CERTIFICATION STATEMENT

GEDDES BROOK/NINEMILE CREEK
OPERABLE UNIT 1
SUPPLEMENTAL FEASIBILITY STUDY REPORT

I, the undersigned, on behalf of Honeywell, certify that I am and at all pertinent times hereinafter mentioned was a Professional Engineer licensed or otherwise authorized under Article 145 of the Education Law of the State of New to practice engineering; that that I am the person who had primary direct responsibility for the performance of the work performed to complete the Supplemental Feasibility Study, and that activities described in this report were performed in accordance with the Remedial Investigation/ Feasibility Study Work Plan dated April 2000, including Department-approved modifications.

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LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPOI	Chemical Parameter of Interest
FS	Feasibility Study
HEC-RAS	Hydrologic Engineering Centers River Analysis System
LCP	Linden Chemical and Plastics
LEL	Lowest Effect Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRC	National Research Council
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
OU-1	Operable Unit 1
PAH	Polycyclic Aromatic Hydrocarbon
PbP	Point-by-Point
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objectives
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RTK-GPS	Real Time Kinematic-Global Positioning System
Supplemental FS	Supplemental Feasibility Study
SWAC	Surface Weighted Average Concentration
TBC	To Be Considered
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

BACKGROUND

The Record of Decision (ROD) for the Onondaga Lake Bottom Site (New York Stated Department of Environmental Conservation (NYSDEC), United States Environmental Protection Agency (USEPA) – July 2005) notes that "the control of contamination migrating from…upland subsites to Onondaga Lake is an integral part of the overall remediation of Onondaga Lake." The ROD also acknowledges the need to coordinate the timing of the remedial work related to the lake bottom with the work that is performed as part of the remedies at the upland sites.

These key elements of the ROD reflect the fact that Onondaga Lake does not exist by itself. It is located at the bottom of an expansive watershed that includes creeks, rivers, wetlands, floodplains and wildlife that are interconnected with the lake. Achieving the goals of the ROD and the community's vision of a restored Onondaga Lake requires a healthy and sustainable watershed.

Ninemile Creek and its tributary, Geddes Brook, collectively referred to as Geddes Brook/Ninemile Creek, are located northwest of the City of Syracuse. Ninemile Creek, a primary tributary of Onondaga Lake, originates at Otisco Lake, approximately 16 miles southwest of Onondaga Lake. Geddes Brook originates in the town of Camillus and flows approximately 3.3 miles to its confluence with Ninemile Creek; in the area being evaluated, Geddes Brook is currently culverted and channelized into a straight ditch. Today, Geddes Brook/Ninemile Creek are impacted by past industrial pollution, relocated and channelized by road and bridge construction, and populated largely by non-native invasive plant species.

The recommended alternative in this Supplemental Feasibility Study (Supplemental FS) protects human health and the environment and would support a healthy lake watershed by restoring wetlands, improving habitat, and enhancing opportunities for recreation for the people of Central New York. Honeywell's Geddes Brook/Ninemile Creek remedy addresses a large area of the northwest lake watershed and is an essential next step in the cleanup of Onondaga Lake. Completing the remediation in the timelines described in this Supplemental FS is critical to prevent delays in implementation of the ROD for the Onondaga Lake Bottom Site.

KEY OBSERVATIONS AND CONCLUSIONS

The Geddes Brook/Ninemile Creek Feasibility Study Report (FS) (Parsons, 2005) evaluated a variety of ways to address channel sediment and floodplain soil/sediment. Since submittal of the FS (Parsons, 2005), several developments and activities have occurred including:

- the reorganization of the site into two operable units (OU);
- updates to Preliminary Remediation Goal (PRG) target concentrations;

- site investigations to evaluate physical features, soil/sediment sample collection and chemical analysis, habitat evaluation, geomorphic evaluation, and groundwater elevations, and resulting updates to estimates of remedial areas, volumes, and masses; and
- modeling of the hydrodynamic/geomorphic conditions and effectiveness of the chemical isolation layer.

These activities resulted in a better understanding of site conditions, the identification of opportunities for tailoring the remedy to site-specific features, the development of a new remedial alternative, and further development of synergies between site remediation and habitat enhancement opportunities. Based on these developments and activities, this Supplemental FS has been prepared to support the development of a Proposed Plan for Operable Unit 1 (OU-1) of the site.

