document "Screening and Assessment of Contaminated Sediment". In addition, the Corporate Defendants voluntarily collected sediment samples from six additional locations downstream of the Site to the intersection of the West Branch of the Ramapo River and the railroad and Interstate Route 87, and tested these samples for metals including mercury.

With the exception of laboratory estimated values (J-qualified), VOCs were not detected in the sediment samples. The reported VOC concentrations were below the applicable Class A SGV (sediment with concentrations below the Class A threshold pose little risk of harm to aquatic life).

With the exception of low levels of polyaromatic hydrocarbons (PAHs), other SVOCs were not detected in the sediment samples with reported SVOC concentrations below the applicable Class A SGV.

Arsenic, copper, lead, mercury, nickel, and zinc, were detected at concentrations applicable to Class B SGVs in one or more samples and three metals were detected at concentrations applicable to Class C SGVs: zinc in one sample, lead in three samples and nickel in three samples.

Mercury concentrations were reported at concentrations applicable to Class B criteria (0.2 - 1 mg/kg) ranging from 0.22 to 0.59 mg/kg at the downstream locations near the site (transects 6 and 7) and at intermittent farther downstream locations, and not adjacent to the Parking Lot area. Class B sediment guidance values are used to indicate that additional data is necessary to assess toxicity and/or risk. Mercury concentrations found in the upstream most locations adjacent to the Parking Lot area were below the Class A criterion of 0.2 mg/kg (the highest value upstream of the Parking Lot area being 0.14 mg/kg). However, the collective sediment data set is consistent with regional, background mercury concentrations found in soils (NYSDEC, 2003, revised 2006), there are no mercury concentration trends adjacent to or downstream of the Site, and overall the potential for Site-related impacts to sediment cannot be distinguished from other urban impacts.

The most recent sediment sample results obtained during the Supplemental RI and the voluntary additional sampling and analysis are consistent with observations reported in the July 1995 RI and indicate that background concentrations of VOCs, SVOCs, and inorganics are generally comparable to and mostly higher than the downstream sample results. This distribution and the constituents (e.g., zinc, lead, nickel not associated with the former Nepera site operations) leads to the conclusion that the metals are not Site related and are an artifact of the urban character of the tributary area (see additional discussion in Section 3.4).

3.3.3 Riverbank Soil

Riverbank soil samples were collected from 7 locations (along the transects with the surface water and sediment sample locations) along the West Branch of the Ramapo River.

With the exception of J-qualified concentrations of two common laboratory contaminants, VOCs were not detected with all results below the applicable SCGs.

Two PAHs were reported above the Restricted Residential SCGs at the most upstream location (near the north-west corner of the Site), and only one PAH was reported above the Part 375 SCGs (Restricted Residential, Commercial and Industrial), in three samples located along the Site. Other detected SVOCs were below the applicable SCGs. The PAHs present in the two deeper samples near the north-west corner of the Site are likely related to fill material associated with construction of Route 17 and are therefore unrelated to the Site. The single PAH, benzo(a)pyrene, near the north-east corner of the Site, is likely related to the pile of asphalt from the parking lot placed near this sampling location.

Metals (other than mercury discussed in the paragraph below) were not detected or were detected at concentrations below the applicable SCGs.

Mercury was detected at each of the sampling locations. The highest concentrations were reported at the location near the center of the Parking Lot boundary ranging from 51.6 to 414 mg/kg and at the location near the north-east corner of the Parking Lot area ranging from 27.6 to 30.9 mg/kg. Concentrations farther downstream from the Site ranged from 0.1 mg/kg to 28 mg/kg. Mercury concentrations throughout the former Nepera Harriman site based on the RCRA RFI averaged 40.6 mg/kg, and based on the RI, averaged 30.0 mg/kg. Therefore, these stream bank results are similar to and generally less than site-wide concentrations. No visible calcium sulfate was observed at the riverbank sampling locations.

3.3.4 Lagoon Area

Samples of soils within and adjacent to the northern berm of the SPDES lagoon were collected at 16 locations. The samples were analyzed for TCL VOCs, SVOCs, and TAL Metals.

VOC results were below the Subpart 375-6 SCGs with only acetone and benzene reported at J-qualified concentrations.

Similarly, with the exception of low levels of PAHs, generally reported at J-qualified values, SVOCs were also not detected in the lagoon area soil samples or were reported at concentrations below the applicable SCGs.

Arsenic was reported at 19.6 mg/kg (above the Restricted/Commercial/Industrial SCGs of 16 mg/kg) in one sample near the north-east end of the lagoon, while other analyzed metals, with the exception of mercury discussed below, were detected below the applicable SCGs.

Mercury was detected in 27 out of the 32 samples collected from the lagoon area (at concentrations up to 107 mg/kg). The highest concentrations were found at locations near the north-west end of the lagoon. Mercury concentrations found within samples collected from the other locations along the northern berm ranged from not detected to 28.2 mg/kg. These concentrations are below the site wide average mercury concentration of 40.6 and 30.0 mg/kg reported in the RFI and RI reports as previously noted.

3.4 Summary of Qualitative Exposure Assessment and Fish and Wildlife Resources Impact Assessment

The Supplemental RI report presents both a qualitative human health exposure assessment and a fish and wildlife resources impact assessment in accordance with NYSDEC DER-10 guidance. These assessments are based on data and information available from the RI, RFI, an NYSDEC study of mercury concentrations in fish from the West Branch of the Ramapo River, a NYSDEC biological assessment of the West Branch of the Ramapo River, and the Supplemental RI. The salient conclusions of these assessments, particularly as they relate to this FS, may be summarized as follows:

- At the Parking Lot area, maintenance of the pavement and the erosion control IRM results in an incomplete direct contact pathway with the calcium sulfate material.

- At two sample locations (RBS-2 and RBS-3) mercury concentrations in surface soil are above the published Part 375 SCG. However, the published SCG for mercury is based on elemental mercury. Table 375-6.8(b) notes that the mercury cleanup objective is "...the lower of the values for mercury (elemental) or mercury (inorganic salts). See TSD Table 5.6-1." The reference to TSD Table 5.6-1 is to "New York State Brownfield Cleanup Program, Development of Soil Cleanup Objectives Technical Support Document" (NYSDEC and NYSDOH, 2006). Table 5.6-1 provides additional detail on mercury soil cleanup objectives categorized by elemental mercury and inorganic mercury salts. As previously noted, the site data indicate that the mercury is present as a salt for which the relevant commercial or industrial SCG would be 47 mg/kg and 220 mg/kg, respectively, as shown in TSD Table 5.6-1. The concentrations of mercury found in the surface soils in this area (126 mg/kg and 28 mg/kg, respectively in surface soils) are below the relevant (industrial) mercury salts SCG.

- The area of soil investigation adjacent to the SPDES lagoon indicated mercury concentrations in various samples above the published Part 375 SCG. However, as noted above, the published SCG for mercury is based on elemental mercury and the site data indicate that the mercury is present as a salt for which the relevant commercial or industrial SCG would be 47 mg/kg and 220 mg/kg, respectively. The concentrations of mercury found in the soils in this area are below the relevant industrial SCG for mercury salts.

- In general, mercury is found in soils within the Supplemental RI study area, at concentrations similar to, but generally lower than, the concentrations found site-wide at the former Nepera facility. The soil areas outside of the Parking Lot calcium sulfate area identified in this FS as the Site, are beyond the scope of this FS.

- Surface water did not show Site related impacts or complete exposure pathways.

- The NYSDEC fish study did not indicate concentrations of mercury in fish above the New York State Department of Health Fish Consumption Advisory Level of 1,000 ng/g, indicating an absence of significant impacts from the Site as may relate to bioaccumulation of mercury. In addition, further analysis of the NYSDEC fish study data performed as a part of the Supplemental RI, did not indicate distinguishable impacts associated with the Site or the sediments of the West Branch of the Ramapo River adjacent to or downstream of the Site.

- The NYSDEC biological assessment of the West Branch of the Ramapo River generally showed conditions similar upstream of, adjacent to, and downstream of the Site, again indicating an absence of significant impacts from the Site on the stream.

- Sediments did not show Site related impacts or complete exposure pathways when the low-level mercury detections in sediment are coupled with the fish study and biological assessment results, and the regional background soils data the NYSDEC collected for the Hudson Valley. Of note, because of the nature of the stream bed in the West Branch of the Ramapo River (turbulent) there is limited fine-grained sediment in which mercury or other metals can accumulate, which is also reflective of the results of the fish study and biological assessment.

- Overall, the collective data provided by the surface water quality and sediments investigations, the groundwater quality monitoring, regional background soils data, the NYSDEC fish study, and the NYSDEC biological assessment show that mercury migration into the West Branch of the Ramapo River (i.e., the subject of the 1997 ROD remediation decision related to Area B) is not occurring, and conditions within this stream are consistent with its urban character.

4 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

4.1 Remedial Action Goal

The overall remedial action goal, consistent with 6 NYCRR Part 375 requirements, is to attain applicable Standards, Criteria, and Guidance values (SCGs) and be protective of human health and the environment.

4.2 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the overall site were previously established in the ROD and remain relevant to the Parking Lot area, and are as follows:

- To the maximum extent practicable, reduce the potential for direct human contact with the contaminated soils at the site [in the case of the Parking Lot this would be the calcium sulfate material].
- To the maximum extent practicable, remove the source of the groundwater plumes on the site [groundwater quality at the sentinel wells meets the 6 NYCRR Part 703 Groundwater Quality Standards and source area remediation related to groundwater was previously completed in accordance with the 1997 ROD].
- Mitigate the migration (or introduction) of mercury into the river ecosystem [the collective data show that this has been accomplished with the remedial actions and maintenance programs instituted to date].
- Protect the biota in the West Branch of the Ramapo River.

4.3 Standards, Criteria, and Guidance

As a guide to assessing the overall remedial goal of attaining applicable SCGs, the following SCGs are considered to be potentially applicable depending on the final selection of an alternative:

- 6 NYCRR Part 375, which establishes numerical soil cleanup levels. In case of the Site, the relevant cleanup objectives may include, depending on the action, Site characteristics, future use, and location of the work:
    - Commercial
    - Industrial
    - Restricted Residential

- Protection of Ecological Resources
- Protection of Groundwater

- 6 NYCRR Part 703, which establishes numerical surface water and groundwater quality standards, which would be relevant to assessing potential impacts and reduction of impacts from an alternative.

- 6 NYCRR Part 608, which provides requirements for protection of streams, as relates to work which may be undertaken for an alternative within or adjacent to the West Branch of the Ramapo River.

- 6 NYCRR Part 360, which provides requirements for solid waste management facilities and would potentially be relevant to on-site containment alternatives or off-site disposal alternatives.

- 6 NYCRR Part 364, which pertains to transportation requirements if contaminated materials were to be transported off-site for an alternative.

As previously described in Section 3, the data on the calcium sulfate material indicates it is non-hazardous by characteristic, and it is not a listed waste, and therefore, hazardous waste regulations would not be relevant SCGs.

5 GENERAL RESPONSE ACTIONS

General response actions are broad categories of remedial response that may meet the RAOs and provide technologies applicable to site-specific characteristics. The general response actions that were reviewed for their applicability to the Site are as follows:

- No action
- Limited Action/Institutional Controls
- Containment
- In-situ Treatment
- Ex-situ Treatment
- Collection & Discharge
- Excavation/Removal
- Disposal

The applicability of each of these general response actions to the Site are described below, and the screening of these general response actions is summarized in Table 5-1.

5.1 No Action

No action would not include any future activity on the Site (e.g., use restrictions, maintenance). No action is typically retained as a baseline for comparison with other alternatives and is retained as such for this FS.

5.2 Limited Action/Institutional Controls

The limited action general response action would include institutional controls (e.g., environmental easement) that would be a mechanism for implementation of various restrictions on the Site (e.g., potential future redevelopment of the Parking Lot area). Institutional controls are retained in this FS because they can be a component of many alternatives. Limited action could also include maintenance of the existing features at the Site (e.g., the existing stream bank IRM).

5.3 Containment

The purpose of the containment general response action is to isolate the calcium sulfate material to meet the RAOs. Technologies that could be considered under this general response action include capping, subsurface barriers such as cutoff walls, and horizontal barriers (e.g., liner systems). The containment general response action is considered applicable to the Site and is retained for further analysis in this FS.

5.4 In-Situ or Ex-Situ Treatment

The general response action of treatment, whether in-situ or ex-situ, typically involves the application of physical, chemical, or biological treatment methods for Site-related constituents. The primary constituent of interest in the calcium sulfate material, mercury, has been the subject of various treatment evaluations (solidification/stabilization, amalgamation, thermal treatment) as reported in the literature. In the case of the Parking Lot, the calcium sulfate material does not pose impediments to in-situ treatment (e.g., obstructions) and considering the increased difficulty of ex-situ treatment (e.g., treatment area, material classification, potential need for a corrective action management unit, and increased handling), in-situ treatment would be preferred for this general response action. Therefore, the general response action of in-situ treatment has been retained for further analysis in this FS, while ex-situ treatment has been eliminated from further evaluation.

5.5 Collection and Discharge

The general response action of collection and discharge, involves the means by which groundwater is collected and following treatment is released to the environment in accordance with relevant treatment standards. Groundwater data collected on a routine basis since 2008, when the biosparging system at the facility was shut down with NYSDEC approval, has consistently shown that groundwater quality meets SCCs at the sentinel wells. In addition, the data evaluations performed to assess groundwater quality have shown that prior remedial actions have removed the sources of groundwater contamination, and definable areas of source material are no longer evident at the site; rather, contaminants are present primarily as residuals dispersed in the fine-grained fraction of soils. The current program for management of groundwater is monitored natural attenuation.

In addition, as described in Section 3, the investigation results for the Parking Lot showed that mercury was present as low mobility mercury salt (mercuric sulfide) and the mercury present in the calcium sulfate is not manifesting in down-gradient groundwater. In addition, the analyses of the calcium sulfate for volatile organic compounds, generally showed an absence of these constituents. Of six samples collected for Target Compound List volatile organic analysis, only one detection of benzene was above the impact to groundwater Part 375 cleanup levels (acetone was detected in two samples above the impact to groundwater cleanup level but appears to be laboratory related). As such, the collection and discharge general response action has been eliminated from further consideration as there are no groundwater issues associated with the Parking Lot area or data indicating the need for further evaluation of groundwater remediation alternatives.

5.6 Excavation/Removal

The general response action of excavation/removal typically involves active management of contaminated media. The removal general response would meet remedial action objectives, for example, by excavating the calcium sulfate material and then managing the material on-site or off-site. This general response action could control potential direct contact exposure, and therefore, is retained for further analysis in this FS.

5.7 Disposal

The general response action of disposal involves the means by which contaminated materials are managed in accordance with relevant regulations. Off-site disposal of the calcium sulfate material would include landfilling at a permitted facility. Disposal is a component of excavation/removal technologies, and therefore, is retained for further analysis in this FS.

Section 6.0 identifies various technologies that are applicable to the retained general response actions, and screens these technologies further for development of alternatives that will address the remedial action objectives for the Site.

6 TECHNOLOGY IDENTIFICATION AND SCREENING

As described in Section 5, the following general response actions are potentially applicable to the Site:

- No action
- Limited Action/Institutional Controls
- Containment
- In situ Treatment
- Excavation/Removal
- Disposal

This section presents the process of identifying and screening technologies within each of the general response actions, which are potentially applicable to the development of alternatives.

6.1 Technology Identification

A list of candidate technologies within the general response actions was generated based on a review of available literature, published databases, and prior experience, and includes both conventional and innovative remedial technologies. Technologies were identified for the medium of concern on the Site which is the calcium sulfate material. The technologies identified within the corresponding general response actions are shown in the first two columns of Table 6-1.

6.2 Technology Screening

The identified technologies were then screened based on potential applicability to the contaminants present in the calcium sulfate material (principally mercury, but volatile organics are included because of the benzene detection, albeit limited), developmental status (e.g., commercially available technology), or other considerations (e.g., likely effectiveness, available capacity, potential implementation impacts). The technology screening is also summarized in Table 6-1.

6.2.1 Retained Technologies

The remedial technologies that were retained for consideration in developing alternatives are listed below along with a description of the basis for retaining each.

Institutional Controls (ICs): ICs, such as an environmental easement, are likely remedial components of any alternative that includes contaminants remaining on site above the relevant Part 375 cleanup levels. This technology is retained as it would control potential exposure pathways through use restrictions.

Caps/Covers: This technology is commonly employed and is readily implemented. Caps/covers are effective for a wide-range of constituents and can effectively control direct contact risks and limit inter-media transfer of constituents (e.g., leaching to groundwater). Caps and covers can be constructed of soil components, geomembranes, and structural materials (e.g., asphalt, concrete).

Vertical Barriers: This technology is commonly employed and is readily implemented. Vertical barriers are effective for a wide-range of constituents and can control lateral movement of constituents or isolate the contaminated materials from the surrounding environment. There are a variety of options for vertical barriers such as sheet piles, slurry trench cut-off walls, and mandrel driven geomembrane barriers.

Excavation: This technology is also commonly employed as a component of other remedial technologies, is readily available, and is readily implemented. For instance, excavation would be used to manage the calcium sulfate material prior to off-site disposal at a landfill. It would also be used if an on-site containment cell (i.e., landfill) were used so that the calcium sulfate could be placed in the constructed containment cell.

Landfill: This technology is commonly employed and can be implemented with conventional technology. On-site or off-site landfill disposal could effectively contain the calcium sulfate material, and control direct contact risks. In addition, the liners/caps employed in landfill systems would, similar to the caps/covers noted above, limit inter-media transfer of constituents.

In-Situ Treatment by Solidification/Stabilization (S/S): This technology is commercially available and implementable. The effectiveness of this technology is primarily dependent on the type of S/S agent, characteristics of the media to be treated, degree of mixing, mercury species present, and remedial objectives. Given the nature of the technology, S/S could only be expected to reduce leachability and not to achieve a total concentration goal. S/S technology could help to physically stabilize the calcium sulfate material that is subject to solubilization through infiltration of precipitation. However, the Site data show that mercury mobility is low under existing Site conditions, and there may be little benefit in applying an S/S technology. This is in particular a consideration because S/S of mercury contaminated soils has shown mixed results relating to solubility of mercury.

Previous studies of S/S for mercury stabilization have principally focused on converting elemental and mobile forms of mercury (e.g., HgCl, HgO) to mercuric sulfide (EPA, 2003). Mercuric sulfide has the lowest solubility of the various forms of mercury. Previous studies (EPA, 2003) have also indicated that leaching following S/S is pH dependent (typically greater leaching at both lower and higher pH). Pozzolanic materials can raise the pH of the material, for example. Solubility may also be affected by the concentration of major ions. For example, high chloride concentrations may increase leaching through the formation of more soluble mercury complexes (EPA, 2003). During the S/S process, mercury can also be transformed (e.g., formation of HgO during mixing and aeration).

In its 2003 evaluation of treatment standards for mercury, under the Land Disposal Restrictions (LDRs) (40 CFR 268), the USEPA considered solidification/stabilization as an alternative to the thermal treatment requirements under the regulations. In this evaluation, four solidification/stabilization reagents were tested. Following the completion of this work, the USEPA chose not to change the LDR treatment requirements because S/S could not be reliably used to immobilize or transform elemental mercury.

Brookhaven National Laboratories (BNL) has performed considerable research on mercury solidification/stabilization principally using sulfide to convert mercury to the insoluble mercuric sulfide form. BNL patented the Sulfur Polymer Stabilization-Solidification (SPSS) process, and has implemented several pilot studies (BNL, 2001, 2003). While as of the writing of this report, there does not appear to be an example of full-scale application of the BNL process, the studies performed have generally indicated low leachability following treatment. Thus, S/S for wastes containing elemental mercury focuses on processes that promote the formation of mercuric sulfide.