The site investigations completed since the submittal of the FS (Parsons, 2005) include supplemental floodplain soil/sediment sampling (i.e., chemical characterization), and investigations of physical features (e.g., depth to groundwater, extent of floodplain gravel). In addition to these site investigations, an evaluation of habitat and fluvial geomorphic conditions was completed to gather additional data on the existing ecological site conditions and identify habitat enhancement opportunities that could be incorporated into the remediation. The specific conclusions and observations from these activities were instrumental in developing a new alternative for the site and included:

- Along significant portions of the Geddes Brook and Reach CD floodplains, a defined break in grade is present, which is generally consistent with the 370-ft elevation contour and above which only low levels (average 0.2 ppm) of mercury were detected. Similarly, a break in grade is also present along the length of Reach BC. Based on these observations, the break in grade is used to define the portion of the site which may require remediation.
- Clay appears to underlie the entire Geddes Brook floodplain and the western portion of the Reach CD floodplain south of the small islands.
- Re-alignment of Geddes Brook and Reach CD of Ninemile Creek would provide opportunities to increase sinuosity, provide a wider floodplain and riparian buffer, and create synergies between remediation and restoration. Decreasing the surface elevation of the Geddes Brook floodplain will foster development of an improved emergent wetland community and assist with the control of invasive species.
- Opportunities exist to improve substrate conditions for benthic and fish communities in Geddes Brook and Ninemile Creek.

These observations and conclusions, which are based on additional analytical data and a better understanding of site physical and ecological features, have been integrated into the alternatives presented in this Supplemental FS, as described below.

ALTERNATIVES PRESENTED IN SUPPLEMENTAL FS

Remedial Action Objectives (RAOs) for the site were identified in the FS (Parsons, 2005) and were retained for use in the Supplemental FS. PRGs from the FS (Parsons, 2005), including target concentrations, were updated for use in the Supplemental FS. The alternatives presented in this Supplemental FS were evaluated using the RAOs and PRGs to determine remedy effectiveness and overall protection of human health and the environment. Specifically, the four alternatives evaluated in this Supplemental FS include:

- **Alternative 1: No Action**: This alternative is consistent with Alternative C1/FP1 in the FS (Parsons, 2005) - the no action alternative.
- **Alternative 2: Removal and Cover:** This alternative is consistent with Alternative C2(C3)/FP2(B3) in the FS - a removal and cover alternative based on meeting a mid-range mercury PRG, to depths of 3 ft in the channel and 2 ft in the floodplain. An overview of Alternative 2 is presented on Figure 3-1.
- **Alternative 3: Removal and Cover/Backfill (Integrated Approach):** This alternative, which is new, integrates site remediation and habitat development with site features by tailoring the application of the removal, cover, and backfill technologies evaluated in the FS (Parsons, 2005) to site areas and limits based on physical features (e.g., breaks in grade horizontally, clay or gravel vertically). Effectiveness for this alternative is assessed using a range of mercury PRGs. An overview of Alternative 3 is presented on Figure 3-2.
- **Alternative 4: Removal and Backfill:** This alternative is consistent with Alternative C3(E)/FP3(E) in the FS (Parsons, 2005) - a removal and backfill alternative based on meeting the most conservative of the mercury PRGs evaluated in the FS (Parsons, 2005) to the maximum depths evaluated. An overview of Alternative 4 is presented on Figure 3-3.

The three action alternatives (i.e., Alternatives 2, 3, and 4) include a combination of removal (dredging, excavation), cover, and backfill, to various depths, to meet a range of PRGs. In addition, based on a geomorphic assessment of Geddes Brook and Ninemile Creek, the three action alternatives include the relocation of Geddes Brook to provide more natural conditions, including increased channel length, increased sinuosity, and improved connectivity between the brook and floodplain. Similarly, Alternative 3 relocates Reach CD in Ninemile Creek away from Wastebeds 9 and 10, to facilitate remedy implementation and to create a broader area on the north side of the channel for riparian habitat (e.g., vernal pools, forested floodplains) and a sloped transition between the creek and adjacent upland areas. The geomorphic assessment also evaluated the stability, hydraulic geometry, and flood characteristics of the proposed channel and floodplain modifications and provided detailed information on the substrate material types that could be used in the cover system for erosion protection and habitat.

In addition to the geomorphic assessment, modeling of the chemical isolation layer, which may be a component of the cover system depending on residual concentrations, was completed for each alternative.

EVALUATION OF ALTERNATIVES

All alternatives, with the exception of Alternative 1 – No Action, can be implemented to effectively meet the RAOs established for the Geddes Brook/Ninemile Creek site. Public use and access (e.g., the canoe launch) to Ninemile Creek will be preserved under each alternative.

Alternatives 2, 3, and 4 meet sediment targets for protection of bioaccumulation and direct contact (by humans). Alternatives 2, 3, and 4 are all also expected to result in reduced contaminant concentrations in fish and, consequently, reduced risk to humans and ecological receptors from fish consumption. Alternative 3 addresses risk to benthic macroinvertebrates through removal and provision of clean cover or backfill in the entire channel and floodplain, whereas Alternatives 2 and 4 rely on screening values to define areas of remediation. As such, the area of the site remediated by Alternative 2 is less than that of either Alternative 3 or 4, which are roughly equivalent.

Alternatives 2, 3, and 4 will take approximately 1, 2, and 3 construction seasons to implement, respectively. The longer duration for Alternative 4 is largely related to the installation and removal of deep sheet pile to allow for removal of deeper sediments and greater volume. The additional effort to effect the removals required by Alternative 4 would be disproportionate to any potential marginal increases in protectiveness, if any, compared to Alternative 3, and would result in greater short-term impacts, increased implementation risks and longer schedule duration. The estimated volume, duration of construction and costs for the three action alternatives (including the Geddes Brook IRM) are shown in the table below:

	Total Volume Removed (cy)	Duration (Construction Seasons)	Capital Costs	O&M Costs (Present Worth)	Total Cost (Present Worth)
Alternative 2	64,000	1	$18.5 M	$1.7 M	$20.2 M
Alternative 3	126,000	2	$31.7 M	$1.7 M	$33.4 M
Alternative 4	146,000	3	$42.5 M	$1.2 M	$43.7 M

RECOMMENDED ALTERNATIVE

Based on the evaluation of the four alternatives using the seven Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) evaluation criteria, Alternative 3 is Honeywell's recommended alternative for the Geddes Brook/Ninemile Creek site. Alternative 3 provides the best balance of the seven CERCLA evaluation criteria and would achieve the RAOs and PRGs established for the Geddes Brook/Ninemile Creek site.

Alternative 3 is comprehensive in that it is a physically-defined remediation, wherein the entire site within the breaks in grade (horizontally) and clay or gravel (vertically, where present in the upper 2 or 3 ft) is addressed. Alternative 3 will result in the removal of approximately 90% of the mercury from the site. Following the removals, channel and floodplain habitat/cover systems would be designed and installed to create a suitable/enhanced ecological habitat and prevent exposure to residual concentrations. Alternative 3 includes the realignment of the Geddes Brook channel which will improve connectivity with the floodplain and provide greater habitat value following remediation. Alternative 3 also includes realignment of Reach CD in Ninemile Creek to facilitate remedy implementation, provide enhanced riparian, wetland and instream habitats following remediation, and increase the distance from the Creek to the wastebeds. Specifically, Alternative 3 would result in a remedy that:

- is protective, meeting all RAOs and PRGs, and implementable in a reasonable period of time;
- coordinates the remedy with site infrastructure, provides sufficient water depth for fish and canoe passage, and relocates Ninemile Creek away from the wastebeds, allowing opportunities to create diverse habitats (e.g., vernal pools, forested floodplains);
- improves the connectivity of Geddes Brook and Ninemile Creek with their floodplains, and allows for the creation of wildlife corridors by providing easier transitions (shallower slopes) from the channels to the floodplains to adjacent upland areas;
- provides an improved emergent wetland community in the Geddes Brook floodplain; and
- improves substrate conditions in the channels for benthic and fish communities through the habitat/cover systems, and allows for the establishment of native vegetation to increase allochthonous inputs (e.g. leaf litter) and help to reduce water temperature.

SECTION 1

PURPOSE AND OBJECTIVES

The FS (Parsons, 2005) evaluated a variety of channel and floodplain alternatives for the Site, and was determined to be acceptable by the NYSDEC. Since submittal of the FS (Parsons, 2005), the site has been organized into two operable units. In addition, a number of supplemental site investigations and assessments have been conducted, including an analysis of site topography and features, additional chemical data collection and analysis, and an evaluation of habitat and fluvial geomorphic conditions. These assessments have resulted in a better understanding of site conditions, the identification of opportunities for tailoring the remedy to site-specific features, the development of a new remedial alternative, and further development of synergies between site remediation and habitat enhancement opportunities.