Based on the above, treatability testing and potentially pilot testing would be necessary prior to full-scale implementation, and would be used to assess the suitability of S/S, and the types of additives. This is particularly true because research and evaluations of S/S are performed for soil remediation, and documentation has not been found that would indicate that S/S has been applied to calcium sulfate.

S/S can also be used to alter the strength properties of soils or materials such as the calcium sulfate material, although, again, the technology has not been demonstrated on calcium sulfate. The calcium sulfate in prior investigations has exhibited physical properties similar to stiff or soft clay, and depending on water content also exhibited physical properties more like a slurry which could benefit from physical solidification.

Based on the above analysis, at the technology level, S/S has been retained because of its potential applicability for both mercury stabilization as well as mass solidification, for further assessment during the alternative evaluations.

6.2.2 Eliminated Technologies

The remedial technologies that were not retained for consideration in developing remedial alternatives for the Site are listed below with the basis for their elimination.

Thermal Treatment/Retort: This technology was eliminated from further consideration for two reasons. To the extent that off-site thermal treatment (disposal) were to be considered, retort capacity (i.e., the treatment method for mercury) is limited to drum or infrequent roll-off quantities. As described in Section 3, the quantity of calcium sulfate material is approximately 22,000 cubic yards, and thermal treatment at small quantity acceptance rates is not practicable. Second, given the history of the former Nepera facility and the surrounding land use, it would be impracticable to assume that a retort with sufficient capacity could be constructed and operated on the site.

Biological Treatment: This technology was eliminated because the primary constituent of concern is mercury and biological treatment is not applicable to mercury.

In-situ Vitrification: This technology has a number of considerations that would make it infeasible including no history in application to a material such as calcium sulfate, the potential for damage to Route 17 and adjacent utilities because of the high heat levels, emissions considerations because of the presence of mercury, and the high energy consumption.

Thermal Desorption: this is not an accepted technology for mercury, and is not demonstrated on a calcium sulfate matrix.

Electrokinetic Separation: this is a technology that shows some promise for removal of metals such as mercury. However, it is not a commercially available technology demonstrated for mercury, and it has not been established for a calcium sulfate matrix.

Phytoremediation: This technology is not practicable in a non-soil matrix.

Soil Flushing (Chemical Leaching): This technology was eliminated from consideration because of the high solubility of calcium sulfate (the process would most likely result in solubilization not leaching), and the unproven nature of the technology on this matrix. This technology would also present problems with introduction of chemicals adjacent to the West Branch of the Ramapo River, require an effective collection system, and involve a low solubility constituent (i.e., mercury).

7 DEVELOPMENT AND SCREENING OF ALTERNATIVES

7.1 Alternative Development

The technologies retained after screening, as described in Section 6, provide the basis for development of alternatives for potential applicability to the Parking Lot area. Alternatives are created by combining technologies to meet the remedial action objectives for the Site, as defined in Section 4. In addition, a no action alternative is maintained throughout the FS process as a baseline for comparison of other alternatives.

The retained technologies used to create alternatives may be summarized as follows:

- Institutional controls, which may be a component of any alternative.
- Limited action, which may be a component of other alternatives (e.g., maintain or enhance the stream bank IRM in conjunction with a capping technology).
- Containment technologies, including capping and vertical barriers as well as landfill technology (i.e., a containment cell).
- Removal via excavation which would be applicable with another technology of containment or disposal (i.e., landfill).
- Treatment via solidification/stabilization.
- On-site or off-site disposal at a landfill, in conjunction with excavation.

Presented below are the alternatives developed from the above technologies and the rationale for each.

Alternative No. 1, No Action

As noted above, this alternative is retained as a baseline for comparison to other alternatives. However, based on the current Site conditions, if the existing infrastructure were maintained (i.e., building remains in place, existing pavement and the stream bank IRM are maintained), the RAOs would generally be met. Direct contact exposure would be an incomplete pathway (building and pavement), there are currently no groundwater impacts above SCGs at sentinel wells, there is no evidence of adverse impacts on the biota in the adjacent West Branch of the Ramapo River, the stream bank IRM is controlling the potential for contaminated sediment transport to the West Branch of the Ramapo River, and surface soil mercury concentrations are below the relevant SCG for inorganic salts of 220 mg/kg.

Alternative No. 2, Limited Action

Given the status under existing conditions as described above and in further detail in the Supplemental Remedial Investigation Report, the limited action alternative would enhance existing measures to meet the RAOs. Under this alternative, an institutional control in the form of an environmental easement would be put into place to control the potential for future uses that could result in exposure. The environmental easement would restrict access to and handling of contaminated media (soils and groundwater for example), and will also be dependent on the end use of the property. The property is zoned for commercial or industrial use and this end use would be expected to remain and an environmental easement under such conditions could contain provisions for use of health and safety plans for disturbance of media (e.g., for utility repairs) and for vapor migration assessment and mitigation beneath buildings, if any such activity occurred over the Parking Lot area. If the property were used for residential purposes, additional restrictions in the environmental easement could apply, such as restrictions on disturbance for gardening, if such uses were considered in the Parking Lot area.

Under this alternative, the stream bank IRM would be enhanced with a more permanent stabilization measure such as a turf reinforcement mat or stone/rip-rap cover, and the existing pavement and building slab (the building has been demolished) would be maintained as cover to control the direct contact potential, or supplemental pavement could be placed in the area of the former administration building. In addition, under this alternative, the pavement and stream bank erosion controls would be tied in over the intervening area of soil to eliminate the direct contact pathway in this area as well (surface soil mercury is above the published Part 375 criterion, but below the inorganic salts SCG, deeper soil mercury is above the inorganic salts SCG).

This alternative was developed because it would meet the RAOs with minimal action, and would be consistent with the 1997 ROD which indicated only that additional assessment of mercury contaminant flux to the stream would be necessary in the Parking Lot area, along with potential stream bank stabilization to prevent contaminant transport via erosion and sediment transport.

Alternative No. 3, Containment with Stream Bank Stabilization and New Cover/Cap

This alternative would consist of the following components:

- An environmental easement, as previously described, to control the potential for future use that could result in exposure.
- Pull back of calcium sulfate material to the 100-year flood plain boundary and placement under the new cover/cap, and permanent stream bank stabilization in the form of a turf reinforcement mat with vegetated cover (stone or rip-rap could also be supplements to the vegetative cover if necessary to control erosion, such as at the toe of the stream bank).

- A new cover/cap over the calcium sulfate material that would control direct contact exposure and eliminate the maintenance associated with pothole formation in the existing parking lot. The new cover/cap would also replace the existing building as a means of direct contact control. As noted previously, there are a variety of cover types available. For the purpose of this FS, an asphalt cover (Alternative 3a) with an impregnated geotextile base to help control pothole formation, and a geocomposite cover (Alternative 3b) consisting of topsoil, subsoil (minimum 18 inches of soil cover), geomembrane, and cushion material (e.g., geotextile), were selected as representative of the cover types most applicable to the Site conditions.

- The existing administration building would be demolished (which for the purpose of this FS is assumed to be part of the site-wide building demolition).

This alternative was developed because the technologies would meet the RAOs (i.e., control direct contact and eliminate the potential for impacts to the West Branch of the Ramapo River - water quality or biota), and be representative of the least intrusive containment alternative.

Alternative No. 4, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cover/Cap

This alternative would have the same components as Alternative No. 3, but would add the following:

- A vertical barrier would be emplaced at the 100-year flood elevation and would be keyed into the underlying soils. The material outside of the barrier would be removed and placed beneath the cap/cover (asphalt-Alternative 4a, geocomposite-Alternative 4b).

- The stream bank outside the barrier wall would be restored with clean fill and stabilization as described in Alternative No. 3.

- The vertical barrier for the purpose of this FS is assumed to be sheet pile wall because of the space constraints adjacent to the West Branch of the Ramapo River, the difficulty that may be encountered with slurry loss if a slurry trench cutoff wall were considered, and because the sheet pile wall is a process option representative of the range of costs for a vertical barrier wall.

This alternative was developed because the combination of technologies would meet the RAOs (i.e., control direct contact and eliminate the potential for impacts to the West Branch of the Ramapo River - water quality or biota), and would provide an additional layer of protectiveness for the ecological resources represented within the West Branch of the Ramapo River through the emplacement of the vertical barrier to isolate the stream from the calcium sulfate material.

Alternative No. 5, Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Geocomposite Cap

This alternative would essentially be the same as Alternative No. 4, but would add the vertical barrier around the entire area of calcium sulfate material. This alternative was developed because the combination of technologies would meet the RAOs in the same manner as Alternative No.4, but would add a layer of protectiveness by providing a vertical barrier around the entire area of the calcium sulfate material to isolate the contaminated materials from the surrounding environment. For this alternative, because the circumferential barrier wall could restrict lateral groundwater flow, only a geocomposite cap is considered so that long-term management of water that could accumulate within the barrier wall would not be necessary.

Alternative No. 6, Excavation and In-Place Containment Cell

This alternative would be containment based and would essentially create an on-site landfill for the calcium sulfate material. The components of this alternative would be as follows:

- Excavation of the calcium sulfate material.
- Construction of a lined (based on Part 360 requirements for a landfill but likely with some variance provisions based on the material types and limited leachability such as a single composite liner) cell which could either be in place (i.e., excavate and construct in segments) or elsewhere on the site (e.g., within a portion of the adjacent lagoon). The location of the cell would not materially affect the evaluation of this alternative. However, if placed outside of the Parking Lot, consideration would need to be given to site restoration, and to agreement from the current property owner.
- Reconstruction of the stream bank along the perimeter of the lined cell with a permanent erosion control measure such as turf reinforcement mat with vegetation and/or stone/rip-rap.
- Placement of a cap over the lined cell to complete the containment cell (also based on the Part 360 requirements for landfill caps).

This alternative was developed because the landfill technology would meet the RAOs in the same manner as the other containment-based alternatives, but would do so through the construction of an on-site landfill.

Alternative No. 7, Excavation and Off-Site Disposal

This alternative would involve excavation of the calcium sulfate material and disposal in an off-site landfill. As previously noted, the characterization data for the calcium sulfate material indicate it would not be classified as a hazardous waste, and so disposal would be in a state-of-the-art, permitted Subtitle D disposal facility. This alternative was developed because the technologies would meet the RAOs by permanently removing the calcium sulfate material with management of the excavated material in a permitted disposal facility.

Alternative No. 8, In-Situ Solidification/Stabilization, Stream Bank Stabilization, and New Cover/Cap

This alternative would have the components of Alternative No. 3, but would include solidification/stabilization to treat the calcium sulfate material to control solubilization and/or provide additional physical solidification of the calcium sulfate and provide a stable base for the new cover/cap. The cover would be included because the S/S technology does not eliminate the mercury from the matrix, but rather stabilizes the matrix with the intent of structural stability and minimization of migration of contaminants. However, as previously noted, the S/S technology has the potential to actually enhance mercury solubility depending on the additives used, and those additives with the least potential for enhancing mercury solubility are not available commercially.

This alternative was developed because it represents a treatment-based alternative that has the potential to meet the RAOs in combination with the containment-based technologies described for Alternative No. 3.

7.2 Preliminary Alternative Screening

The above alternatives were preliminarily screened to assess how well each would potentially meet the RAOs. The intent of the preliminary screening is to eliminate alternatives that would not effectively meet the RAOs, based on site-specific, contaminant-specific, or implementation considerations. Based on the foregoing analysis, the alternative that was considered for elimination is in-situ solidification/stabilization. The basis for this consideration is as follows:

- Conventional S/S technology has a significant potential to increase the mobility of mercury, whereas current data show that the mercury present in the calcium sulfate is of low mobility.
- More innovative S/S technologies that could avoid increasing mercury mobility are not proven, are not proven in a calcium sulfate matrix, or if proven at bench or pilot scale, are not available commercially.
- Other alternatives exist with implementable, commercially available technology, without the problem of potential mercury mobilization.

Therefore, despite the regulatory preference for alternatives that are treatment based, the elimination of S/S was considered in the preliminary screening. However, this alternative was retained for further analysis, as it may be beneficial to use S/S to further solidify the calcium sulfate material.

Table 7-1 summarizes the preliminary alternative screening process on the basis of ability to effectively meet the RAOs.

8 EVALUATION OF ALTERNATIVES

Based upon the development and preliminary screening of alternatives presented in Section 7, a total of seven alternatives have been retained for detailed analysis against the evaluation criteria in the NYSDEC's DER-10 guidance. The sections that follow provide a more detailed description of the alternatives, discuss the evaluation criteria, and present the evaluation of each of the alternatives against the criteria.

8.1 Description of the Alternatives

8.1.1 Alternative No. 1, No Action

Alternative No. 1, No Action, is intended as a baseline for comparison of other Site alternatives. In theory, this alternative would not include any future actions nor would it continue any existing activities (e.g., stream bank maintenance). This alternative would also not have any costs associated with it, as it does not require any action. However, under the existing ROD, the Corporate Defendants are obligated to maintain the remedial actions that have already been undertaken so that groundwater monitoring would continue, and the stream bank would be inspected and maintained.

8.1.2 Alternative No. 2, Limited Action

Alternative No. 2, Limited Action, focuses on maintaining the existing infrastructure components and enhancing the stream bank stabilization to meet the RAOs. Specifically, the components of this alternative, which are shown on Figure 8-1, include the following:

- An environmental easement to control potential future land uses or disturbance of the calcium sulfate material, with the objective of maintaining consistency with the RAOs.
- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:
  - Clearing and grading of the stream bank to permit installation of the permanent erosion controls.
  - Placement of clean fill to provide a stable stream bank at a flatter slope.
  - Placement of a permanent turf reinforcement mat (TRM) for erosion control (100-year design storm).
  - Topsoil and vegetation placement in conjunction with the TRM, and possibly a component of stone or rip-rap (e.g., toe reinforcement).

- Leaving the former administration building slab in place as cover above the calcium sulfate material. However, if a suitable structural cover does not exist after building demolition, then asphalt pavement would be installed over the disturbed area. As of the preparation of this FS, the building demolition per se has been completed and, therefore, is not considered further in this report. Pavement and/or stream bank stabilization would also be extended into the small area of intervening soils between the existing pavement and the existing stream bank IRM.

- Maintenance of the existing pavement (e.g., fill potholes), new pavement and/or building slab, and the stream bank.

- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as a part of the requirements under the existing ROD (every 5 quarters, site wide). The groundwater monitoring is also not included in the cost estimates discussed below as this is a site-wide issue not specifically related to the Parking Lot area.

A cost estimate for Alternative No. 2 is presented in Table 8-1, and is based on the components described above. The basis for the cost estimates is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.1.3 Alternative No. 3, Containment with Stream Bank Stabilization and New Cover/Cap

Alternative No. 3, Containment with Stream Bank Stabilization and New Cover, focuses on containment of the calcium sulfate material through enhancement of the stream bank stabilization and application of a new cover/cap to meet the RAOs. Specifically, the components of this alternative, which are shown on Figure 8-2, include the following:

- An environmental easement to control potential future land uses or disturbance of the calcium sulfate material, with the objective of maintaining consistency with the RAOs.

- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:

    - Clearing and grubbing of the stream bank to permit installation of the permanent erosion controls.

- Pull back of calcium sulfate material within the 100-year flood plain and placement of the material under the new cap/cover.
  - Placement of clean fill to provide a stable stream bank at a flatter slope.
  - Placement of a permanent TRM for erosion control (100-year design storm).
  - Topsoil and vegetation placed in conjunction with the TRM, and possibly a stone/rip-rap component (e.g., toe reinforcement).

- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.

- A new cover/cap would be placed over the area of calcium sulfate material including extending the cover/cap or stream bank stabilization into the intervening area of soils between the existing pavement and the existing stream bank IRM. Two cover/cap types are evaluated for this alternative as follows:

  - Alternative 3a – Pavement Cover

    - Removal and recycle (on-site as base course) of the existing pavement in the parking lot.
    - Placement of the recycled asphalt along with supplementary stone base course for the new pavement.
    - Placement of an asphalt impregnated geotextile above the base course to aid control of pothole formation in the new pavement.
    - Application of a three-inch wearing course of asphalt.

  - Alternative 3b – Geocomposite Cap

    - Removal and recycle (off-site) of existing pavement
    - Placement of a geotextile cushion layer, a geomembrane, and a geocomposite drainage net as the synthetic portion of the cap to restrict infiltration to aid in the management of settlement of the underlying calcium sulfate material.
    - Placement of 18 inches of soil above the top of the geosynthetics comprised of a base soil (12") and topsoil (6").
    - Vegetation of the completed geocomposite cap and installation of drainage controls.

- Maintenance of the new cover/cap and the stream bank.

- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as part of the requirements under the existing ROD (every 5 quarters, site-wide, but excluded from the cost estimates as previously noted).

Cost estimates for Alternative Nos. 3a and 3b are presented in Tables 8-2a and 8-2b, and are based on the components described above. The basis for the cost estimates is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.1.4 Alternative No. 4, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cover/Cap

Alternative No. 4, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cover/Cap, focuses on containment of the calcium sulfate material to meet the RAOs, through enhancement of the stream bank stabilization, application of a new cover/cap, and the addition of a barrier wall at the 100-year flood elevation to protect the Site from flooding. Specifically, the components of this alternative, which are shown on Figure 8-3, include the following:

- An environmental easement to control potential future land uses or disturbance of the calcium sulfate material, with the objective of maintaining consistency with the RAOs.

- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:

  - Clearing and grubbing of the stream bank to permit installation of the permanent erosion controls.

  - Pull back of calcium sulfate material within the 100-year flood plain and placement of the material under the new cap/cover.

  - Placement of clean fill to provide a stable stream bank at a flatter slope.

  - Placement of a TRM for erosion control (100-year design storm).

  - Topsoil and vegetation placed in conjunction with the TRM, and possibly a stone/rip-rap component (e.g., toe reinforcement).

- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.

- A barrier wall along the 100-year flood plain boundary, which is tied into the ground surface at an elevation 12" or more, higher than the 100-year flood elevation (elevation 523 feet). The barrier wall is assumed to be sheet piles for the purpose of the FS, but the actual selection of the wall type would be made in the design if this alternative were selected. The sheet pile barrier wall provides an effective means to install the barrier with limited potential implications to the adjacent stream, and minimal space requirements. It is also a process option that represents a mid-range of typical costs of a barrier wall.

- A new cover/cap would be placed over the area of calcium sulfate material including extending the cover/cap and/or stream bank stabilization into the area of intervening soils between the existing pavement and existing stream bank IRM. Two cover/cap types are evaluated for this alternative as follows:

    - Alternative 4a – Pavement Cover

        - Removal and recycle (on-site as base course) of the existing pavement in the parking lot.

        - Placement of the recycled asphalt along with supplementary stone base course for the new pavement.

        - Placement of an asphalt impregnated geotextile above the base course to aid control of pothole formation in the new pavement.

        - Application of a three-inch wearing course of asphalt.

    - Alternative 4b – Geocomposite Cap

        - Removal and recycle (off-site) of existing pavement.

        - Placement of a geotextile cushion layer, a geomembrane, and a geocomposite drainage net as the synthetic portion of the cap to restrict infiltration to aid in the management of settlement of the underlying calcium sulfate material.

        - Placement of 18 inches of soil above the top of the geosynthetics comprised of a base soil (12") and topsoil (6").

        - Vegetation of the completed geocomposite cap and installation of drainage controls.

- Maintenance of the new cover/cap and the stream bank.

- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as a part of the requirements under the existing ROD (every 5 quarters, site-wide, but as previously explained not included in the cost estimates).