In consideration of the organization of the site into two operable units and the recent investigations and assessments, and pursuant to a request by NYSDEC, this Supplemental FS has been prepared to support the development of a Proposed Plan for OU-1 of the site. This Supplemental FS builds upon the evaluations presented in the FS (Parsons, 2005), provides refined evaluations of representative alternatives from the FS (Parsons, 2005), and presents and evaluates the new alternative.

SECTION 2

UPDATED SITE INFORMATION AND ASSESSMENT

2.1 INTRODUCTION

This section describes developments and activities that have occurred since submittal of the FS (Parsons, 2005), including:

- the organization of the site into two operable units;
- updates to PRG target concentrations;
- site investigations completed since submittal of the FS (Parsons, 2005) (e.g., physical features, soil/sediment sample collection and chemical analysis, habitat evaluation, geomorphic evaluation, and groundwater elevations), and resulting updates to estimates of remedial areas, volumes, and masses; and
- modeling completed since submittal of the FS (Parsons, 2005), including hydrodynamic/geomorphic modeling and chemical isolation layer modeling.

These assessments have resulted in a better understanding of site conditions, the identification of opportunities for tailoring the remedy to site-specific features, the development of a new remedial alternative, and further development of synergies between site remediation and habitat enhancement opportunities. These assessments are discussed below and the resulting findings and conclusions are incorporated into the remedial alternatives developed and evaluated in Section 3.

2.2 OPERABLE UNIT APPROACH

Following submittal of the FS in May 2005 and based on the need to coordinate the remedy for the lower reach of Ninemile Creek (Reach AB) with the remedy for Wastebeds 1 - 8, the Geddes Brook/Ninemile Creek Site was organized into two Operable Units (i.e., OU-1 and OU-2). As shown on Figure 2-1, OU-1 consists of channel sediment and floodplain soils/sediment in and along lower Geddes Brook, as well as in Reaches BC and CD of lower Ninemile Creek. OU-2 consists of channel sediment and floodplain soil/sediment in and along Reach AB of lower Ninemile Creek. This Supplemental FS develops and evaluates alternatives for OU-1 only.

The separation of the site into two operable units does not affect the identification of RAOs and PRGs, which, as described below, have been retained from the FS (Parsons, 2005) for this Supplemental FS. Likewise, the target contaminant concentrations for fish tissue and sediment are unaffected by the designation of two operable units, because they are based on literature values or toxicity values that remain constant regardless of the spatial division used.

Moreover, much of the information and evaluation presented in the FS (Parsons, 2005) remains relevant for both operable units, especially with respect to the evaluation of remedial technologies and approaches, which are generally not reach-specific. This Supplemental FS builds upon the evaluations presented in the FS (Parsons, 2005), provides refined evaluations of representative alternatives from the FS (Parsons, 2005), and presents a new alternative based upon information developed since submittal of the FS (Parsons, 2005).

2.3 ARARs, REMEDIAL ACTION OBJECTIVES, PRELIMINARY REMEDIATION GOALS, AND TARGET CONCENTRATIONS

2.3.1 Applicable or Relevant and Appropriate Requirements

The FS (Parsons, 2005) presented Applicable or Relevant and Appropriate Requirements (ARARs) for the Geddes Brook / Ninemile Creek Site. These ARARs have been updated, as shown in Appendix A.

2.3.2 Remedial Action Objectives, Preliminary Remediation Goals, and Target Concentrations

The FS (Parsons, 2005) identified the following RAOs for the site:

- RAO – 1: To eliminate or reduce, to the extent practicable, releases of mercury and other chemical parameters of interest (CPOI) from channel sediment and from floodplain soils/sediments of lower Geddes Brook and lower Ninemile Creek.
- RAO – 2: To eliminate or reduce, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources and potential risks to humans.
- RAO – 3: To eliminate or reduce, to the extent practicable, levels of mercury and other CPOIs in surface water in order to meet surface water quality standards.

PRGs presented in the FS (Parsons, 2005) were retained for use in this Supplemental FS and are listed below;

- PRG1: Reduce, contain, or control, to the extent practicable, mercury and other CPOI concentrations in erodable channel sediment and in erodable floodplain soil/sediment within Geddes Brook and Ninemile Creek.
- PRG2: Achieve CPOI concentrations, to the extent practicable, in channel sediment and floodplain soil/sediment that are protective of human health, fish and wildlife resources. The PRG covers a range of risk levels for mercury and other CPOIs as warranted.
- PRG3: Achieve CPOI concentrations, to the extent practicable, in fish tissue that are protective of humans and wildlife that consume fish.
- PRG4: Achieve, to the extent practicable, aqueous CPOI concentrations to meet surface water quality standards.

These PRGs reference target contaminant concentrations in fish tissue, channel sediment, and floodplain soil/sediment based on NYSDEC sediment screening levels, the ecological and human health risk assessments, and site-specific data. Target concentrations for use in this Supplemental FS were updated as described in Appendix A, and are presented in Tables 2-1 and 2-2 for fish tissue and sediment, respectively.

The fish tissue target concentrations presented in Table 2-1 are applied as a comparison to an appropriate estimate of the mean, consistent with risk assessment guidance (i.e., the mean of contaminant concentrations in multiple fish tissue samples would be compared to the target concentration.) The fish tissue target concentrations were not developed as “not-to-exceed” values (FS Appendix I, Parsons, 2005).

The sediment target concentrations presented in Table 2-2 are applied on either a point-by-point (PbP) basis or a surface area-weighted average concentration (SWAC). In general, the point-by-point basis is used for targets that address direct toxicity to relatively immobile organisms (e.g., sediment toxicity to macroinvertebrates). The SWAC basis is used for targets that address direct toxicity or bioaccumulation where receptors such as humans, shrews, or belted kingfishers are exposed to contaminants throughout an area rather than a single location.

The alternatives presented in Section 3 of this Supplemental FS will be assessed against the range of target concentrations presented in Tables 2-1 and 2-2 when evaluating remedy effectiveness and overall protection of human health and the environment.

2.4 SITE CHARACTERIZATION

2.4.1 2007 Supplemental Site Investigations

Subsequent to submittal of the FS (Parsons, 2005), the following field investigations and evaluations were conducted at the Site during the summer of 2007:

- Depth to Floodplain Groundwater Investigation;
- Extent of Floodplain Gravel Investigation; and
- Supplemental Floodplain Sampling Investigation.

These field investigations were implemented by Parsons pursuant to work plans approved by NYSDEC, which are provided in Appendix B. The investigations were conducted to gather additional data to advance remedy development and evaluation at the site. Figures 2-2a, 2-2b, and 2-2c summarize mercury results, including historic and new data, for channel and floodplain sediment. A summary report of the investigations and associated data is presented in Appendix B. Conclusions and observations for Geddes Brook and Ninemile Creek OU-1 resulting from these investigations are as follows:

- Along significant portions of the Geddes Brook and Reach CD floodplains, a defined break in grade is present, which is generally consistent with the 370-ft elevation contour. Similarly, a break in grade is also present along the length of Reach BC.

- Consistent with previously characterized areas of the Geddes Brook floodplain, mercury was detected in floodplain soil/sediment southwest of the inactive utility berm.
- Groundwater is generally 1-2 ft below grade in the Geddes Brook floodplain and greater than 3 ft below grade in the Reach CD floodplain south of the channel.
- A continuous layer of armoring stone and/or gravel is present on the Ninemile Creek banks along the length of Reach BC. The armoring stone and gravel were placed during highway construction, and are consistent with as-built drawings dated 1970 made available by the New York State Department of Transportation (Appendix B, Attachment B-5).
- Clay appears to underlie the entire Geddes Brook floodplain and the western portion of the Reach CD floodplain south of the small islands.
- Low levels of mercury (average 0.15 ppm) were detected above the break in grade that borders the southern extent of the Reach CD floodplain.

In addition to these investigations, an evaluation of habitat and fluvial geomorphic conditions was completed to gather additional data on the existing ecological site conditions and identify habitat enhancement opportunities that could be incorporated into the remediation. Field inspections were completed in 2007 by Honeywell's consultants and discussed with agency personnel during subsequent meetings. The results of the fluvial geomorphic assessment are discussed in Section 2.5. Based on the field observations and the results of the geomorphic assessment, it was concluded that:

- A stable cover system, consisting of a chemical isolation layer (where required), an erosion protection layer, and a habitat layer can be installed in Ninemile Creek. The erosion protection layer can be composed of either graded gravel or riprap. The habitat layer, placed on top of the erosion protection layer, can be composed of graded gravel (i.e., the same material as the erosion protection layer) that would provide habitat for fish and benthic macroinvertebrates.
- Geddes Brook and Reach CD of Ninemile Creek can be re-aligned to improve connectivity between the creek and floodplain, create diverse habitats (e.g., vernal pools, forested floodplains), and facilitate remedy implementation.
- Re-alignment of Geddes Brook would provide opportunities to increase sinuosity, connectivity with the floodplain, and provide a buffer from State Fair Landfill.
- Decreasing the surface elevation of the Geddes Brook floodplain may foster development of an improved emergent wetland community and assist with the control of invasive species.
- Reach BC of Ninemile Creek is highly incised and constrained, limiting opportunities for habitat improvements.
- Geddes Brook and Ninemile Creek should be allowed to meander, where feasible.