Cost estimates for Alternative Nos. 4a and 4b are presented in Tables 8-3a and 8-3b, and are based on the components described above. The basis for the cost estimates is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.1.5 Alternative No. 5, Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Geocomposite Cap

Alternative No. 5, Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Geocomposite Cap, focuses on containment of the calcium sulfate material to meet the RAOs, through enhancement of the stream bank stabilization, application of a new cap, and the addition of a circumferential barrier wall to encapsulate the calcium sulfate material. Specifically, the components of this alternative, which are shown on Figure 8-4, include the following:

- An environmental easement to control potential future land uses or disturbance of the calcium sulfate material, with the objective of maintaining consistency with the RAOs.
- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:
  - Clearing and grubbing of the stream bank to permit installation of the permanent erosion controls.
  - Pull back of calcium sulfate material within the 100-year flood plain and placement of the material under the new cap/cover.
  - Placement of clean fill to provide a stable stream bank at a flatter slope.
  - Placement of a permanent TRM for erosion control (100-year design storm).
  - Topsoil and vegetation placed in conjunction with the TRM, and possibly a stone/rip-rap component (e.g., toe protection).
- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.

- A barrier wall along the 100-year flood plain boundary and also extending around the perimeter of the calcium sulfate material. The barrier wall is assumed to be sheet piles for the purpose of the FS, but the actual selection of the wall type would be made in the design if this alternative were selected. The sheet pile barrier wall provides an effective means to install the barrier with limited potential implications to the adjacent stream, and minimal space requirements. It is also a process option that represents a mid-range of typical costs of a barrier wall.

- Since the barrier wall could restrict groundwater movement by tying into the lower permeability marsh deposits that exist in the Parking Lot area, this alternative would also have an interior groundwater collection system to control buildup of groundwater until the full remedy components are in place. The interior collection system would be comprised of perforated pipe, stone, and a pump vault(s).

- A geocomposite cap would be placed over the area of calcium sulfate material including extending the cap and/or stream bank stabilization into the intervening area of soils between the existing pavement and the existing stream bank IRM. Because groundwater flow could be impeded by the circumferential barrier wall, only a low permeability cap, with a permeability less than the underlying soil, would be considered so that long-term groundwater management would not be necessary. The low-permeability geocomposite cap evaluated for this alternative is as follows:

    - Removal and recycle (off-site) of existing pavement.

    - Placement of a geotextile cushion layer, a geomembrane, and a geocomposite drainage net as the synthetic portion of the cap to restrict infiltration to aid in the management of settlement of the underlying calcium sulfate material.

    - Placement of 18 inches of soil above the top of the geosynthetics comprised of a base soil (12") and topsoil (6")..

    - Vegetation of the completed geocomposite cap and installation of drainage controls.

- Maintenance of the new cap/cover and the stream bank.

- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as a part of the requirements under the existing ROD (every 5 quarters, site-wide, but not included in the cost estimates as previously explained).

A cost estimate for Alternative No. 5 is presented in Table 8-4, and is based on the components described above. The basis for the cost estimate is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.1.6 Alternative No. 6, Excavation and In-Place Containment Cell

Alternative No. 6, Excavation and In-Place Containment Cell, focuses on containment of the calcium sulfate material to meet the RAOs, through emplacement of the material in a lined and capped cell, creating a landfill-type environment encapsulating the material. Specifically, the components of this alternative, which are shown on Figure 8-5, include the following:

- An environmental easement to control potential future land uses or disturbance of the calcium sulfate material, with the objective of maintaining consistency with the RAOs.
- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:
    - Clearing and grubbing of the stream bank to permit installation of the permanent erosion controls.
    - Pull back of calcium sulfate material within the 100-year flood plain and placement of the material within the containment cell.
    - Placement of clean fill to provide a stable stream bank at a flatter slope.
    - Placement of a permanent TRM for erosion control (100-year design storm).
    - Topsoil and vegetation placed in conjunction with the TRM, and possibly a stone/rip-rap component (e.g., toe reinforcement).
- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.
- Excavation of the calcium sulfate material, temporarily stockpiling the material, and constructing a lined and capped containment cell to accept the excavated material.
- The liner system for the containment cell is assumed to be a geosynthetic membrane, with a geocomposite drainage net to convey water collected in the cell to a collection system, a geotextile protective layer, and a leachate collection system (pipe, pump vault, stone). Because the groundwater data shows no impact from the calcium sulfate material at the sentinel wells, a single liner system is assumed for the containment cell rather than a full Part 360 liner system. However, the principals of

design of the cell would be similar to those required by the Part 360 regulations. For the purpose of this FS, the excavation and placement of the material in the cell is assumed to occur in segments so that the calcium sulfate material is replaced in the same location. However, the containment cell could be constructed elsewhere (e.g., within a portion of the SPDES lagoon) without materially affecting the evaluation of this alternative. If the cell were constructed elsewhere than the Parking Lot, and this alternative was selected, consideration would be given during the design to how to restore the Parking Lot area. Alternatives could include restoration to grade or conversion to a wetland area.

- A geocompsite cap would be placed over the top of the calcium sulfate containment cell. Because groundwater flow would be impeded by the containment cell, and infiltration could occur if not controlled, only a low permeability cap, with a permeability equal to or less than the underlying liner system, would be considered so that long-term groundwater management would not be necessary. The low-permeability geocomposite cap evaluated for this alternative is as follows:
    - Placement of a geotextile cushion layer, a geomembrane, and a geocomposite drainage net as the synthetic portion of the cap to restrict infiltration.
    - Placement of 18 inches of soil above the top of the geosynthetics comprised of a base soil (12") and topsoil (6").
    - Vegetation of the completed geocomposite cap and installation of drainage controls.
- Maintenance of the new cap/cover and the stream bank.
- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as a part of the requirements under the existing ROD (every 5 quarters, site-wide, but not included in the cost estimates as previously explained).

A cost estimate for Alternative No. 6 is presented in Table 8-5, and is based on the components described above. The basis for the cost estimate is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.1.7 Alternative No. 7, Excavation and Off-Site Disposal

Alternative No. 7, Excavation and Off-Site Disposal focuses on permanent removal of the calcium sulfate material to meet the RAOs. Specifically, the components of this alternative, which are shown on Figure 8-6, include the following:

- Removal and recycle (off-site) of the existing pavement.
- Placement of soil erosion and sediment controls to manage the potential for sediment transport during the excavation and handling of the calcium sulfate material.
- Clearing and grubbing of the stream bank to permit excavation of the calcium sulfate material.
- Excavation of the calcium sulfate material. Based on the prior characterization data for this material (see Section 3), the material is assumed to be characterized as a non-hazardous waste for disposal purposes.
- Transportation to and disposal of the material in a state-of-the-art Subtitle D solid waste disposal facility.
- Backfill of the excavation area with clean fill, or beneficial re-use material consistent with the cleanup levels established site-wide. Alternatively, the area could be restored as a wetland at a lower elevation. For the purpose of this FS, the restoration is assumed to be uncontaminated fill meeting, unrestricted use, Part 375 criteria. If wetlands restoration were considered during the design, it would not materially affect evaluation of this alternative as such an effort would incur additional costs for wetland soil, vegetation, and monitoring and maintenance of the wetland vegetation typically for a period of at least 5 years.
- Replacement of the stream bank with permanent stream bank stabilization consisting of:
    - Placement of clean fill to provide a stable stream bank.
    - Placement of a permanent turf reinforcement mat (TRM) for erosion control (100-year design storm).
    - Topsoil and vegetation placed in conjunction with the TRM and possibly a stone/rip-rap component (e.g., toe reinforcement).
- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.
- Placement of six inches of topsoil and vegetative cover above the excavation backfill to establish permanent stabilization of the disturbed soil area.

- Based on the complete removal of the calcium sulfate material, operation and maintenance is assumed to be unnecessary after the site has been stabilized following remedy implementation.

A cost estimate for Alternative No. 7 is presented in Table 8-6, and is based on the components described above. The basis for the cost estimate is literature (e.g., RS Means cost guides), experience, and contractor/vendor information.

8.1.8 Alternative Nos. 8a and 8b, In-Situ Solidification/Stabilization, Stream Bank Stabilization and New Cover/Cap

Alternative No. 8, In-Situ Solidification/Stabilization, Stream Bank Stabilization and New Cover/Cap, focuses on altering the physical properties of the calcium sulfate, enhancement of the stream bank stabilization, and application of a new cover/cap to meet the RAOs. The components and limits of this alternative are the same as shown in Figure 8-2, except that the area with the boundary of the calcium sulfate material would be solidified/stabilized. Specifically, the components of this alternative include the following:

- An environmental easement to control potential future land uses or disturbance of the solidified calcium sulfate material, with the objective of maintaining consistency with the RAOs.

- Replacement of the stream bank stabilization IRM with a more permanent stream bank stabilization consisting of:

    - Clearing and grubbing of the stream bank to permit installation of the permanent erosion controls.

    - Pull back of calcium sulfate material within the 100-year flood plain, Solidification/Stabilization (S/S) of the pull-back material, and placement of the material under the new cap/cover.

    - Placement of clean fill to provide a stable stream bank at a flatter slope.

    - Placement of a permanent TRM for erosion control (100-year design storm).

    - Topsoil and vegetation placed in conjunction with the TRM, and possibly a stone/rip-rap component (e.g., toe reinforcement).

- As previously noted for Alternative No. 2, building demolition is not included in the cost estimates discussed below, as it has already been completed.

- In-situ solidification/stabilization of the calcium sulfate material. For the purpose of evaluating this alternative, standard pozzolanic material admixture has been assumed, however, a treatability study and/or pilot study would be necessary to select the S/S agent. The percentage of S/S agent required could vary from a low of approximately 5% to as much as 50% and would be determined from the treatability/pilot studies.

- A new cover/cap would be placed over the area of calcium sulfate material including extending the cover/cap or stream bank stabilization into the intervening area of soils between the existing pavement and the existing stream bank IRM. Two cover/cap types are evaluated for this alternative as follows:
  - Alternative 8a – Pavement Cover
    - Removal and recycle (on-site as base course) of the existing pavement in the parking lot.
    - Placement of the recycled asphalt along with supplementary stone base course for the new pavement.
    - Placement of an asphalt impregnated geotextile above the base course to aid control of pothole formation in the new pavement.
    - Application of a three-inch wearing course of asphalt.
  - Alternative 8b - Geocomposite Cap
    - Removal and recycle (off-site) of existing pavement
    - Placement of a geotextile cushion layer, a geomembrane, and a geocomposite drainage net as the synthetic portion of the cap to restrict infiltration to aid in the management of settlement of the underlying calcium sulfate material.
    - Placement of 18 inches of soil above the top of the geosynthetics comprised of a base soil (12") and topsoil (6").
    - Vegetation of the completed geocomposite cap and installation of drainage controls.
- Maintenance of the new cover/cap and the stream bank.
- Routine Site inspections (assumed to be quarterly) and reporting, and continued groundwater monitoring as part of the requirements under the existing ROD (every 5 quarters, site-wide, but excluded from the cost estimates as previously noted).

Cost estimates for Alternative Nos. 8a and 8b are presented in Tables 8-7a and 8-7b, and are based on the components described above. The basis for the cost estimates is literature (e.g., RS Means cost guides), experience, and contractor/vendor information. The net present worth of the annual operation and maintenance costs is calculated at a discount rate of 5% (estimated long-term differential between interest and inflation) for 30 years. The 30 years does not necessarily represent the actual time frame estimated for the term of remedial activities, but rather, is a common time frame after which the time value of money is diminished and does not have a material impact on cost comparisons. The actual term of O&M may vary based on the remedial progress and results of monitoring.

8.2 Evaluation Criteria

The alternatives described above were analyzed by comparison to eight evaluation criteria established in the NYSDEC DER-10 Guidance, Section 4.2, Remedy Selection Evaluation Criteria.

The first two of the eight criteria are threshold criteria. These criteria must be met by a particular alternative for it to be eligible for selection as a remedial action and include the following individual criteria:

- Overall protectiveness of public health and the environment: This criterion assesses the overall performance of an alternative in protecting human health and the environment by evaluation of the alternative's ability to meet the remedial action objectives, the efficacy of the alternative, and its ability to control or eliminate the potential risk pathways (e.g., direct contact).
- Compliance with standards, criteria, and guidance (SCGs): This criterion is used to establish whether an alternative complies with officially promulgated standards and criteria that are directly applicable or that are relevant and appropriate. This criterion also considers relevant guidance.

The next six of the eight evaluation criteria are balancing criteria. These criteria are used to compare the positive and negative attributes of each alternative, provided it meets the threshold criteria. The balancing criteria are as follows:

- Long-term effectiveness and permanence: This criterion is used to assess how the alternative is expected to perform over the long-term and whether the remedy is permanent. In addition, this criterion deals with the magnitude of the remaining risk and ability of the alternative to meet remedial action objectives in the future if contaminants remain on-site after implementation.
- Reduction of toxicity, mobility or volume: This criterion is used to assess how the remedy reduces the toxicity, mobility, or volume of site-related constituents through treatment.
- Short-term impact and effectiveness: This criterion is used to evaluate the implementation related impacts of an alternative, safety, and the alternative's protectiveness related to the community, the workers, and the environment during the short-term implementation period. Factors such as traffic, odors, habitat disturbance, noise, and others are considered under this criterion. In addition, this criterion is used to evaluate the length of the time required for the alternative to meet remedial action objectives.

- Implementability: This criterion is used to evaluate the availability of equipment, materials, and methods associated with an alternative, the practicability of implementing the alternative, and the administrative feasibility of the alternative (e.g. property owner concurrence).
- Cost effectiveness: This criterion provides an overall estimate of the capital, operation, maintenance, and monitoring costs associated with an alternative, for comparison to the alternative's expected performance and to other alternatives. Cost estimates are typically evaluated on an accuracy of +50%/-30%.
- Land use: This criterion evaluates the current or reasonably foreseeable future use of the property and surrounding areas, particularly if residual contamination remains above unrestricted use cleanup levels. This criterion is also intended to consider such issues as brownfield redevelopment opportunity, environmental justice, population growth patterns, proximity to natural resources, and current institutional controls, to the extent such items are relevant.

8.3 Analysis of the Alternatives

A summary of the evaluation of the alternatives against the eight criteria described in Section 8.2 is presented in Tables 8-8 and 8-9. The results of this evaluation are discussed in the Sections that follow.

8.3.1 Alternative No. 1 – No Action

This alternative was retained as a baseline for comparison with other alternatives and its evaluation against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
    - The direct contact exposure route is incomplete for the calcium sulfate as a result of the stream bank IRM and maintenance of the parking lot pavement. In addition, if the mercury salts' industrial SCG was appropriately applied to the intervening soil area between the existing pavement and the existing stream bank IRM, the concentrations of mercury in surface soils would be below the SCG.
    - There is no groundwater impact at the sentinel wells.
    - There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments).
    - Under current conditions with maintenance, the Parking Lot area meets the RAOs. If No Action were to result in termination of maintenance then in the future it is possible that the RAOs would not be met at the Parking Lot area.
- Compliance with SCGs
    - Complies with groundwater and surface water quality SCGs.

- Control provided by the parking lot pavement and stream bank IRM addresses calcium sulfate exceeding Part 375 cleanup levels.
  - The intervening soil area (between existing pavement and the existing stream bank IRM) does not meet SCGs (i.e., published Part 375 cleanup levels) but does meet the relevant mercury inorganic salts SCG.
- Long-Term Effectiveness and Permanence
  - Without some continued maintenance, this alternative would not provide long-term effectiveness.
- Reduction of Toxicity, Mobility, or Volume through Treatment
  - The stream bank IRM controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD.
  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.
  - There is no reduction of toxicity, mobility or volume through treatment.
- Short-Term Effectiveness
  - No remedial or construction activities occur, therefore, there are no short-term impacts associated with implementation.
- Implementability
  - Readily implementable.
- Cost Effectiveness
  - No associated cost.
- Land Use
  - Continuation of the area as a parking lot would be consistent with the surrounding land use that is primarily commercial and industrial with a mix of currently undeveloped land.
  - The stream bank IRM, which is well vegetated, is consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
  - Without an environmental easement the potential to redevelop the Site would exist without the controls necessary to avoid exposure to contaminated materials.

8.3.2 Alternative No. 2 – Limited Action

Evaluation of the limited action alternative against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment

- The direct contact exposure route would be incomplete as a result of the permanent stream bank stabilization, maintenance of the parking lot pavement, and additional pavement in the area of the former administration building. Under this alternative the pavement or stream bank stabilization would also be extended over the intervening soil area between the existing pavement and the existing IRM thereby providing additional control of the direct contact pathway in this area as well.
- There is no groundwater impact at the sentinel wells.
- There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the added controls would further support the absence of impacts.
- Under this alternative and with maintenance, the Parking Lot area would meet the RAOs.

- Compliance with SCGs
    - Complies with groundwater and surface water quality SCGs.
    - Control provided by the pavement, building foundation, and stream bank stabilization address calcium sulfate material regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
    - The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.
- Long-Term Effectiveness and Permanence
    - With continued maintenance, this alternative would provide long-term effectiveness. However, residuals would remain on-site, and so the alternative is not considered permanent.
- Reduction of Toxicity, Mobility, or Volume through Treatment
    - The stream bank stabilization controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD.
    - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.
    - There is no reduction of toxicity, mobility or volume through treatment.
- Short-Term Effectiveness

- The limited action alternative could likely be completed in a time frame of approximately two months, and the actions would not involve any major construction. As a consequence, there is not likely to be any significant short term impact (e.g., dust, noise, health and safety).
  - The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability
  - Readily implementable with conventional materials, equipment, technology and processes.
- Cost Effectiveness
  - The limited action alternative would meet the RAOs for an estimated total net present worth cost of approximately $713,000 (see Table 8-1 for cost estimate, and Table 8-7 for a summary of cost estimates).
  - While low cost, continued maintenance of the parking lot would be necessary because it is prone to pothole formation which can expose the underlying contaminated material.
- Land Use
  - Continuation of the area as a parking lot would be consistent with the surrounding land use that is primarily commercial and industrial with a mix of currently undeveloped land.
  - The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
  - The environmental easement would properly control potential future use of the Site.

8.3.3 Alternative Nos. 3a and 3b – Containment with Stream Bank Stabilization and New Cover/Cap

Evaluation of these stream bank stabilization and cover/cap alternatives against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
  - The direct contact exposure route would be incomplete as a result of the permanent stream bank stabilization, construction of new pavement

(Alternative 3a) or a geocomposite cap (Alternative 3b), and maintenance of these features.

  - There is no groundwater impact at the sentinel wells.
  - There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the added controls would further support the absence of impacts.
  - Under this alternative and with maintenance, the Parking Lot area would meet the RAOs.

- Compliance with SCGs
  - Complies with groundwater and surface water quality SCGs.
  - Control provided by the pavement or geocomposite cap and stream bank stabilization addresses the calcium sulfate material regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
  - The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.

- Long-Term Effectiveness and Permanence
  - With continued maintenance, these alternatives would provide long-term effectiveness. However, residuals would remain on-site, and so the alternative is not considered permanent.

- Reduction of Toxicity, Mobility, or Volume through Treatment
  - The stream bank stabilization controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD. In addition, the new pavement or geocomposite cap would provide enhanced control over the potential for exposure of underlying contaminated material (e.g., at pot holes) further reducing the potential for mobility of contaminants via the sediment pathway.
  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.
  - There is no reduction of toxicity, mobility or volume through treatment.