- Opportunities exist to improve substrate conditions for benthic and fish communities in Geddes Brook and Ninemile Creek.
- Relocating Ninemile Creek away from the wastebeds would provide opportunities to create diverse habitats (e.g. vernal pools, forested floodplains).
- Wildlife corridors could be created by providing easier transitions (shallower slopes) from Ninemile Creek to adjacent upland areas.
- Planting of native trees along channels would provide riparian habitat, allochthonous inputs (e.g. leaf litter), and may help to reduce water temperature.

The conclusions summarized above, which are based on additional analytical data and a better understanding of site physical and ecological features, have been integrated into the alternatives carried forward in this Supplemental FS.

2.4.2 Revised Remedial Boundaries

The remedial boundaries used in the FS (Parsons, 2005) were primarily based on the extent of site analytical data at that time. Since submittal of the FS (Parsons, 2005), and based on additional information, the portion of the site which may require remediation has been revised as shown on Figure 2-3. The revised boundary is based on the additional analytical data from the 2007 investigations and observations regarding physical site features. Specifically, along significant portions of Reach CD and Geddes Brook, a defined break in grade is present which is generally consistent with the 370-ft elevation contour. Similarly, a break in grade is also present along the length of Reach BC. Mercury is the most pervasive contaminant at the site, and based on the site conceptual model, mercury is a good surrogate for the presence of other CPOIs. Review of Appendix B indicates that mercury concentrations above the break in grade are low, and average less than 0.2 mg/kg. Based on these observations, the break in grade has been determined to define the portion of the site which may require remediation.

2.4.3 Revised Pre- and Post-Remediation SWACs

To support the evaluation of alternatives in the Supplemental FS, revised pre-remediation surface weighted average concentrations (SWACs) were calculated for the same CPOIs that were evaluated in the FS (Parsons, 2005). The revised SWACs were calculated based on new site data, revised analysis boundaries, and upgraded analysis tools. In general, the process used to calculate the pre-remediation SWACs is consistent with the FS (Parsons, 2005) effort. However, some parameters that are used to calculate the pre-remediation SWACs have changed since submittal of the FS (Parsons, 2005), as noted below:

- Floodplain analytical data collected during the 2007 Supplemental Site Investigations were incorporated into the dataset used to calculate the pre-remediation SWACs;
- Analysis boundaries were modified based on the revised site boundary map discussed in Section 2.4.2;

- Analysis boundaries were modified based on organizing the site into two operable units (only OU-1 is included in the calculations); and
- ArcView 9.2 ET Geowizard extension was used to create the Thiessen Polygons instead of the Thiessen Polygon tool for ArcView 9.0, as a result of a software upgrade.

Documentation of the CPOI concentrations and Thiessen Polygon areas used to generate the pre-remediation SWACs is provided in Appendix C. A summary of the revised pre-remediation SWACs is provided in Table 2-3. The revised floodplain pre-remediation SWACs differ somewhat from those estimated in the FS (Parsons, 2005), primarily as a result of incorporating the new floodplain data and revised remedial boundaries, while the revised channel pre-remediation SWACs are generally consistent with those estimated in the FS (Parsons, 2005).

Appendix C also presents post-remediation SWACs for the alternatives evaluated in Section 3. The pre-remediation SWACs are compared to post-remediation SWACs in the evaluation of alternatives presented in Section 3.

2.4.4 Remedial Areas, Volumes, and Masses

Based on the new information and software modifications described in Section 2.4.3, remedial areas, volumes, and masses for mercury were estimated for the alternatives evaluated in Section 3. An overview of the process used for this Supplemental FS, which differs from the process used in this FS (Parsons, 2005), is described in Appendix C and summarized below:

- As shown in Appendix C, Thiessen polygons, drawn around each sampling location, were used to estimate remedial areas. Based on alternative-specific criteria, individual polygon areas were summed to estimate remedial areas for each alternative.
- To estimate remedial volumes, an alternative-specific depth of removal was assigned to each sample location. This depth, when multiplied by the area of the associated Thiessen polygon, produced a volume of removal per polygon. The removal volumes associated with each polygon were then summed to estimate remedial volumes for each alternative.
- To estimate remedial masses, a mass was estimated for each polygon, based on the alternative-specific depth of removal, mercury concentration data, and an assumed bulk density. The masses associated with each polygon were then summed to estimate remedial masses for each alternative.

The remedial area, volume, and mass estimates are presented in Appendix C and used in the alternative evaluations presented in Section 3.

2.5 HYDRODYNAMIC MODELING / GEOMORPHIC ANALYSIS

Hydrodynamic modeling was initially completed for the FS (Parsons, 2005) to assess erosional and depositional areas under various flood conditions based on available sediment particle size data. The HEC-RAS model (Hydrologic Engineering Center – River Analysis

System) was used to perform the analysis. HEC-RAS modeling was also used to evaluate the alternative recommended in the FS (Parsons, 2005). The alternative analyses assumed no change in the bed elevation of the channel (i.e., the stream bottom would be restored to pre-remediation elevations).

Since submittal of the FS (Parsons, 2005), a geomorphic assessment of Ninemile Creek and Geddes Brook was conducted to identify opportunities for synergy between site remediation and habitat development. The assessment included evaluating the relocation of Geddes Brook to improve connectivity of the brook and floodplain, and the relocation of a portion of Ninemile Creek to facilitate remedy implementation and to move the creek further from Wastebeds 9 and 10. The geomorphic assessment also evaluated the stability, hydraulic geometry, and flood characteristics of the proposed channel and floodplain modifications.

Based on the geomorphic assessment, the remedial alternatives presented in this Supplemental FS include some changes to the planform, cross section, and profile of Geddes Brook. Likewise, one alternative includes the relocation of a portion of Ninemile Creek. HEC-RAS models were formulated to simulate and evaluate these revised conditions. The revised HEC-RAS models and evaluations are further described in Appendix D, and include discussion of the effect of the different removal and cover system alternatives on:

- hydraulic properties over a range of flow conditions and lake levels;
- extent of the 100-yr flood;
- minimum water depth to allow fish passage and canoe access under low flows;
- water surface elevation during storm events to clear structures; and
- sediment stability during 100-yr flows to assess habitat layer and erosion protection layer composition.

The results of the model simulations were also used in this Supplemental FS to evaluate sediment removal and habitat cover systems that could be used within the channels, as further described in Section 3.

2.6 CHEMICAL ISOLATION LAYER MODELING

2.6.1 Overview

Consistent with the FS (Parsons, 2005), two of the alternatives evaluated in Section 3 of this Supplemental FS include a habitat layer underlain by a chemical isolation layer. This section describes the chemical isolation layer model used to evaluate alternatives, which has been revised from that used in the FS (Parsons, 2005), and presents model results.

2.6.2 Groundwater Upwelling Velocity

Groundwater upwelling velocity is an important chemical isolation layer model parameter. An upwelling study was conducted at the site between November 2004 and January 2005 to support the evaluation of alternatives in the FS (Parsons, 2005). The study used 14 seepage meters and 14 piezometers in the bed of Ninemile Creek in Reaches BC and CD. This study yielded a maximum measured Darcy upwelling velocity of 27 cm/year, and a maximum estimated Darcy upwelling velocity in Ninemile Creek of 89 cm/yr based on an analysis of uncertainty in the measured data (Attachment H-2 of the FS [Parsons, 2005]). However, due to the limited duration of the study and the potential need for additional data to verify these results, a value of 334 cm/year was used as an estimate of the Darcy velocity for the purposes of evaluating alternatives in the FS (Parsons, 2005), as described in Appendix H of the FS (Parsons, 2005).

Since submittal of the FS (Parsons, 2005), additional groundwater level data were collected from four shallow monitoring locations adjacent to Ninemile Creek, at hourly intervals for 33 months. Evaluation of these data has provided additional information on groundwater discharge and the resulting upwelling velocities in Ninemile Creek. The data that were collected and the evaluation that was completed are described in Appendix E. Based on evaluation of these data, and in consideration of the data collected in the 2004/2005 upwelling study, the estimated Darcy upwelling velocities for use in this Supplemental FS are 100 cm/yr in Reach BC and 150 cm/yr in Reach CD.