- Short-Term Effectiveness

- These alternatives could likely be completed in a time frame of approximately three to five months. As such, construction related impacts would be short term. The largest element of construction would be if the geocomposite cap were implemented that would involve importation of approximately 11,000 cubic yards of soils material (including the stream bank work) resulting in approximately 1,500 truck trips (round trips). However, the area is commercial and industrial in character, and access to the Site is directly off major highways so that this level of activity is not likely to result in significant impact.

- Increases in truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in safety concerns, but the materials being trucked would be uncontaminated so there would not be any health or environmental concerns.

- There is not likely to be any significant other short term impacts (e.g., dust, noise, health and safety) given the character of the area, the relative isolation of the Site, and the short term nature of the work which is conducive to normal construction hours and days and routine control measures.

- The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability

  - Readily implementable with conventional materials, equipment, technology and processes.

- Cost Effectiveness

  - The new pavement cover alternative (3a) would meet the RAOs for an estimated total net present worth cost of approximately $1,730,000. The geocomposite cap alternative (3b) would meet the RAOs for an estimated total net present worth cost of approximately $2,150,000 (see Tables 8-2a and 8-2b for cost estimates). Absent contaminant (i.e., mercury) transport via the groundwater pathway, there is no advantage to the geocomposite cap (i.e., the need for additional restriction of infiltration is not indicated), so the new pavement cover would be considered more cost-effective, for the same resultant effectiveness.

- Land Use

  - Continuation of the area as a parking lot would be consistent with the surrounding land use that is primarily commercial and industrial with a mix of currently undeveloped land.

- If the vegetated cap were implemented the open field nature of the resulting cap would also be consistent with much of the surrounding area that is undeveloped land, and with the adjacent West Branch of the Ramapo River.
- The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
- The environmental easement would properly control potential future use of the Site (e.g., parking for adjacent development) that would be consistent with the surrounding land use.

8.3.4 Alternative Nos. 4a and 4b – Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cover/Cap

Evaluation of these stream bank stabilization, stream bank barrier wall, and cover/cap alternatives against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
  - The direct contact exposure route would be incomplete as a result of the permanent stream bank stabilization, construction of new pavement (Alternative 4a) or a geocomposite cap (Alternative 4b), and maintenance of these features. The barrier wall adds another level of protection for isolation of the calcium sulfate from the adjacent West Branch of the Ramapo River.
  - There is no groundwater impact at the sentinel wells.
  - There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the added controls would further support the absence of impacts.
  - Under this alternative and with maintenance, the Parking Lot area would meet the RAOs.
- Compliance with SCGs
  - Complies with groundwater and surface water quality SCGs.
  - Control provided by the pavement or geocomposite cap and stream bank stabilization/barrier wall address the calcium sulfate material regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
  - The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.

- Long-Term Effectiveness and Permanence
    - With continued maintenance, these alternatives would provide long-term effectiveness. The barrier wall component would not require any maintenance and has an estimated life span of 50-100 years or more. However, residuals would remain on-site, and so the alternative is not considered permanent.
- Reduction of Toxicity, Mobility, or Volume through Treatment
    - The stream bank stabilization controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD. In addition, the new pavement or geocomposite cap would provide enhanced control over the potential for exposure of underlying contaminated material (e.g., at potholes) further reducing the potential for mobility of contaminants via the sediment pathway.
    - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.
    - There is no reduction of toxicity, mobility or volume through treatment.
- Short-Term Effectiveness
    - This alternative could likely be completed in a time frame of approximately four to six months. As such, construction related impacts would be short term. The largest element of construction would be if the geocomposite cap were implemented that would involve importation of approximately 11,000 cubic yards of soils material (including the stream bank work) resulting in approximately 1,500 truck trips (round trips). However, the area is commercial and industrial in character, and access to the Site is directly off major highways so that this level of activity is not likely to result in significant impact.
    - Increases in truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in safety concerns, but the materials being trucked would be uncontaminated so there would not be any health or environmental concerns.
    - There is not likely to be any significant other short term impacts (e.g., dust, noise, health and safety) given the character of the area, the relative isolation of the Site, and the short term nature of the work which is conducive to normal construction hours and days and routine control measures.

    - The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability
    - Readily implementable with conventional materials, equipment, technology and processes.

- Cost Effectiveness
    - The new pavement cover alternative (4a) would meet the RAOs for an estimated total net present worth cost of approximately $2,820,000. The geocomposite cap alternative (4b) would meet the RAOs for an estimated total net present worth cost of approximately $3,240,000 (see Tables 8-3a and 8-3b for cost estimates). Absent contaminant (i.e., mercury) transport via the groundwater pathway, there is no advantage to the geocomposite cap (i.e., the need for additional restriction of infiltration is not indicated), so the new pavement cover would be considered more cost effective, for the same resultant effectiveness.

- Land Use
    - Continuation of the area as a parking lot would be consistent with the surrounding land use that is primarily commercial and industrial with a mix of currently undeveloped land.
    - If the vegetated cap were implemented the open field nature of the resulting cap would also be consistent with much of the surrounding area that is undeveloped land, and with the adjacent West Branch of the Ramapo River.
    - The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
    - The environmental easement would properly control potential future use of the Site (e.g., parking for adjacent development) that would be consistent with the surrounding land use.

8.3.5 Alternative No. 5 – Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Geocomposite Cap

Evaluation of this stream bank stabilization, circumferential barrier wall, and geocomposite cap alternative against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment

- The direct contact exposure route would be incomplete as a result of the permanent stream bank stabilization, construction of the geocomposite cap and maintenance of these features. The circumferential barrier wall adds another level of protection for isolation of the calcium sulfate from the surrounding environment, essentially forming a type of containment cell.
- There is no groundwater impact at the sentinel wells.
- There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the added controls would further support the absence of impacts.
- Under this alternative and with maintenance, the Parking Lot area would meet the RAOs.

- Compliance with SCGs
  - Complies with groundwater and surface water quality SCGs.
  - Control provided by the geocomposite cap, stream bank stabilization, and circumferential barrier wall address the calcium sulfate material regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
  - The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.
- Long-Term Effectiveness and Permanence
  - With continued maintenance, this alternative would provide long-term effectiveness. The barrier wall component would not require any maintenance and has an estimated life span of 50-100 years or more. However, residuals would remain on-site, and so the alternative is not considered permanent.
- Reduction of Toxicity, Mobility, or Volume through Treatment
  - The stream bank stabilization controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD. In addition, the geocomposite cap would provide enhanced control over the potential for exposure of underlying contaminated material (e.g., at potholes) further reducing the potential for mobility of contaminants via the sediment pathway.
  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.

- There is no reduction of toxicity, mobility or volume through treatment.

- Short-Term Effectiveness
  - This alternative could likely be completed in a time frame of approximately six to eight months. As such, construction related impacts would be short term. The largest elements of construction would include the barrier wall and geocomposite cap. The cap would involve importation of approximately 11,000 cubic yards of soils material (including the stream bank work) resulting in approximately 1,500 truck trips (round trips). However, the area is commercial and industrial in character, and access to the Site is directly off major highways so that this level of activity is not likely to result in significant impact.
  - Increases in truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in safety concerns, but the materials being trucked would be uncontaminated so there would not be any health or environmental concerns.
  - There is not likely to be any significant other short term impacts (e.g., dust, noise, health and safety) of any significance given the character of the area, the relative isolation of the Site, and the short term nature of the work which is conducive to normal construction hours and days and routine control measures.
  - The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability
  - Readily implementable with conventional materials, equipment, technology and processes.

- Cost Effectiveness
  - This alternative would meet the RAOs for an estimated total net present worth cost of approximately $3,663,000 (see Table 8-4 for cost estimate). Absent contaminant (i.e., mercury) transport via the groundwater pathway, there is no advantage to the geocomposite cap (i.e., the need for additional restriction of infiltration is not indicated). However, because of the circumferential barrier wall that could restrict lateral groundwater flow, the cap is necessary so as not to have long-term handling of groundwater that could build up inside the barrier wall. For this reason, this alternative has an element of cost-ineffectiveness that is not off-set well by the benefit of the barrier wall (i.e., the wall does not materially increase protectiveness because

lateral migration of contaminants is not an issue even under existing conditions).

- Land Use
  - The open field nature of the vegetated geocomposite cap would be consistent with much of the surrounding area that is undeveloped land, and with the adjacent West Branch of the Ramapo River.
  - The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
  - The environmental easement would properly control potential future use of the Site (e.g., open land) that would be consistent with the surrounding land use.

8.3.6 Alternative No. 6 – Excavation and In-Place Containment Cell

Evaluation of this containment cell alternative against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
  - The direct contact exposure route would be incomplete as a result of the permanent stream bank stabilization and construction of the containment cell (both baseliner and geocomposite cap) and maintenance of these features.
  - There is no groundwater impact at the sentinel wells.
  - There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the added controls would further support the absence of impacts.
  - Under this alternative and with maintenance, the Parking Lot area would meet the RAOs.
- Compliance with SCGs
  - Complies with groundwater and surface water quality SCGs.
  - Control provided by the containment cell addresses calcium sulfate regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
  - The containment cell would generally follow the requirements for landfill design in 6 NYCRR Part 360, however, as previously noted there may be

variances that would be applicable, which are permitted within the regulations.

- The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.

- Long-Term Effectiveness and Permanence

  - With continued maintenance, this alternative would provide long-term effectiveness. The containment cell components would require limited maintenance, and the geosynthetic components have life spans typically estimated in hundreds of years. However, residuals would remain on-site, and so the alternative is not considered permanent.

- Reduction of Toxicity, Mobility, or Volume through Treatment

  - The containment cell controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD. In addition, the geocomposite cap would provide enhanced control over the potential for exposure of underlying contaminated material (e.g., at potholes) further reducing the potential for mobility of contaminants via the sediment pathway.

  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.

  - There is no reduction of toxicity, mobility or volume through treatment.

- Short-Term Effectiveness

  - This alternative could likely be completed in a time frame of approximately six to eight months. As such, construction related impacts would be short term. The largest elements of construction include excavation of the estimated 22,000 cubic yards of calcium sulfate, and construction of the cell liner and cap. The liner and cap construction would involve importation of approximately 27,000 cubic yards of soils material (including the stream bank work) resulting in approximately 3,600 truck trips (round trips). This is a substantial number of truck trips and while the area is commercial and industrial in character, and access to the Site is directly off major highways there is likely to be a noticeable short-term change in the character of traffic in the region during the construction.

  - Increases in truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in safety concerns, but the materials being trucked would be uncontaminated so there would not be any health or environmental concerns.

- This alternative also includes the excavation of approximately 22,000 cubic yards of calcium sulfate that are contaminated with mercury. Handling and stockpiling of this material while the containment cell is prepared increases the potential for air borne contamination. The work will be subject to a community air monitoring program to help control the potential for such impacts.
- There is not likely to be other significant short term impacts (e.g., noise, health and safety) of any significance associated with the other aspects of construction given the character of the area, the relative isolation of the Site, and the short term nature of the work which is conducive to normal construction hours and days and routine control measures.
- The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability
  - Implementable with conventional materials, equipment, technology and processes.
  - Excavation of the mercury contaminated calcium sulfate will require more care in materials handling that when just constructing with uncontaminated materials.
- Cost Effectiveness
  - This alternative would meet the RAOs for an estimated total net present worth cost of approximately $4,179,000 (see Table 8-5 for cost estimate). Absent contaminant (i.e., mercury) transport via the groundwater pathway, there is no advantage to the full containment cell. However, because the cell would contain any infiltrating rainfall, a geocomposite cap is necessary so as not to have long-term handling of "leachate" that would build up inside the barrier wall. For this reason, this alternative has an element of cost-ineffectiveness that is not off-set well by the construction of a full containment cell (i.e., the liner system does not materially increase protectiveness because lateral migration of contaminants is not an issue even under existing conditions).
- Land Use

- o The open field nature of the vegetated geocomposite cap would be consistent with much of the surrounding area that is undeveloped land, and with the adjacent West Branch of the Ramapo River.
- o The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.
- o The environmental easement would properly control potential future use of the Site, and uses would be available (e.g., open land) that are consistent with the surrounding land use.

8.3.7 Alternative No. 7 – Excavation and Off-Site Disposal

Evaluation of this excavation and off-site disposal alternative against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
    - o The direct contact exposure route would be incomplete as a result of the removal and off-site disposal of the calcium sulfate material.
    - o There is no groundwater impact at the sentinel wells.
    - o There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the removal of the contaminated materials would obviate potential future impacts.
    - o Under this alternative, the Parking Lot area would meet the RAOs.
- Compliance with SCGs
    - o Complies with groundwater and surface water quality SCGs.
    - o Removal and off-site disposal in a permitted facility addresses calcium sulfate material regardless of whether elemental mercury or inorganic mercury salts SCGs are used.
    - o The stream bank restoration/stabilization work after excavation would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the current stream habitat. If the alternative of restoration to a wetland environment were implemented, the construction would also be consistent with these regulatory requirements for stream protection.
    - o Transportation would comply with 6 NYCRR Part 364 transporter requirements.

- The off-site disposal facility would require a permit for acceptance of non-hazardous waste either in compliance with Subtitle D and any state program if outside of New York State or with the Part 360 regulations if in New York State.

- Long-Term Effectiveness and Permanence
  - Under this alternative, residual contamination above relevant cleanup levels would not remain on Site, and so the alternative is considered permanent, and would provide corresponding long-term effectiveness.

- Reduction of Toxicity, Mobility, or Volume through Treatment
  - There is no reduction of toxicity, mobility or volume through treatment, only through excavation and off-site disposal at a permitted disposal facility.
  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt.

- Short-Term Effectiveness
  - This alternative could likely be completed in a time frame of approximately four to six months. As such, construction related impacts would be short term. The largest elements of construction would be excavation of the estimated 22,000 cubic yards of calcium sulfate, and backfill of the open excavation area. The total estimated volume of material that would be exported or imported to the Site is approximately 65,000 cubic yards resulting in approximately 8,700 truck trips (round trips) of which approximately 3,000 would be carrying material contaminated with mercury. This is a substantial number of truck trips and while the area is commercial and industrial in character, and access to the Site is directly off major highways there is likely to be a noticeable short-term change in the character of traffic in the region during the construction. Even if an alternative of Site restoration to a wetland environment were implemented, the importation of wetland substrate soil and re-vegetation along with the 3,000 truck trips for removal of contaminated material would result in similar short-term impacts.
  - Increases in truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in both health and safety concerns, because of the truck trips that would be carrying contaminated (mercury) materials.
  - This alternative also includes the excavation of approximately 22,000 cubic yards of calcium sulfate material that are contaminated with mercury. Handling and stockpiling of this material for export to a disposal facility

increases the potential for air borne contamination. The work will be subject to a community air monitoring program to help control the potential for such impacts.

  - The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are not anticipated.

- Implementability
  - Implementable with conventional materials, equipment, technology and processes.
  - Excavation of the mercury contaminated calcium sulfate will require more care in materials handling than when just constructing with uncontaminated materials.

- Cost Effectiveness
  - This alternative would meet the RAOs for an estimated total net present worth cost of approximately $8,150,000 (see Table 8-6 for cost estimate). Given the absence of current impacts, the cost-effectiveness of this alternative is questionable.

- Land Use
  - Once the Site is restored, since there would not be any residual contamination above relevant cleanup levels, the Site could accommodate any permitted, applicable land use.

8.3.8 Alternative Nos. 8a and 8b – In-Situ Solidification/Stabilization, Stream Bank Stabilization and New Cover/ Cap

Evaluation of these in-situ solidification/stabilization, stream bank and cover/cap alternatives against the eight criteria is as follows:

- Protectiveness of Public Health and the Environment
  - The direct contact exposure route would be incomplete as a result of the in-situ solidification/stabilization (S/S), permanent stream bank stabilization, construction of new pavement (Alternative 8a) or a geocomposite cap (Alternative 8b), and maintenance of these features.
  - There is no groundwater impact at the sentinel wells.

- There is no evidence of ecological impacts to the West Branch of the Ramapo River (surface water or sediments), and the S/S and containment of the contaminated materials would obviate potential future impacts.
- Under this alternative, the Parking Lot area would meet the RAOs.

- Compliance with SCGs
  - Complies with groundwater and surface water quality SCGs.
  - Control provided by the S/S process, pavement or geocomposite cap, and stream bank stabilization addresses the calcium sulfate material regardless of whether the elemental mercury or inorganic mercury salts SCGs are used.
  - The permanent stream bank stabilization work would be in accordance with the 6 NYCRR Part 608 permitting requirements. The final vegetated surface would also be designed to be consistent with the stream habitat.

- Long-Term Effectiveness and Permanence
  - With continued maintenance, these alternatives would provide long-term effectiveness. However, residuals would remain on-site since the S/S process affects physical properties and potential leaching but does not remove the contaminants, and so the alternative is not considered permanent.

- Reduction of Toxicity, Mobility, or Volume through Treatment
  - S/S treatment of the mercury contaminated calcium sulfate would potentially structurally stabilize the matrix to increase strength properties. The S/S process would also be designed to minimize the mobility of contaminants, in particular mercury. However, the S/S technology has the potential to enhance mercury solubility depending on additives used, potentially increasing the mobility of mercury. Additives with the least potential for enhancing mercury solubility are not currently available commercially.
  - The stream bank stabilization controls the potential sediment transport pathway from the calcium sulfate consistent with the current ROD, albeit this potential mechanism should be reduced via S/S treatment. In addition, the new pavement or geocomposite cap would provide enhanced control over the potential for exposure of underlying contaminated material (e.g., at pot holes) further reducing the potential for mobility of contaminants via the sediment pathway.
  - Mercury, the contaminant of concern in the calcium sulfate, is of low mobility based on prior site investigation data indicating it is present primarily as the insoluble mercuric sulfide salt. As noted above, S/S admixtures have the potential to increase mobility or change the form of the mercury during the

admixture process (e.g., conversion of HgS to HgO) to one that is more soluble and mobile.

- There is no reduction of toxicity or volume through S/S treatment, just potential mobility.

- Short-Term Effectiveness
  - These alternatives could likely be completed in a time frame of approximately 6-8 months. As such, construction related impacts would be short term. The largest elements of construction would be the S/S process for 22,000 cubic yards of calcium sulfate, and if the geocomposite cap were implemented that would involve importation of approximately 11,000 cubic yards of soils (including the stream bank work) resulting in approximately 1,500 truck trips (round trips). However, the area is commercial and industrial in character, and access to the Site is directly off major highways so that this level of activity is not likely to result in significant impact.
  - Increased truck trips have inherent potential impacts associated with an increase in accidents. Accidents in this instance would result in safety concerns, but the materials being trucked would be uncontaminated so there would not be any health or environmental concerns.
  - The in situ mixing of the calcium sulfate material has the potential to volatilize mercury vapor, and measures would have to be taken to minimize vapor and perform the work under a community air monitoring program.
  - There is not likely to be any significant other short term impacts (e.g., dust, noise, health and safety) given the character of the area, the relative isolation of the Site, and the short term nature of the work which is conductive to normal construction hours and days and routine control measures.
  - The construction along the stream bank would be in accordance with a stream disturbance permit and stormwater management plan, so short term impacts to the West Branch of the Ramapo River are also not anticipated.

- Implementability
  - Implementable with conventional materials, equipment, technology and processes with the exception of S/S agents that are not yet commercially available and have the greatest ability to maintain or reduce mercury mobility. A treatability and/or pilot study will be necessary prior to implementation, and would be used to confirm S/S applicability and performance, and may indicate that the appropriate admixture materials are not commercially available.

- As previously noted, the S/S admixture ratio could be in the range of 5% to 50%. On a volume basis this would mean a change of in the range of 1,100 to 11,000 cubic yards. At the higher end of the range of volume change, this would mean an increase in the elevation of the Parking Lot area of approximately two feet. While this could be accommodated at the site, it would need to be considered in the design.

- Handling and treatment of the mercury contaminated calcium sulfate during in-situ S/S will require more care than when just constructing with uncontaminated materials. As noted above, care will be necessary in controlling the potential for mercury vapor emissions.

- Cost Effectiveness

    - The new pavement cover alternative (8a) would meet the RAOs for an estimated total net present worth cost in a range of approximately $3,458,000 - $6,833,000. The geocompostire cap alternative (8b) would meet the RAOs for an estimated total net present worth cost in a range of approximately $3,827,000 - $7,203,000 (see Tables 8-7a and 8-7b for cost estimates). Absent contaminant (i.e., mercury) transport via the groundwater pathway, there is no advantage to the geocomposite cap (i.e., the need for additional restriction of infiltration is not indicated), and in addition, the objective of the S/S treatment process is to reduce mobility, so the new pavement cover would be considered more cost effective, for the same resultant effect.

    - The total net present worth cost range is based on the type and ratio of admixture and ease of mixing. As noted previously, a treatability and/or pilot study of the S/S treatment of the mercury containing calcium sulfate material would need to be completed to determine proper admixture and feasibility of S/S on the calcium sulfate matrix. This could affect the cost evaluation.

- Land Use

    - Continuation of the area as a parking lot would be consistent with the surrounding land use that is primarily commercial and industrial with a mix of currently undeveloped land.

    - The stream bank stabilization, which would be vegetated, would be consistent with the ecological conditions of the West Branch of the Ramapo River in this urban setting.

    - The environmental easement would properly control potential future use of the Site (e.g., parking for adjacent development) that would be consistent with the surrounding land use.

9 ALTERNATIVES COMPARISON AND RECOMMENDATION

9.1 Comparative Analysis

A comparative analysis was performed of the alternatives evaluated in Section 8 to assess the relative advantages and disadvantages of each and to facilitate the recommendation of an alternative. This comparative analysis was performed using the eight evaluation criteria described in Section 8 and is summarized in Table 9-1. The details of the comparative analysis are discussed further below.

Protectiveness of Public Health and the Environment

As expected, because Alternative No. 1 - No Action was retained as a baseline for comparison with other alternatives, it does not fully satisfy the evaluation criteria principally because this alternative necessarily assumes that even existing actions (e.g., current inspection and maintenance programs) are not implemented. However, with maintenance, Alternative No. 1 actually does satisfy the evaluation criteria (assuming the relevant mercury salts SCG is used). That No Action generally satisfies the evaluation criteria would be expected since the remediation has been performed in accordance with the previously issued 1997 ROD, and inspection and maintenance programs are ongoing.

Each of the remaining alternatives (Nos. 2, 3a, 3b, 4a, 4b, 5, 6, 7, 8a, and 8b) would meet the remedial action objectives and would generally be protective of public health and the environment through the elimination of the direct contact pathway and control of potential future movement/dispersion of contaminants from the calcium sulfate material. Alternatives 8a and 8b have the potential through the S/S process to increase mercury mobility, and this uncertainty would rank effectiveness of this alternative less than the other alternatives.

Alternative No. 2 - Limited Action may be considered potentially less protective if taking into account the potential for more frequent pothole formation in the existing parking lot pavement. However, with ongoing maintenance, the protectiveness levels are considered equivalent for the various alternatives.

Compliance with SCGs

In general, with the exception of Alternative No. 1 (because of the dependency on which SCG is used), as shown in Table 9-1, the alternatives are generally equally consistent in the ability to comply with SCGs. The SCGs vary somewhat by alternative. For example, for alternatives that do not require off-site disposal, there would not be a need to comply with the Part 364 waste transportation regulations. However, all of the alternatives would need to comply with the relevant Part 375 cleanup levels. Nonetheless, there is no distinction among the alternatives in ability to comply with relevant SCGs.

Long-Term Effectiveness and Permanence

In general, again with the exception of Alternative No. 1, the alternatives are effective in the long-term given proper maintenance of the cover/cap, the stream bank stabilization, and appurtenant features.

Alternative No. 2, Limited Action, is considered somewhat less effective in the long-term because of the state of disrepair of the existing pavement which would remain as the cover system. Conversely, Alternative No. 7, Excavation and Off-Site Disposal, is considered somewhat more effective in the long-term because it is the only remedy that is considered permanent.

The remaining alternatives (cover/cap options, barrier wall options, S/S, and containment cell) are considered comparable in long-term effectiveness, but none are considered permanent as residual contamination above relevant cleanup levels would remain on Site.

Reduction of Toxicity, Mobility, or Volume

None of the alternatives reduce toxicity or volume through treatment, and thus, each of the alternatives are considered comparable for this criterion. Alternatives 8a and 8b are designed to reduce mobility through S/S treatment, and have the potential to actually increase mobility, which can only be determined through a treatability and/or pilot study. None of the other alternatives reduce mobility through treatment.

In actuality, because mercury is the principal contaminant, and it is an element, only its form can be modified by treatment processes or it can be extracted from a mixed medium to reduce volume, but not the volume of the contaminant. Of note, at the Site, mercury is present, as described in Section 3, in a low mobility form (mercuric sulfide), and in the absence of retort capacity that can manage material volumes of the scale at the Site, treatment based technologies such as S/S that can actually increase mobility, are not applicable, as is supported in this FS.

Short-Term Impact & Effectiveness

In general, Alternative Nos. 2, 3, 4 and 5 have relatively short implementation time frames, and do not have attendant short-term, significant adverse impacts. These alternatives, are therefore, considered comparable for this criterion, with only nominal differences.

Alternative Nos. 6, 7, 8a and 8b on the other hand, require the handling of 22,000 cubic yards of mercury contaminated calcium sulfate which increases the potential for the adverse impact of air borne contamination (e.g., dust from handling or stockpiling and mercury vapor emissions from mixing and handling). In addition, because of the need for greater soils quantities to construct the containment cell for Alternative No. 6, the number of truck trips to import materially is substantially larger than Alternatives 2, 3, 4, and 5, with associated increased potential for safety hazards due to accidents.

Alternative No. 7 is considered the least effective in the short term for two reasons. First, the same handling of 22,000 cubic yards of mercury contaminated calcium sulfate is required for the remedy. In addition, the estimated number of truck trips for this alternative to export the contaminated materials for disposal and import backfill to restore the Site is increased to approximately 8,700 of which approximately 3,000 (all values round trips) are associated with hauling contaminated material off site. Therefore, the potential for adverse impacts associated with accidents involve both safety (injury from accident) and potential environmental (release of mercury contaminated materials) concerns.

Implementability

In general, each of the alternatives is implementable with conventional materials, equipment, technology, and processes. However, Alternative Nos. 6, 7, 8a and 8b as noted above, require the handling, stockpiling, and/or transportation of mercury contaminated materials, and therefore require greater care during implementation. In addition, without a treatability and/or pilot study it is not clear that the proper S/S agent would be commercially available for Alternatives 8a and 8b. As a consequence, these three alternatives are considered slightly less effective in addressing this criterion than the other alternatives. In addition, there is currently no agreement in place with the current property owner regarding the excavation and containment cell option, particularly if other than an in-place cell were constructed.

Cost

Alternative No. 2 is the least costly alternative that meets the RAOs at $713,000 (NPW). Alternative No. 3a, pavement cover, is the next least costly alternative that meets the RAOs at $1,730,000 (NPW). The more complex containment Alternatives 4, 5, and 6 are in the range of 3 to 4.5 million dollars to implement and maintain without concomitant increase in benefits with respect to meeting the RAOs. Alternative No. 7 is over an order of magnitude more costly than Alternative No. 2, and approximately 5 times more costly than Alternative 3a, and except for being permanent, does not provide a concomitant increase in benefit in meeting the RAOs. Alternatives 8a and 8b on the low end of the S/S admixture range are comparable to the more complex containment alternatives at a cost in the range of $3.5 million. At the high end of the S/S admixture range, the cost of Alternatives 8a and 8b are similar to the most costly alternative of excavation and off-site disposal. Alternatives 8a and 8b also do not provide a concomitant increase in benefit in meeting the RAOs and may actually increase mercury mobility. Consequently, of the various alternatives, Alternatives 2 and 3 are considered the most cost effective.

Land Use

Each of the alternatives would permit an existing or future land use consistent with the surrounding land uses whether it be commercial/industrial or undeveloped land. The alternatives were considered equally effective for this criterion.

9.2 Recommended Alternative

As previously noted, Table 9-1 provides a summary comparison of the various alternatives against the eight evaluation criteria. Based on the comparative analysis presented in Section 9.1, as summarized in Table 9-1, Alternatives 2 and 3 are considered comparable in overall performance and effectiveness, and the most applicable to the Site. This conclusion is the result of the following:

- Remediation alternatives were evaluated previously for the Parking Lot area and resulted in the 1997 ROD which determined that the only additional action required was "An evaluation of the erosional stability of the western stream bank of the West Branch of the Ramapo River [i.e., the parking lot stream bank].... If required, measures would be implemented to prevent the streambank from eroding into the River."

- Since the ROD was issued the NYSDEC undertook a fish study, the Corporate Defendants enhanced the stability of the stream bank through implementation of an IRM which through routine inspection and maintenance has maintained its effectiveness (including through a number of extreme storm events), and most recently, the Corporate Defendants undertook the Supplemental RI of the stream banks, sediments, and surface water to further add to the characterization work that has been completed from prior studies. Each of these activities has demonstrated the absence of impacts from the Parking Lot area on the ecological receptors (see Section 3 for additional details) of the West Branch of the Ramapo River or potential for public health impacts from direct contact (based on the appropriate inorganic salts mercury SCG for industrial use for comparison to the mercury concentrations).

- The stream bank IRM was implemented as an interim measure in anticipation of further design work for a more permanent bank stabilization design. The Corporate Defendants have proposed proceeding with the permanent bank stabilization as described in this FS (i.e., a turf reinforcement mat with vegetative cover). In the interim, however, the IRM has been effective in isolating the calcium sulfate material along the stream bank and controlling the potential for erosion into the stream.

- Maintenance of the Parking Lot pavement (i.e., filling potholes) also makes the direct contact exposure pathway for the calcium sulfate material incomplete.

The foregoing analysis in this FS along with the above-described factors related to the 1997 ROD indicate that the recommended alternative for implementation at the Parking Lot area is Alternative 3a. This alternative is recommended because of the above factors and the following:

- The permanent stream bank stabilization component of this alternative would in effect, along with the results of the Supplemental RI, close out the requirement of the ROD for assessment and erosional stability of the stream bank.

- The pavement cover component of Alternative 3a would reduce long-term maintenance by more permanently addressing the formation of potholes in the old pavement, and in so doing enhance the dependability of the cover in meeting the RAOs and maintaining direct contact as an incomplete pathway.

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LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

TABLES

Table 5-1
Summary of General Response Action Screening

General Response Action	Retained	Eliminated	Basis
No Action	X		Provides baseline for comparison of other alternatives
Limited Action & Institutional Controls	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material covered by pavement or building, maintenance program in place; incomplete direct contact pathway Stream bank stabilized by IRM; no sediment transport or complete exposure pathway of calcium sulfate material
Containment	X		Same as limited action and institutional controls but would provide permanent stream bank stabilization, potentially enhance direct contact exposure controls through alternative cap or barrier systems
In-situ Treatment	X		The primary constituent of interest in the calcium sulfate material, mercury, has been the subject of various treatment evaluations (solidification/stabilization, amalgamation, thermal treatment)
Ex-situ Treatment		X	Since the calcium sulfate material does not pose impediments to in situ treatment (e.g., obstructions) there is no advantage to excavating the material for treatment Waste handling procedures (e.g., classification, CAMU) are complicated by excavation and handling
Collection & Discharge		X	Applicable to groundwater, and groundwater is currently under control, groundwater quality meets standards at sentinel wells, monitored natural attention is currently in effect and effective, no further action necessary
Excavation/ Removal	X		It would be possible to excavate the calcium sulfate material to be managed elsewhere on or off site.
Disposal	X		Disposal is a component of removal technologies

Table 6-1
Identification of Candidate Technologies and Screening

Medium	General Response Action	Candidate Technology	Constituent Type		Development Status With Respect to Hg Treatment	Retained for Development of Alternatives (Y or N)	Screening Comments
			Hg	O			
Calcium Sulfate Material	Limited Action /Institutional Controls	Environmental Easement	A	A	n/a	Y	Likely component of any remedial alternative.
		Maintenance of Stream Bank IRM and Parking Lot	A	A	n/a	Y	Incomplete direct contact pathway, no current groundwater impacts at sentinel wells, MNA for groundwater
	Containment	Caps/Covers	A	A	n/a	Y	Options include: soil, geosynthetics, composites, concrete, and asphalt caps. Caps would control direct contact exposure pathway, and could contribute further to MNA for groundwater by reducing flux from infiltration of precipitation
		Vertical Barriers	A	A	n/a	Y	Options include: slurry, sheet pile, geomembrane, and others. Would provide lateral control for potential movement of contaminated material
	Excavation/ Removal	Excavation	A	A	n/a	Y	Includes complete or partial removal. Requires ex situ soil management. RCRA regulations including LDRs would apply.
	Disposal	Off-Site Landfill	A	A	n/a	Y	Pre-treatment may be required. LDRs may have to be considered although data do not indicate material is hazardous.
		On-Site Landfill	A	A	n/a	Y	Pre-treatment may be required. May require construction of a land disposal unit.
		Thermal/Retort	A	A	X	N	Thermal/Retort treatment for mercury contaminated materials is available only in small (e.g., drum) quantities, and would not be practicable for the volume of calcium sulfate material within the parking lot area.

Table 6-1
Identification of Candidate Technologies and Screening

Medium	General Response Action	Candidate Technology	Constituent Type		Development Status With Respect to Hg Treatment	Retained for Development of Alternatives (Y or N)	Screening Comments
			Hg	O			
Calcium Sulfate Material	In Situ Treatment	Biological Treatment	n/a	A	Z	N	Biological treatment is not established for mercury treatment.
		Vitrification	A	A	Y	N	Off-gas collection and treatment required, over large area. Mercury emissions controls are complex. Could affect adjacent highway. High energy consumption. Not proven on calcium sulfate matrix.
		Thermal Desorption (ISTD)	A	A	Z	N	ISTD is not established for Hg treatment, nor on a calcium sulfate matrix.
		Electrokinetic Separation	A	n/a	Z	N	Limited experience with Hg. Effect on elemental Hg unclear. Not established for calcium sulfate matrix.
		Phytoremediation	A	A	Z	N	Not practicable in non-soil matrix
		Solidification/ Stabilization	A	A	Z	Y	Includes micro or macro encapsulation and chemical stabilization. S/S is not fully established for mercury treatment, technology demonstration only at pilot scale. May require off-gas controls. Possible application to stabilize the calcium sulfate matrix and use in conjunction with cap/cover.
		Soil Flushing (Chemical Leaching)	A	A	Z	N	May include various chemicals (e.g., acids) to increase leaching. Requires extraction and treatment system. Not applicable to calcium sulfate matrix. Calcium sulfate soluble in water.

Notes:
Constituent Type: Hg: Mercury; O: Organics. Organics shown for completeness although no detections above Part 375 residential standards, and few detections above Part 375 impact to groundwater standards, and impact to groundwater not present at sentinel wells.
Applicability to Constituent Type: A = applies to some or all compounds in this class, n/a = not applicable
Development Status: X = Fully Developed: has been successfully implemented at full-scale; Y = Developing: has had some success in full-scale application; Z = Not Established: technology is at most pilot or lab scale; n/a = not applicable because not a treatment technology
Retained for Additional Screening: Y : Yes; N: No

Table 7-1
Preliminary Screening of Alternatives

Alternative No.	Alternative	Retained	Eliminated	Basis
1	No Action	X		Provides baseline for comparison of other alternatives. Also, maintenance of existing pavement, building, and stream bank IRM meets the RAOs
2	Limited Action – Environmental Easement, Permanent Stream Bank Stabilization, Maintain Pavement and Building Slab as Cover	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material covered by existing pavement or building slab; incomplete direct contact pathway Stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors
3	Containment with Stream Bank Stabilization and New Cover	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material covered by new pavement or vegetated cap; incomplete direct contact pathway Stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors
4	Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cover	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material covered by new pavement or vegetated cap; incomplete direct contact pathway Material pulled back behind flood plain barrier wall, and stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors

Table 7-1
Preliminary Screening of Alternatives (continued)

Alternative No.	Alternative	Retained	Eliminated	Basis
5	Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and New Cover	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material covered by new pavement or vegetated cap; incomplete direct contact pathway Material pulled back behind flood plain barrier wall, and stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors. Additional direct contact and migration control provided by circumferential barrier wall.
6	Excavation and In-Place Containment Cell	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material contained with an on-site landfill meeting relevant regulations. Material pulled back from stream bank and placed in the containment cell, and stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors.
7	Excavation and Off-Site Disposal	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Permanent removal of calcium sulfate eliminates direct contact and ecological receptor pathways.

Table 7-1
Preliminary Screening of Alternatives (continued)

Alternative No.	Alternative	Retained	Eliminated	Basis
8	In-Situ Solidification/Stabilization, Stream Bank Stabilization, and New Cover	X		Groundwater meets standards at sentinel wells; no discharge of contaminated groundwater Calcium sulfate material solidified with admixture to provide stable material below cover. Conventional S/S technology may make mercury more soluble and mobile, and innovative technology not commercially available. S/S technology not proven on calcium sulfate material. However, S/S may be beneficial to improve physical properties of the calcium sulfate material. Solidified calcium sulfate covered by new pavement or vegetated cap; incomplete direct contact pathway Stream bank stabilized; no sediment transport and incomplete exposure pathway of calcium sulfate material to ecological receptors.

Table 8-1
Cost Estimate
Alternative No. 2, Limited Action

Capital	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 25,000	$ 25,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, one month)	1	LS	$ 20,000	$ 20,000
Demobilization	1	LS	$ 15,000	$ 15,000
Subtotal				**$ 145,000**
Installation of Pavement - Former Administration Building and Adjacent Soil Area				
Building Demolition (not included in cost, assumed to be implemented site wide)				
6" Crushed Stone Leveling/Grading Course	2,000	SY	$ 5.00	$ 10,000
Asphalt Impregnated Geotextile	2,000	SY	$ 5.00	$ 10,000
3" Asphalt Wearing Course - Hauling, assume within 10 miles	200	CY	$ 5.00	$ 1,000
3" Asphaltic Paving Wearing Course, Material, Place, Compact	200	SY	$ 15.00	$ 3,000
Subtotal				**$ 24,000**
Pull Back with Stream Bank Stabilization				
Miscellaneous Calcium Sulfate Material Management for Stream Bank Grading	500	CY	$ 10.00	$ 5,000
Dispose of Calcium Sulfate Material Off-site (non-hazardous)	750	Tons	$ 100	$ 75,000
Rough Grade - Prepare Proper Slopes	1,500	CY	$ 1.00	$ 1,500
Install Clean Fill to Provide Proper Grading	1,500	CY	$ 7.00	$ 10,500
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	2,700	Tons	$ 13.00	$ 35,100
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 142,600**
Subtotal Capital				**$ 311,600**
Contingencies	25	%		$ 78,000
Engineering and Administration	10	%		$ 31,000
Total Capital				**$ 421,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Pavement Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				$ 15,000
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				$ 19,000
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 713,000**

Table 8-2a
Cost Estimate
Alternative No. 3a, Containment with Stream Bank Stabilization and New Pavement Cover

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Crush Pavement for Reuse	11,000	SY	$ 5.00	$ 55,000
Stockpile Asphalt for Base Course Reuse	2,500	CY	$ 5.00	$ 12,500
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 3 months)	1	LS	$ 60,000	$ 60,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 582,500**
Installation of Pavement Cover				
Place Stockpiled Asphalt for Initial Base Course or Mix with Stone Leveling Course	2,500	CY	$ 3.00	$ 7,500
3" Crushed Stone Leveling/Grading Course	15,000	SY	$ 5.00	$ 75,000
Asphalt Impregnated Geotextile	15,000	SY	$ 5.00	$ 75,000
3" Asphalt Wearing Course - Hauling, assume within 10 miles	1,500	CY	$ 5.00	$ 7,500
3" Asphaltic Paving Wearing Course, Material, Place, Compact	15,000	SY	$ 15.00	$ 225,000
Subtotal				**$ 390,000**
Pull Back with Stream Bank Stabilization				
Pull Back of Calcium Sulfate Adjacent to Stream Bank	1,500	CY	$ 10.00	$ 15,000
Place Calcium Sulfate Under New Pavement	1,500	CY	$ 10.00	$ 15,000
Rough Grade - Prepare Proper Slopes	1,500	CY	$ 1.00	$ 1,500
Install Clean Fill to Provide Proper Grading	1,500	CY	$ 7.00	$ 10,500
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	2,700	Tons	$ 13.00	$ 35,100
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 92,600**
Subtotal Capital				**$ 1,065,100**
Contingencies	25	%		$ 266,000
Engineering and Administration	10	%		$ 107,000
Total Capital				**$ 1,438,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Pavement Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 1,730,000**

Table 8-2b
Cost Estimate
Alternative No. 3b, Containment with Stream Bank Stabilization and Geocomposite Cap

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Recycle Asphalt - 6 inch asphalt	3,500	Tons	$ 30.00	$ 105,000
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 3 months)	1	LS	$ 60,000	$ 60,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 620,000**
Installation of Geocomposite Cap				
Geotextile	135,000	SF	$ 0.40	$ 54,000
Geomembrane	135,000	SF	$ 1.00	$ 135,000
Gecomposite Drainage Net	135,000	SF	$ 0.90	$ 121,500
Drainage Piping	1,500	LF	$ 25.00	$ 37,500
12" Base - Clean Fill - installation	5,000	CY	$ 7.00	$ 35,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	9,000	Tons	$ 13.00	$ 117,000
Stormwater Swales Directed to WB Ramapo River	1,500	LF	$ 15.00	$ 22,500
6" Topsoil - installation	2,500	CY	$ 6.00	$ 15,000
Topsoil (10% mark-up on cost) - material	2,500	CY	$ 25.00	$ 62,500
1' of Riprap Around Cell, Drainage Control	1,000	Tons	$ 50.00	$ 50,000
Hydroseed Vegetative Cover	135,000	SF	$ 0.10	$ 13,500
Subtotal				**$ 663,500**
Pull Back with Stream Bank Stabilization				
Pull Back of Calcium Sulfate Material Adjacent to Stream Bank	1,500	CY	$ 10.00	$ 15,000
Place Calcium Sulfate Material Under New Geocomposite Cap	1,500	CY	$ 10.00	$ 15,000
Rough Grade - Prepare Proper Slopes	1,500	CY	$ 1.00	$ 1,500
Install Clean Fill to Provide Proper Grading	1,500	CY	$ 7.00	$ 10,500
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	2,700	Tons	$ 13.00	$ 35,100
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 92,600**
Subtotal Capital				**$ 1,376,100**
Contingencies	25	%		$ 344,000
Engineering and Administration	10	%		$ 138,000
Total Capital				**$ 1,858,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Vegetated Cover Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 2,150,000**

Table 8-3a
Cost Estimate
Alternative No. 4a, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Pavement Cover

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Crush Pavement for Reuse	11,000	SY	$ 5.00	$ 55,000
Stockpile Asphalt for Base Course Reuse	2,500	CY	$ 5.00	$ 12,500
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 5 months)	1	LS	$ 100,000	$ 100,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 622,500**
Installation of Pavement Cover				
Place Stockpiled Asphalt for Initial Base Course or Mix with Stone Leveling Course	2,500	CY	$ 3.00	$ 7,500
3" Crushed Stone Leveling/Grading Course	15,000	SY	$ 5.00	$ 75,000
Asphalt Impregnated Geotextile	15,000	SY	$ 5.00	$ 75,000
3" Asphalt Wearing Course - Hauling, assume within 10 miles	1,500	CY	$ 5.00	$ 7,500
3" Asphaltic Paving Wearing Course, Material, Place, Compact	15,000	SY	$ 15.00	$ 225,000
Subtotal				**$ 390,000**
Pull Back with Sheet Pile				
Pull Back of Calcium Sulfate Material Adjacent to Stream Bank to Sheet Pile	1,500	CY	$ 10.00	$ 15,000
Place Calcium Sulfate Material Under New Pavement	1,500	CY	$ 10.00	$ 15,000
Rough Grade - Prepare Proper Slopes	12,000	SF	$ 1.00	$ 12,000
Install Clean Fill to Provide Proper Grading	2,000	CY	$ 7.00	$ 14,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	3,600	Tons	$ 13.00	$ 46,800
Sheet Pile Structural Divider, 30' Length, 550' Stream Frontage	16,500	SF	$ 45.00	$ 742,500
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 860,800**
Subtotal Capital				**$ 1,873,300**
Contingencies	25	%		$ 468,000
Engineering and Administration	10	%		$ 187,000
Total Capital				**$ 2,528,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Pavement Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 2,820,000**

Table 8-3b
Cost Estimate
Alternative No. 4b, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and Geocomposite Cap

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Recycle Asphalt - 6 inch asphalt	3,500	Tons	$ 30.00	$ 105,000
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 5 months)	1	LS	$ 100,000	$ 100,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 660,000**
Installation of Geocomposite Cap				
Geotextile	135,000	SF	$ 0.40	$ 54,000
Geomembrane	135,000	SF	$ 1.00	$ 135,000
Gecomposite Drainage Net	135,000	SF	$ 0.90	$ 121,500
Drainage Piping	1,500	LF	$ 25.00	$ 37,500
12" Base - Clean Fill - installation	5,000	CY	$ 7.00	$ 35,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	9,000	Tons	$ 13.00	$ 117,000
Stormwater Swales Directed to WB Ramapo River	1,500	LF	$ 15.00	$ 22,500
6" Topsoil - installation	2,500	CY	$ 6.00	$ 15,000
Topsoil (10% mark-up on cost) - material	2,500	CY	$ 25.00	$ 62,500
1' of Riprap Around Cell, Drainage Control	1,000	Tons	$ 50.00	$ 50,000
Hydroseed Vegetative Cover	135,000	SF	$ 0.10	$ 13,500
Subtotal				**$ 663,500**
Pull Back with Sheet Pile				
Pull Back of Calcium Sulfate Material Adjacent to Stream Bank to Sheet Pile	1,500	CY	$ 10.00	$ 15,000
Place Calcium Sulfate Material Under New Geocomposite Cap	1,500	CY	$ 10.00	$ 15,000
Rough Grade - Prepare Proper Slopes	12,000	SF	$ 1.00	$ 12,000
Install Clean Fill to Provide Proper Grading	2,000	CY	$ 7.00	$ 14,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	3,600	Tons	$ 13.00	$ 46,800
Sheet Pile Structural Divider, 30' Length, 550' Stream Frontage	16,500	SF	$ 45.00	$ 742,500
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 860,800**
Subtotal Capital				**$ 2,184,300**
Contingencies	25	%		$ 546,000
Engineering and Administration	10	%		$ 218,000
Total Capital				**$ 2,948,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Vegetated Cover Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 3,240,000**

Table 8-4
Cost Estimate
Alternative No. 5, Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Geocomposite Cap

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Recycle Asphalt - 6 inch asphalt	3,500	Tons	$ 30.00	$ 105,000
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 6 months)	1	LS	$ 120,000	$ 120,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				$ 680,000
Sheet Pile Barrier Wall and Interior Groundwater Collection System				
Install Circumferential Sheet Pile Barrier Wall, (~1,500 LF, 12' Deep)	18,000	SF	$ 45.00	$ 810,000
Trench for Installation of Groundwater Collection System (5' avg. depth)	1,000	CY	$ 15.00	$ 15,000
Groundwater Collection System Pipe, Vaults, etc.	1	LS	$ 100,000	$ 100,000
Place Calcium Sulfate from Trench Excavation Beneath New Cap	1,000	CY	$ 10.00	$ 10,000
Backfill Trench and Grade	1,000	CY	$ 20.00	$ 20,000
Groundwater/Stormwater Treatment During Construction (50 gpm skid - $20k per month, 4 months)	1	LS	$ 80,000	$ 80,000
Subtotal				$ 1,035,000
Installation of Geocomposite Cap				
Geotextile	135,000	SF	$ 0.40	$ 54,000
Geomembrane	135,000	SF	$ 1.00	$ 135,000
Gecomposite Drainage Net	135,000	SF	$ 0.90	$ 121,500
Drainage Piping	1,500	LF	$ 25.00	$ 37,500
12" Base - Clean Fill - installation	5,000	CY	$ 7.00	$ 35,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	9,000	Tons	$ 13.00	$ 117,000
Stormwater Swales Directed to WB Ramapo River	1,500	LF	$ 15.00	$ 22,500
6" Topsoil - installation	2,500	CY	$ 6.00	$ 15,000
Topsoil (10% mark-up on cost) - material	2,500	CY	$ 25.00	$ 62,500
1' of Riprap Around Cell, Drainage Control	1,000	Tons	$ 50.00	$ 50,000
Hydroseed Vegetative Cover	135,000	SF	$ 0.10	$ 13,500
Subtotal				$ 663,500
Pull Back with Sheet Pile				
Pull Back of Calcium Sulfate Material Adjacent to Stream Bank to Sheet Plle	1,500	CY	$ 10.00	$ 15,000
Place Calcium Sulfate Material Under New Cap	1,500	CY	$ 10.00	$ 15,000
Rough Grade - Prepare Proper Slopes	12,000	SF	$ 1.00	$ 12,000
Install Clean Fill to Provide Proper Grading	2,000	CY	$ 7.00	$ 14,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	3,600	Tons	$ 13.00	$ 46,800
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				$ 118,300
Subtotal Capital				$ 2,496,800
Contingencies	25	%		$ 624,000
Engineering and Administration	10	%		$ 250,000
Total Capital				$ 3,371,000
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Vegetated Cover Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				$ 15,000
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				$ 19,000
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				$ 3,663,000

Table 8-5
Cost Estimate
Alternative No. 6, Excavation and In-Place Containment Cell

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 1.00	$ 100,000
Recycle Asphalt - 6 inch asphalt	3,500	Tons	$ 30.00	$ 105,000
Install Groundwater Monitoring System	1	LS	$ 20,000	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 6 months)	1	LS	$ 100,000	$ 100,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 660,000**
Construct Containment Cell				
Remove and Stage Calcium Sulfate Material - Both Halves Parking Lot and Stream Bank	27,000	CY	$ 10.00	$ 270,000
Import Soil/Sand for Cell Divider, Berms, Recontouring Base and Slopes - Material and Labor	15,000	CY	$ 30.00	$ 450,000
Install Geosythetic Bottom Liner	105,000	SF	$ 1.20	$ 126,000
Install Geosythetic Drainage Layer for Leachate Collection	105,000	SF	$ 0.90	$ 94,500
Install Geotextile Cushion Layer	105,000	SF	$ 0.40	$ 42,000
Install Leachate Collection System (Include vaults, interconnection piping, etc.)	1	LS	$ 100,000	$ 100,000
Place Calcium Sulfate in Cell in Lifts for Compaction	27,000	CY	$ 15.00	$ 405,000
Groundwater / Stormwater Treatment During Construction (50 gpm skid - $20k per month, 5 months)	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 1,587,500**
Installation of Vegetative Layer Cap				
Geotextile	105,000	SF	$ 0.40	$ 42,000
Geomembrane	105,000	SF	$ 1.00	$ 105,000
Gecomposite Drainage Net	105,000	SF	$ 0.90	$ 94,500
Drainage Piping	1,500	LF	$ 25.00	$ 37,500
12" Base - Clean Fill - installation	4,000	CY	$ 7.00	$ 28,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	7,200	Tons	$ 13.00	$ 93,600
Stormwater Swales Directed to WB Ramapo River	1,500	LF	$ 15.00	$ 22,500
6" Topsoil - installation	2,000	CY	$ 6.00	$ 12,000
Topsoil (10% mark-up on cost) - material	2,000	CY	$ 25.00	$ 50,000
1' of Riprap Around Cell, Drainage Control	1,000	Tons	$ 50.00	$ 50,000
Hydroseed Vegetative Cover	115,000	SF	$ 0.10	$ 11,500
Subtotal				**$ 546,600**
Installation of Stream Bank Stabilization				
Rough Grade - Prepare Proper Slopes	12,000	SF	$ 1.00	$ 12,000
Install Clean Fill to Provide Proper Grading	2,000	CY	$ 7.00	$ 14,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	3,600	Tons	$ 13.00	$ 46,800
Turf Reinforcement Mat	1,500	SY	$ 6.00	$ 9,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 85,300**
Subtotal Capital				**$ 2,879,400**
Contingencies	25	%		$ 720,000
Engineering and Administration	10	%		$ 288,000
Total Capital				**$ 3,887,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Stream Bank and Vegetated Cover Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitoring (not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M				**$ 4,179,000**

Table 8-6
Cost Estimate
Alternative No. 7, Excavation and Off-site Disposal

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 100,000	$ 100,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LF	$ 20,000	$ 20,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt	100,000	SF	$ 0.60	$ 60,000
Recycle Asphalt -- 6 inch asphalt	3,500	Tons	$ 30.00	$ 105,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 3 months)	1	LS	$ 60,000	$ 60,000
Demobilization	1	LS	$ 50,000	$ 50,000
Subtotal				**$ 450,000**
Remove Calcium Sulfate and Associated Soils for Off-site Disposal				
Excavate and Load Calcium Sulfate Material	27,000	CY	$ 15.00	$ 405,000
Groundwater / Stormwater Treatment During Construction (50 gpm skid - $20k per month, 4 months)	1	LS	$ 80,000	$ 80,000
Subtotal				**$ 485,000**
Transportation and Off-site Disposal				
Transportation and Disposal at State-of-the-Art, Subtitle D Landfill	40,500	Tons	$ 100.00	$ 4,050,000
Backfill of Parking Lot, Restore Site, and Install Stream Bank Stabilization				
Backfill Excavation - installation	26,400	CY	$ 7.00	$ 184,800
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	47,520	Tons	$ 13.00	$ 617,760
6" Topsoil - installation	2,000	CY	$ 6.00	$ 12,000
Topsoil (10% mark-up on cost) - material	2,000	CY	$ 25.00	$ 50,000
Hydroseed Vegetative Cover	150,000	SF	$ 0.07	$ 10,500
Rough Grade - Prepare Proper Slopes	8,000	CY	$ 1.00	$ 8,000
Install Clean Fill to Provide Proper Grading	6,000	CY	$ 7.00	$ 42,000
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	9,000	Tons	$ 13.00	$ 117,000
Turf Reinforcement Mat at Stream Bank	2,000	SY	$ 5.00	$ 10,000
Subtotal				**$ 1,052,060**
Subtotal Capital				$ 6,037,060
Contingencies	25	%		$ 1,509,000
Engineering and Administration	10	%		$ 604,000
Total Capital				**$ 8,150,000**

Table 8-7a

Cost Estimate

Alternative No. 8a, In-Situ Solidification/ Stabilization, Stream Bank Stabilization and New Pavement Cover

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 25,000	$ 25,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt (see separate cost for building demolition)	100,000	SF	$ 1.00	$ 100,000
Crush Pavement for Reuse	11,000	SY	$ 5.00	$ 55,000
Stockpile Asphalt for Base Course Reuse	2,500	CY	$ 5.00	$ 12,500
Install Groundwater Monitoring System	1	LS	$ 20,000.00	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 5 months)	1	LS	$ 100,000	$ 100,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 627,500**
In-Situ Stabilization				
Pull back of Calcium Sulfate Adjacent to Stream Bank	1,500	CY	$ 10.00	$ 15,000
In-Situ Stabilization (assume standard pozzolanic materials)				
Low-end estimate (ease of mixing, low admixture ratio)	25,000	CY	$ 50.00	$ 1,250,000
High-end estimate (TCLP issues, high admixture ratio, possible additional reagents)	25,000	CY	$ 150.00	$ 3,750,000
Subtotal - Low				**$ 1,265,000**
Subtotal - High				**$ 3,765,000**
Installation of Pavement Cover				
Place Stockpiled Asphalt for Initial Base Course or Mix with Stone Leveling Course	2,500	CY	$ 3.00	$ 7,500
3" Crushed Stone Leveling/Grading Course	15,000	SY	$ 5.00	$ 75,000
Asphalt Impregnated Geotextile	15,000	SY	$ 5.00	$ 75,000
3" Asphalt Wearing Course - Hauling, assume within 10 miles	1,500	CY	$ 5.00	$ 7,500
3" Asphaltic Paving Wearing Course, Material, Place, Compact	15,000	SY	$ 15.00	$ 225,000
Subtotal				**$ 390,000**
Installation of Stream Bank Stabilization				
Rough Grade - Prepare Proper Slopes	1,500	CY	$ 1.00	$ 1,500
Install Clean Fill to Provide Proper Grading	1,500	CY	$ 7.00	$ 10,500
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	2,700	Tons	$ 13.00	$ 35,100
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 62,600**
Subtotal Capital - Low				**$ 2,345,100**
Contingencies	25	%		$ 586,275
Engineering and Administration	10	%		$ 234,510
Total Capital - Low				**$ 3,166,000**
Subtotal Capital - High				**$ 4,845,100**
Contingencies	25	%		$ 1,211,000
Engineering and Administration	10	%		$ 485,000
Total Capital - High				**$ 6,541,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Steam Bank and Pavement Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitory (Not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				**$ 15,000**
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				**$ 19,000**
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M - Low				**$ 3,458,000**
Total Net Present Worth, Capital and O&M - High				**$ 6,833,000**

Table 8-7b
Cost Estimate
Alternative No. 8b, In-Situ Solidification/ Stabilization, Stream Bank Stabilization and Geocomposite Cap

Description	Quantity	Units	Unit Cost	Total Cost
Mobilization, Demobilization - Parking Lot and Stream Bank				
Mobilization	1	LS	$ 150,000	$ 150,000
Permits (Joint Application Stream Disturbance, SWPPP)	1	LS	$ 35,000	$ 35,000
Environmental Easement	1	LS	$ 10,000	$ 10,000
Install Erosion Controls (Silt Fence and Stream Fence @ Perimeter)	2,000	LF	$ 5.00	$ 10,000
Install Stormwater Controls to Prevent Runon	1	LS	$ 25,000	$ 25,000
Clearing and Grubbing Stream Bank	10,000	SF	$ 1.00	$ 10,000
Remove Asphalt (see separate cost for building demolition)	100,000	SF	$ 1.00	$ 100,000
Crush Pavement for Reuse	11,000	SY	$ 5.00	$ 55,000
Stockpile Asphalt for Base Course Reuse	2,500	CY	$ 5.00	$ 12,500
Install Groundwater Monitoring System	1	LS	$ 20,000.00	$ 20,000
Community Air Monitoring Plan - NYSDEC Requirements ($20k per month, 5 months)	1	LS	$ 100,000	$ 100,000
Demobilization	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 627,500**
In-Situ Stabilization				
Pull back of Calcium Sulfate Adjacent to Stream Bank	1,500	CY	$ 10.00	$ 15,000
In-Situ Stabilization (assume standard pozzolanic materials)				
Low-end estimate (ease of mixing, low admixture ratio)	25,000	CY	$ 50.00	$ 1,250,000
High-end estimate (TCLP issues, high admixture ratio, possible additional reagents)	25,000	CY	$ 150.00	$ 3,750,000
Subtotal - Low				**$ 1,265,000**
Subtotal - High				**$ 3,765,000**
Installation of Geocomposite Cap				
Geotextile	135,000	SF	$ 0.40	$ 54,000
Geomembrane	135,000	SF	$ 1.00	$ 135,000
Geocomposite Drainage Net	135,000	SF	$ 0.90	$ 121,500
Drainage Piping	1,500	LF	$ 25.00	$ 37,500
12" Base - Clean Fill - installation	5,000	CY	$ 7.00	$ 35,000
Clean Fill (1.8 tons/ cy and 10% mark-up on cost) - material	9,000	Tons	$ 13.00	$ 117,000
Stormwater Swales Directed to WB Ramapo River	1,500	LF	$ 15.00	$ 22,500
6" Topsoil - installation	2,500	CY	$ 6.00	$ 15,000
Topsoil (10% mark-up on cost) - material	2,500	CY	$ 25.00	$ 62,500
1' of Riprap Around Cell, Drainage Control	1,000	Tons	$ 50.00	$ 50,000
Hydroseed Vegetative Cover	135,000	SF	$ 0.10	$ 13,500
Subtotal				**$ 663,500**
Installation of Stream Bank Stabilization				
Rough Grade - Prepare Proper Slopes	1,500	CY	$ 1.00	$ 1,500
Install Clean Fill to Provide Proper Grading	1,500	CY	$ 7.00	$ 10,500
Clean Fill (1.8 tons/cy and 10% mark-up on cost) - material	2,700	Tons	$ 13.00	$ 35,100
Turf Reinforcement Mat	2,000	SY	$ 6.00	$ 12,000
Hydroseed Disturbed Area	35,000	SF	$ 0.10	$ 3,500
Subtotal				**$ 62,600**
Subtotal Capital - Low				**$ 2,618,600**
Contingencies	25	%		$ 654,650
Engineering and Administration	10	%		$ 261,860
Total Capital - Low				**$ 3,535,000**
Subtotal Capital - High				**$ 5,118,600**
Contingencies	25	%		$ 1,280,000
Engineering and Administration	10	%		$ 512,000
Total Capital - High				**$ 6,911,000**
Annual Operation and Maintenance				
	Quantity	Units	Unit Cost	Total Cost
Steam Bank and Pavement Maintenance	1	LS	$ 10,000	$ 10,000
Routine Inspections (Quarterly)	1	LS	$ 2,500	$ 2,500
Groundwater Monitory (Not included in cost, under current ROD, site-wide)				
Routine Reporting	1	LS	$ 2,500	$ 2,500
Subtotal Annual O&M				$ 15,000
Contingencies	25	%		$ 4,000
Subtotal Annual O&M				$ 19,000
Net Present Worth Annual O&M, 5%, 30 Years				$ 292,000
Total Net Present Worth, Capital and O&M - Low				$ 3,827,000
Total Net Present Worth, Capital and O&M - High				$ 7,203,000

Table 8-8
Summary of Cost Estimates
Parking Lot Area Remediation Alternatives

Alternative	Capital	O&M (NPW)	Total NPW
Alternative No. 1, No Action	$ -	$ -	$ -
Alternative No. 2, Limited Action	$ 421,000	$ 292,000	$ 713,000
Alternative No. 3a, Containment with Stream Bank Stabilization and New Pavement Cover	$ 1,438,000	$ 292,000	$ 1,730,000
Alternative No. 3b, Containment with Stream Bank Stabilization and Geocomposite Cap	$ 1,858,000	$ 292,000	$ 2,150,000
Alternative No. 4a, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Pavement Cover	$ 2,528,000	$ 292,000	$ 2,820,000
Alternative No. 4b, Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and Geocomposite Cap	$ 2,948,000	$ 292,000	$ 3,240,000
Alternative No. 5, Containment with Stream Bank Stabillzation, Circumferential Barrier Wall, and Geocomposite Cap	$ 3,371,000	$ 292,000	$ 3,663,000
Alternative No. 6, Excavation and In-Place Containment Cell	$ 3,887,000	$ 292,000	$ 4,179,000
Alternative No. 7, Excavation and Off-site Disposal	$ 8,150,000	$ -	$ 8,150,000
Alternative No. 8a, In-Situ Solidification/ Stabilization, Stream Bank Stabilization and New Pavement Cover	$ 3,166,000 - 6,541,000	$ 292,000	$ 3,458,000 - 6,833,000
Alternative No. 8b, In-Situ Solidification/ Stabilization, Stream Bank Stabilization and New Geocomposite Cap	$ 3,535,000 - 6,911,000	$ 292,000	$ 3,827,000 - 7,203,000

Table 8-9.
Summary of Analysis of Alternatives
Threshold Criteria

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b S/S Treatment, Containment with Stream Bank Stabilization and New Cap/Cover
Protectiveness of Public Health and the Environment	Protective under current conditions with maintenance. No action would end maintenance and then long-term protectiveness could be compromised. Would not meet RAOs without maintenance.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment-exposure pathways would be incomplete.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment exposure pathways would be incomplete.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment exposure pathways would be incomplete.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment exposure pathways would be incomplete.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment exposure pathways would be incomplete.	Protective based on excavation and off-site disposal of material above relevant cleanup levels.	Protective with a maintenance program because direct contact, groundwater, surface water, sediment exposure pathways would be incomplete.
Compliance w/ SCGs	Groundwater and surface water quality comply with Part 703 Currently complies with SCGs for calcium sulfate material based on pavement and stream bank IRM cover.	Groundwater and surface water quality comply with Part 703. Cover and stream bank stabilization address calcium sulfate material above Part 375 cleanup levels. Implementation of stream bank stabilization would comport with Part 608.	Groundwater and surface water quality comply with Part 703. Cover and stream bank stabilization address calcium sulfate material above Part 375 cleanup levels. Implementation of stream bank stabilization would comport with Part 608.	Groundwater and surface water quality comply with Part 703. Cover, stream bank stabilization, and barrier wall address calcium sulfate material above Part 375 cleanup levels. Implementation of stream bank stabilization would comport with Part 608.	Groundwater and surface water quality comply with Part 703. Cover, stream bank stabilization, and barrier wall address calcium sulfate material above Part 375 cleanup levels. Implementation of stream bank stabilization would comport with Part 608.	Groundwater and surface water quality comply with Part 703. Containment cell addresses calcium sulfate material above Part 375 cleanup levels. Containment cell would comply with relevant portions of Part 360 regulations. Implementation of stream bank restoration would comport with Part 608.	Groundwater and surface water quality comply with Part 703. Removal and off-site disposal addresses calcium sulfate material above Part 375 cleanup levels. Disposal would be in a state-of-the-art permitted Subtitle D facility. Transportation would comply with Part 364 hauler requirements.	Groundwater and surface water quality comply with Part 703. S/S treatment, cover and stream bank stabilization address calcium sulfate material above Part 375 cleanup levels. Implementation of stream bank stabilization would comport with Part 608.

Table 8-10
Summary of Analysis of Alternatives
Balancing Criteria

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b S/S Treatment, Containment with Stream Bank Stabilization, and New Cap/Cover
Long-Term Effectiveness & Permanence	Would be effective long term only with maintenance. Residual contamination would remain, so not considered permanent.	Effective long term with maintenance. Residual contamination would remain, so not considered permanent.	Effective long term with maintenance. Residual contamination would remain, so not considered permanent.	Effective long term with maintenance. No maintenance on barrier wall. Residual contamination would remain, so not considered permanent.	Effective long term with maintenance. Residual contamination would remain, so not considered permanent.	Effective long term with maintenance. Geosynthetics life spans typically hundreds of years. Residual contamination would remain, so not considered permanent.	Removal and off-site disposal is permanent.	Effective long term with maintenance. Contamination would remain; S/S designed to reduce mobility but does not remove contaminants, so not considered permanent.
Reduction of Toxicity, Mobility, or Volume	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	Stream bank stabilization controls mercury transport in sediment, consistent with 1997 ROD. No reduction of toxicity, mobility, or volume through treatment.	No reduction of toxicity, mobility, or volume through treatment.	S/S designed to increase strength properties of and reduce mobility of mercury in calcium sulfate material. S/S additives have the potential to increase mobility.
Short-Term Impact & Effectiveness	No action – no short term impacts.	Approx. 2 months for implementation. No significant impacts – conventional construction controls.	Approx. 3-5 months for implementation. 1,500 truck trips – inherent potential for safety issues (accidents). No significant impacts – conventional construction controls.	Approx. 4-6 months for implementation. 1,500 truck trips – inherent potential for safety issues (accidents). No significant impacts – conventional construction controls.	Approx. 6-8 months for implementation. 1,500 truck trips – inherent potential for safety issues (accidents). No significant impacts - conventional construction controls.	Approx. 6-8 months for implementation. 3,600 truck trips – inherent potential for safety issues (accidents). Handling 22,000 CY of mercury contaminated calcium sulfate increases potential for air borne contamination.	Approx. 4-6 months for implementation. 9,300 truck trips – inherent potential for safety issues (accidents). 3,000 truck trips with mercury contaminated material. No significant impacts – conventional construction controls. Handling 22,000 CY of mercury contaminated calcium sulfate increases potential for air borne contamination.	Approx. 6-8 months for implementation. Mixing 22,000 CY of mercury contaminated calcium sulfate increases potential for air borne mercury contamination. Depending on cap option could involve 1,500 truck trips with inherent potential for safety issues (accidents). For this alternative, however, pavement cap preferred which would reduce traffic.

Table 8-10
Summary of Analysis of Alternatives (continued)
Balancing Criteria

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b S/S Treatment, Containment with Stream Bank Stabilization, and New Cap/Cover
Implement-ability	No action, readily implementable.	Readily implemented with conventional materials, equipment, technology, and processes.	Readily implemented with conventional materials, equipment, technology, and processes.	Readily implemented with conventional materials, equipment, technology, and processes.	Readily implemented with conventional materials, equipment, technology, and processes.	Readily implemented with conventional materials, equipment, technology, and processes. Excavation of mercury contaminated material requires greater care than handling uncontaminated materials only. No agreement currently in place with property owner regarding cell location.	Readily implemented with conventional materials, equipment, technology, and processes. Excavation of mercury contaminated material requires greater care than handling uncontaminated materials only.	Readily implemented with conventional materials, equipment, technology, and processes. However, S/S additives/processes that show greatest ability to reduce mercury mobility are not yet commercially available.
Cost Effectiveness	No cost, but long-term may not meet RAOs without maintenance.	Total NPW of $713,000	3a-Total NPW $1,730,000 3b-Total NPW $2,150,000	4a-Total NPW $2,820,000 4b-Total NPW $3,240,000	Total NPW $3,736,000	Total NPW $4,462,000	Total NPW $8,332,000	8a - Total NPW $3,458,000 - $6,833,000 8b - Total NPW $3,827,000 - $7,203,000
Land Use	Consistent with surrounding land use as either a parking lot (surrounding commercial & industrial property) or open land (surrounding undeveloped property).	Consistent with surrounding land use as either a parking lot (surrounding commercial & industrial property) or open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.	Consistent with surrounding land use as either a parking lot (surrounding commercial & industrial property) or open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.	Consistent with surrounding land use as either a parking lot (surrounding commercial & industrial property) or open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.	Vegetated cap consistent with surrounding land use as open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.	Vegetated cap consistent with surrounding land use as open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.	After removal Site could accommodate any permitted, applicable land use.	Consistent with surrounding land use as either a parking lot (surrounding commercial & industrial property) or open land (surrounding undeveloped property). Vegetated, stabilized stream bank would be consistent with WB Ramapo River. Environmental easement would control future land use.

Table 9-1
Detailed Analysis Summary and Comparative Analysis of Alternatives

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives. 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b In-Situ S/S, Containment with Stream Bank Stabilization, and New Cap/Cover
Protectiveness of Public Health and the Environment	Not protective without maintenance	Protective of public health and the environment	Protective of public health and the environment	Protective of public health and the environment	Protective of public health and the environment	Protective of public health and the environment	Protective of public health and the environment	Protective of public health and the environment
Compliance w/ SCGs	May not comply with SCGs w/o maintenance	Complies with SCGs	Complies with SCGs	Complies with SCGs	Complies with SCGs	Complies with SCGs	Complies with SCGs	Complies with SCGs
Long-Term Effectiveness & Permanence	Not effective long term without maintenance. Not considered permanent	Effective in long-term with proper maintenance. Not considered permanent.	Effective in long-term with proper maintenance. Not considered permanent.	Effective in long-term with proper maintenance. Not considered permanent.	Effective in long-term with proper maintenance. Not considered permanent.	Effective in long-term with proper maintenance. Not considered permanent.	Effective in long-term. Removal and off-site disposal is permanent.	Effective in long-term with proper maintenance. Not considered permanent.
Reduction of Toxicity, Mobility, or Volume	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume through treatment	Does not reduce toxicity or volume. May reduce or increase mobility

Table 9-1
Detailed Analysis Summary and Comparative Analysis of Alternatives (continued)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives. 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b In-Situ S/S, Containment with Stream Bank Stabilization, and New Cap/Cover
Short-Term Impact & Effectiveness	No short term impacts, no implementation items.	No significant impacts – conventional construction controls. Implementation time approx. 2 months.	No significant impacts – conventional construction controls. 1,500 truck trips, increased potential for accidents. Implementation time approx. 3-5 months.	No significant impacts – conventional construction controls. 1,500 truck trips, increased potential for accidents. Implementation time approx. 4-6 months.	No significant impacts – conventional construction controls. 1,500 truck trips, increased potential for accidents. Implementation time approx. 6-8 months.	3,600 truck trips, increased potential for accidents. Handling 22,000 CY of mercury contaminated material, potential for air borne contamination. Implementation time approx. 6-8 months.	8,700 truck trips, increased potential for accidents. 3,000 truck trips with contaminated material. Handling 22,000 CY of mercury contaminated material, potential for air borne contamination. Implementation time approx. 4-6 months.	Up to 1,500 truck trips, increased potential for accidents. Mixing 22,000 CY of mercury contaminated material, potential for air borne mercury vapor contamination. Implementation time approx. 6-8 months.

Table 9-1
Detailed Analysis Summary and Comparative Analysis of Alternatives (continued)

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Limited Action	Alternatives. 3a and 3b Containment with Stream Bank Stabilization and New Cap/Cover	Alternatives 4a and 4b Containment with Stream Bank Stabilization, Flood Plain Barrier Wall, and New Cap/Cover	Alternative 5 Containment with Stream Bank Stabilization, Circumferential Barrier Wall, and Cap	Alternative 6 Excavation and In-Place Containment Cell	Alternative 7 Excavation and Off-Site Disposal	Alternatives 8a and 8b In-Situ S/S, Containment with Stream Bank Stabilization, and New Cap/Cover
Implement-ability	Readily implemented.	Readily Implemented with conventional materials, equipment, technology, and processes.	Readily Implemented with conventional materials, equipment, technology, and processes.	Readily Implemented with conventional materials, equipment, technology, and processes.	Readily Implemented with conventional materials, equipment, technology, and processes.	Readily Implemented with conventional materials, equipment, technology, and processes. Mercury contaminated material excavation requires greater care.	Readily Implemented with conventional materials, equipment, technology, and processes. Mercury contaminated material excavation requires greater care.	Implemented with conventional materials, equipment, technology, and processes. However, S/S with materials most likely to reduce mercury mobility, not yet commercially available
Cost Effectiveness (NPW, 30 years, 5% discount rate)	None	$713,000	3a - $1,730,000 3b - $2,150,000	4a - $2,820,000 4b - $3,240,000	$3,663,000	$4,179,000	$8,150,000	8a - $3,458,000 to $6,833,000 8b - $3,827,000 to $7,203,000
Land Use	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.	Consistent with current and future land use.

TABLE C2-C
ANALYTICAL RESULTS FOR
METALS IN LAGOON SOILDS
FORMER NEPERA PLANT SITE, HARRIMAN, NY

Sample Location	C-SD-0-1	C-SD-1-2	C-SD-2-3
Samle Interval (ft)	0-1	1-2	2-3
SampleDate	11/13/06	11/13/06	11/13/06
Constituent			
Aluminum	21000 J	30100 J	50100 J
Antimony	9.39 UJ	10.1 UJ	6.1 UJ
Arsenic	11.5	11.8	6.1 UJ
Barium	165 J	157 J	71.3
Beryllium	4.7 UJ	5.05 UJ	3.05 UJ
Cadmium	2.35 U	2.53 UJ	1.52 UJ
Calcium	11400 J	25200 J	23200 J
Chromium	44.9	42.1 J	16.6
Cobalt	18.8 UJ	25.2 J	12.2 UJ
Copper	201 J	174 J	47.1 J
Iron	35900 J	35600 J	10300 J
Lead	82.2 J	85.6	34
Magnesium	15700 J	39100 J	75600 J
Manganese	776 J	887 J	784 J
Mercury	10.7 J	9.98	2.61 J
Nickel	64 J	169 J	56.9 J
Potassium	2810 J	2840 J	1450 J
Selenium	18.8 U	20.2 U	12.2 U
Silver	4.7 U	5.05 U	3.05 U
Sodium	4380 J	10200 J	10700 J
Thallium	0.939 UJ	1.01 UJ	0.61 UJ
Vanadium	175 J	634 J	226 J
Zinc	583 J	807 J	276 J

Notes:
all reported values in mg/kg (milligram per kilogram).
U- constituent not detected above the associated value.
J -associated value is an estimate.

TABLE C2-D
ANALYTICAL RESULTS FOR
AMMONIA IN LAGOON SOILDS
FORMER NEPERA PLANT SITE, HARRIMAN, NY

Sample Location	C-SD-0-1	C-SD-1-2	C-SD-2-3
Samle Interval (ft)	0-1	1-2	2-3
SampleDate	11/13/06	11/13/06	11/13/06
Constituent			
Ammonia	824 J	1100 J	1960 J

Notes:
all reported values in mg/kg (milligram per kilogram).
J -associated value is an estimate.

TABLE C2-E
ANALYTICAL RESULTS FOR
POLYCHLORINATED BIPHENYLS IN LAGOON SOILS
FORMER NEPERA PLANT SITE, HARRIMAN, NY

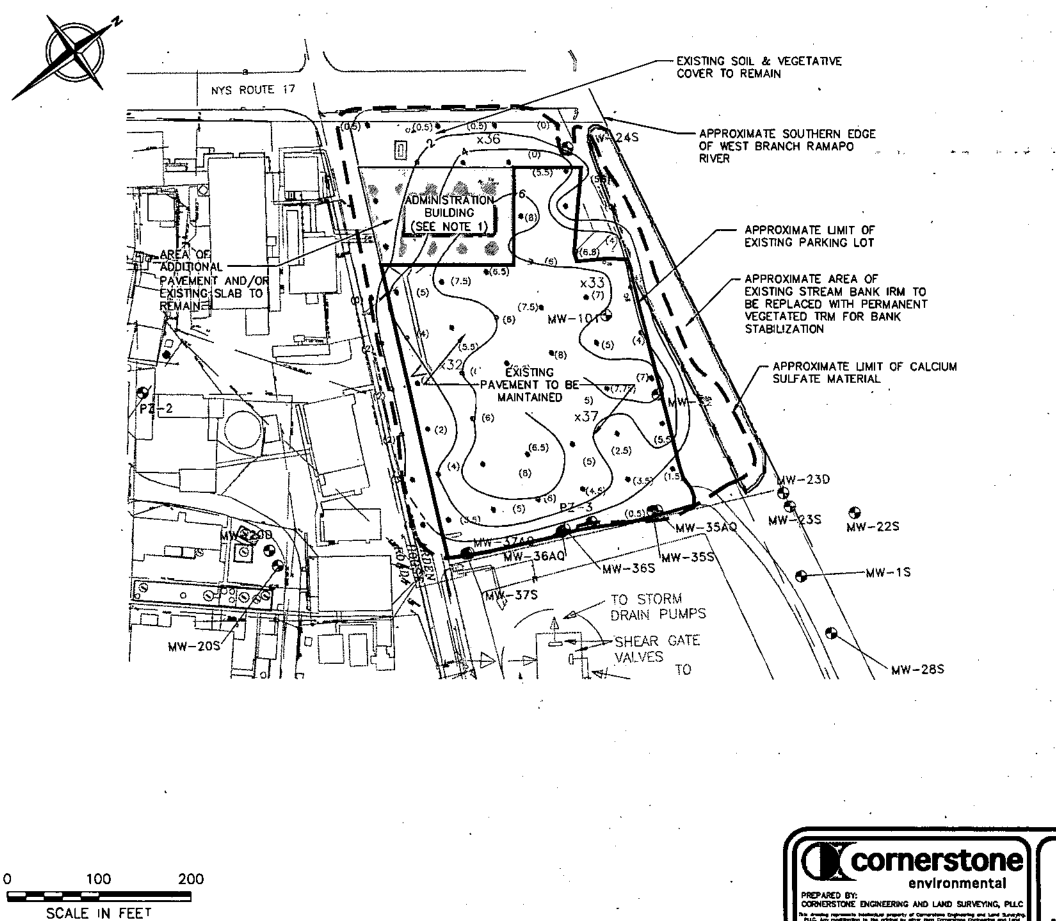
Sample Location	C-SD-0-1	C-SD-1-2	C-SD-2-3
' Samle Interval (ft)	0-1	1-2	2-3
SampleDate	11/13/06	11/13/06	11/13/06
Constituent			
Aroclor 1016	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1221	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1232	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1242	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1248	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1254	0.031 UJ	0.033 R	0.06 UJ
Aroclor 1260	0.031 UJ	0.033 R	0.06 UJ

Notes:
all reported values in mg/kg (milligram per kilogram).
U- constituent not detected above the associated value.
J -associated value is an estimate.
R - associated value is rejected.

previously been found in that area. Sample location A-B-042 was added as a result of operator knowledge that this was a historic loading/unloading area for drums that were stored in the adjacent building. Sample location A-B-043 was added upon request of the NYSDEC to address possible releases from the "Hot Box". This request is documented in the letter from NYSDEC to RC, dated January 11, 2007 a copy of which is provided in Appendix A.

3.2.1.3 **Underground Sewers.** The RFIWP called for collecting samples adjacent to the buried sewer lines at a depth corresponding to the pipe invert. (Note that the chemical sewers were above ground and underground sewers included sanitary, storm and deluge systems.) Pipe invert depths were not well documented. Therefore, samples along sewer lines were collected from the interval demonstrating the greatest impact through field screening or visual inspection. If there was no evidence of impact, the sample was collected from the next change in lithology or from immediately above the water table. Because of the shallow depth-to-water across most of the Site, the inverts are believed to be very close to the water table.

3.2.1.4 SPDES Lagoon. Samples of the solids settled at the bottom of the State Pollutant Discharge Elimination System (SPDES) lagoon were collected from a boat using a sediment corer with polycarbonate tubes. A new polycarbonate tube was used at each sample location. Upon retrieval, a PID was used to field screen the material, so that the sample could be biased towards the 1-foot increment with the highest VOC reading. After collecting the VOC sample, the core was divided in 1-foot increments, and each 1-foot increment was transferred into buckets that were first decontaminated with an Alconox wash followed by a deizonized water rinse. After collecting samples from each of the five locations, the material in each bucket representing a 1-foot increment was homogenized by thoroughly stirring the sample using a single-use plastic spoon. The samples were placed into the appropriate jars, using a single-use plastic spoon.



LEGEND:

MW-36AQ	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
• (6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

NOTE:

1. FOR PURPOSES OF THIS FS, BUILDING DEMOLITION IS ASSUMED TO BE PLANNED FOR THE ENTIRE FACILITY INCLUDING THE FORMER ADMINISTRATION BUILDING.
2. ENVIRONMENTAL EASEMENT ASSUMED TO BE PLACED ON THE ENTIRE FORMER PLANT SITE AND WOULD ENCOMPASS AREA B PARKING LOT.

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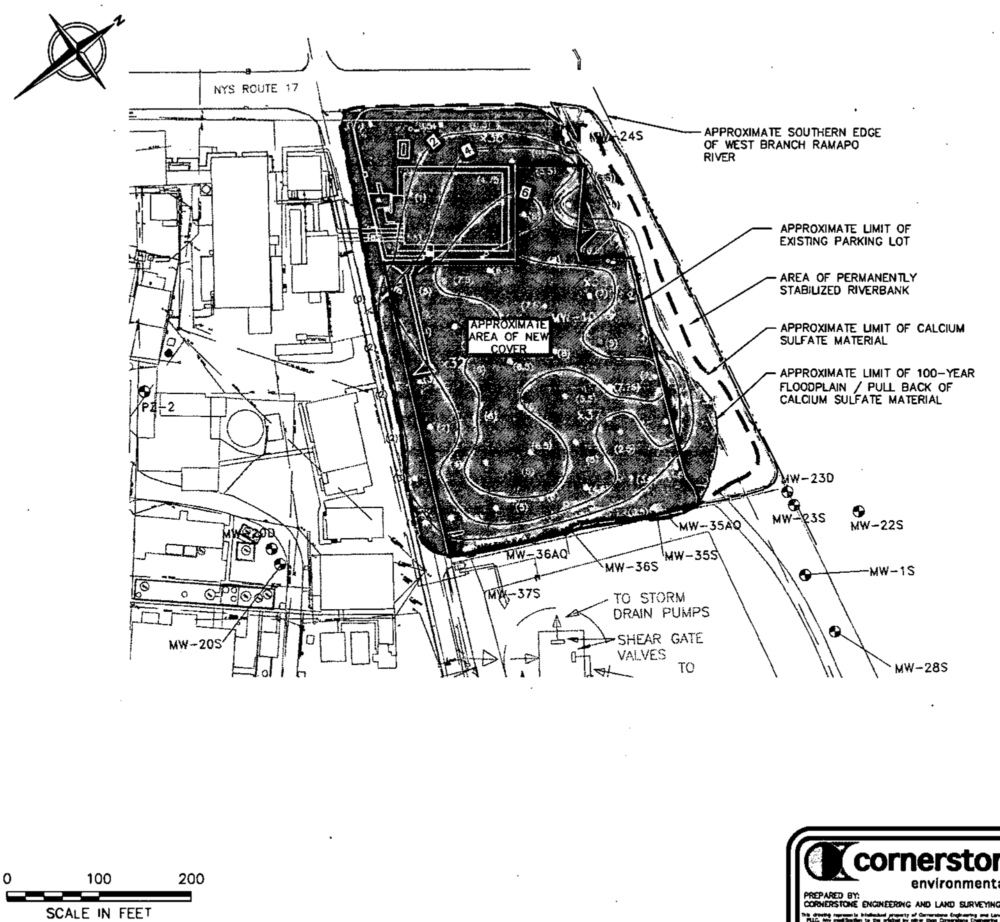
PARKING LOT FEASIBILITY STUDY

ALTERNATIVE NO.2, LIMITED ACTION

FIGURE NO. 8-1

PROJECT NO. 140607



LEGEND:

MW-36AQ ⊕	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
• (6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

NOTES:

1. FOR ALTERNATIVES 8A AND 8B, THE CALCIUM SULFATE MATERIAL WITHIN THE LIMIT SHOWN WOULD BE SUBJECTED TO SOLIDIFICATION/STABILIZATION.

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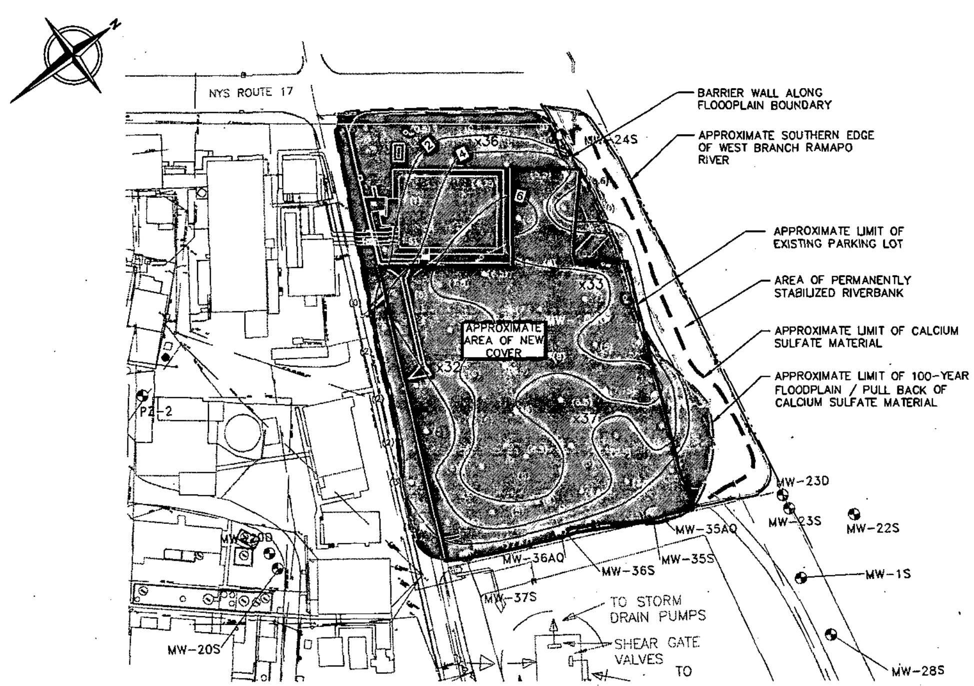
ALTERNATIVES 3A AND 3B
STREAM BANK STABILIZATION AND NEW CAP/COVER
ALTERNATIVES 8A AND 8B
S/S, STREAM BANK STABILIZATION AND NEW CAP/COVER

FIGURE NO.
8-2

PROJECT NO.
140607



LEGEND:

MW-36AQ ⊕	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
• (6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

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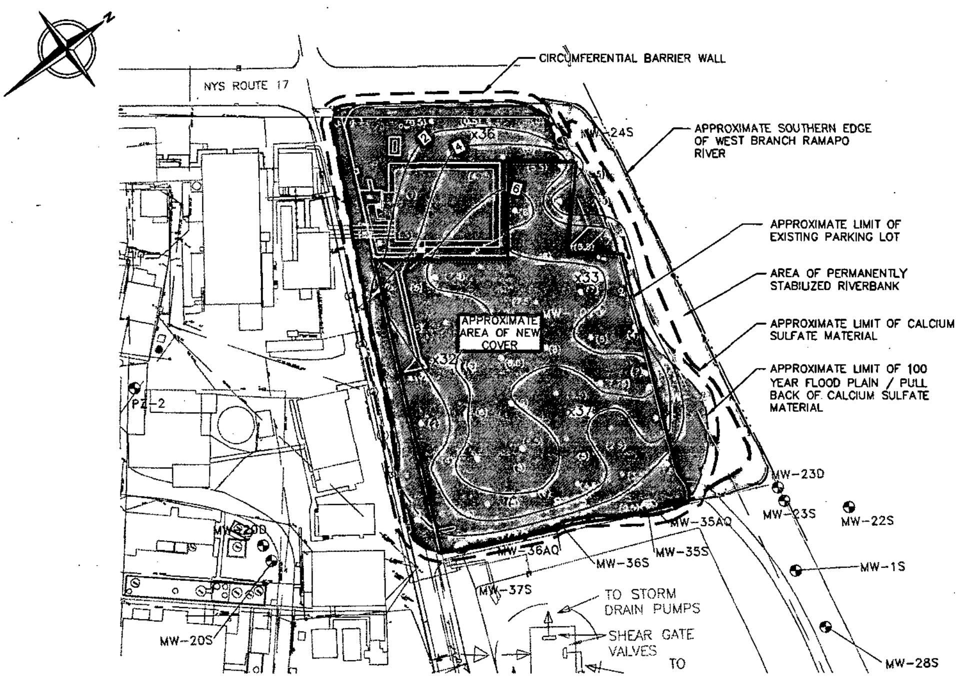
ALTERNATIVES 4A AND 4B STREAM BANK STABILIZATION, NEW CAP/COVER AND FLOODPLAIN BARRIER WALL

FIGURE NO. **8-3**

PROJECT NO. 140607



LEGEND:

MW-36AQ ⊕	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
• (6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

0 100 200

SCALE IN FEET

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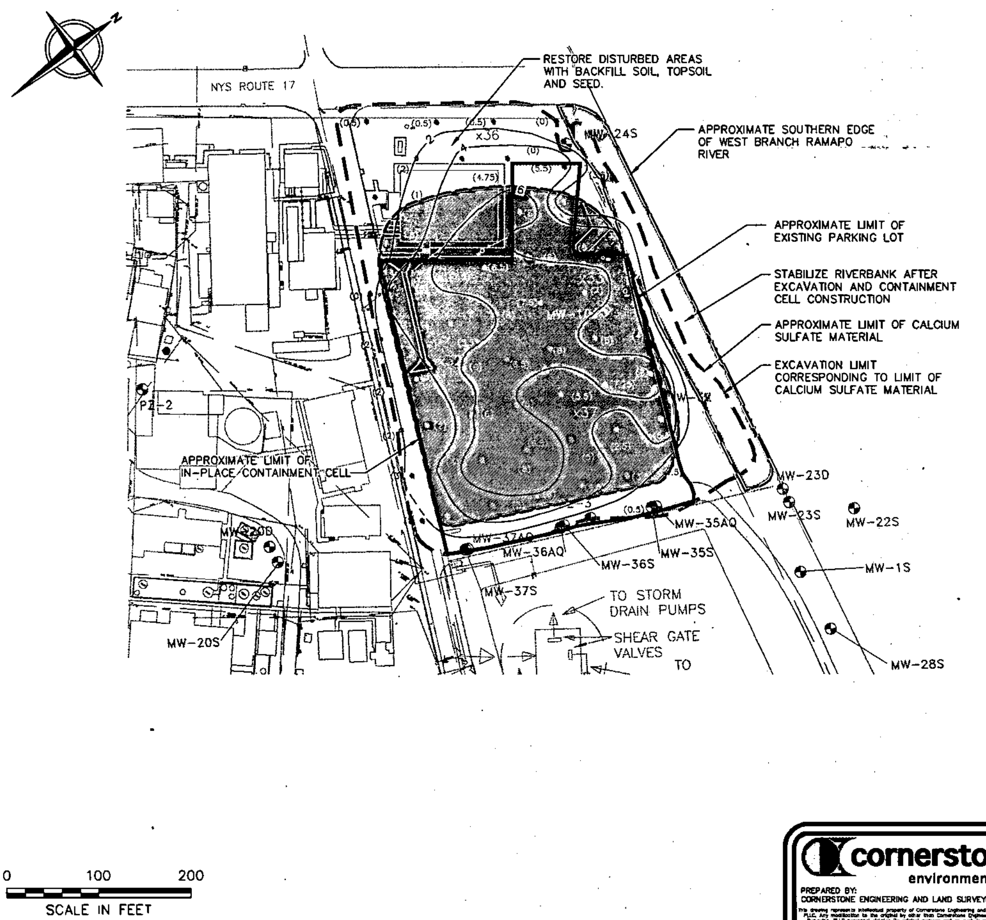
ALTERNATIVE 5 STREAM BANK STABILIZATION, GEOCOMPOSITE CAP AND CIRCUMFERENTIAL BARRIER WALL

FIGURE NO. 8-4

PROJECT NO. 140607



LEGEND:

MW-36AQ	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
•(6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

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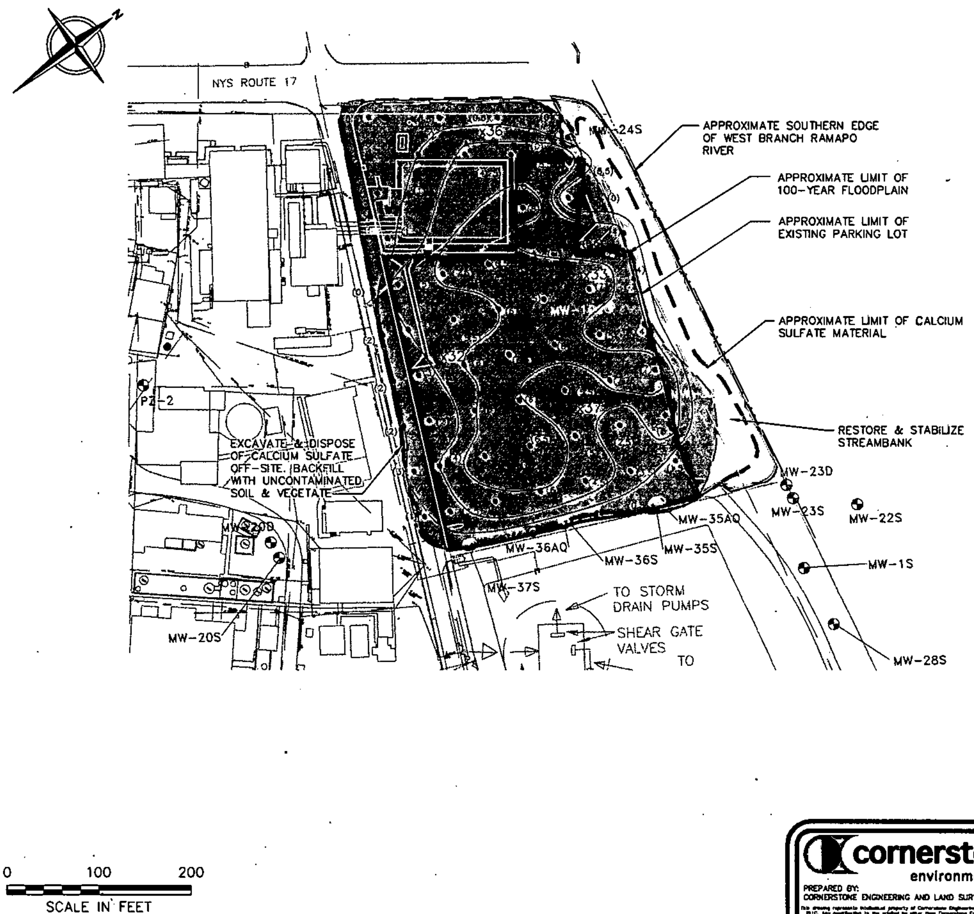
ALTERNATIVE NO. 6
EXCAVATION AND IN-PLACE CONTAINMENT CELL

FIGURE NO. **8-5**

PROJECT NO. 140607



LEGEND:

MW-36AQ	MONITORING WELL
x32	EXISTING TEST PIT LOCATION (APPROXIMATE)
• (6)	GEOPROBE BORING LOCATION AND THICKNESS (FEET) OF CALCIUM SULFATE WHERE PRESENT
— 2 —	CALCIUM SULFATE THICKNESS CONTOUR

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ALTERNATIVE No. 7
EXCAVATION & OFF-SITE DISPOSAL

FIGURE NO. **8-6**

PROJECT NO. 140607