2.6.3 Model Revisions and Results

As described in Appendix E, some of the assumptions used in the chemical isolation layer model to support the Supplemental FS differ from those used in the FS (Parsons, 2005). For example, the point of compliance for cover system effectiveness has been shifted to the bottom of the habitat layer. Positioning the compliance point to the bottom of the habitat layer precludes the use of the steady state model utilized in the FS (Parsons, 2005). Therefore, the transient model, which was also discussed in the FS (Parsons, 2005), is being used to conduct the chemical isolation modeling to support evaluations of alternatives in this Supplemental FS.

Model results are presented in Appendix E, and include matrixes of predicted concentrations of mercury and other CPOIs for various chemical isolation layer thicknesses and underlying sediment concentrations.

2.7 COST ESTIMATION

As was performed for the FS (Parsons, 2005), cost estimates were prepared for the alternatives presented in Section 3 of this Supplemental FS. In general, the procedures used for estimating costs for the Supplemental FS are consistent with those used in the FS (Parsons, 2005). The unit costs and underlying assumptions used in the Supplemental FS build upon those presented in the FS (Parsons, 2005), but may vary based upon labor and material costs estimated on a 2008 vs. 2005 basis; refined construction approaches and production rates based on evaluations completed since 2005; and recent construction experience at other sites in the vicinity (e.g., Linden Chemical and Plastics [LCP] OU-2). The cost estimates prepared for the Supplemental FS also incorporate revised areas and volumes based on the new site data and alternative approaches (e.g., on-site treatment of construction water versus transport off-site for treatment). The cost estimates for this Supplemental FS are presented in Appendix F.

SECTION 3

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

3.1 INTRODUCTION

The FS (Parsons, 2005) evaluated a variety of remedial alternatives for both channel and floodplain, using combinations of removal, cover, and backfill, to various depths, to meet a range of PRGs. Permutations of the channel and floodplain alternatives were then further combined to assemble site-wide alternatives. As described in Section 2, since submittal of the FS (Parsons, 2005), a number of site investigations and assessments have been conducted which have resulted in a better understanding of site features and physical and ecological conditions. In consideration of the recent investigations and assessments, and to facilitate a more focused evaluation of alternatives, this Supplemental FS evaluates four alternatives: three representative alternatives from the FS (Parsons, 2005) (updated to reflect the recent site information), and a new alternative (based on the recent site information). These alternatives are:

- **Alternative 1: No Action**: This alternative is consistent with Alternative C1/FP1 in the FS - the no action alternative.
- **Alternative 2: Removal and Cover:** This alternative is consistent with Alternative C2(C3)/FP2(B3) in the FS (Parsons, 2005) - a removal and cover alternative based on meeting a mid-range mercury PRG, to depths of 3 ft in the channel and 2 ft in the floodplain. An overview of Alternative 2 is presented on Figure 3-1.
- **Alternative 3: Removal and Cover/Backfill (Integrated Approach):** This alternative, which is new, integrates site remediation and habitat development with site features by tailoring the application of the removal, cover, and backfill technologies evaluated in the FS (Parsons, 2005) to site areas and limits based on physical features (e.g., breaks in grade horizontally, clay or gravel vertically). Effectiveness for this alternative is assessed using a range of mercury PRGs. An overview of Alternative 3 is presented on Figure 3-2.
- **Alternative 4: Removal and Backfill:** This alternative is consistent with Alternative C3(E)/FP3(E) in the FS - a removal and backfill alternative based on meeting the most conservative of the mercury PRGs evaluated in the FS (Parsons, 2005) to the maximum depths evaluated. An overview of Alternative 4 is presented on Figure 3-3.

These four alternatives preserve the range of alternatives evaluated in the FS (Parsons, 2005). For consistency in the comparative evaluation, each of the four alternatives reflect the updated site information and opportunities for coordinating site remediation with habitat development described in Section 2. Further description of the alternatives and evaluation of the alternatives using the first seven of the nine criteria outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 CFR 30.300.430, is presented in Section 3.2

below. It should be noted that while the FS (Parsons, 2005) presented and evaluated alternatives separately for channel and floodplain, the alternatives in this Supplemental FS reflect coordinated activities for channel and floodplain to facilitate a focused evaluation. It should also be noted that while the descriptions of the action-alternatives (Alternatives 2, 3 and 4) in Sections 3 and 4 do not discuss certain common components such as onsite treatment/disposal of water from excavated soil/sediment, management of soil/sediment following removal, restoration of wetlands, and institutional controls, assumptions for these remedial components are discussed in Appendix F and are incorporated into the alternatives and associated costs. Alternatives in this Supplemental FS do not explicitly include the removal of visible calcite, but all of the action alternatives will improve the benthic substrate as a by-product of removal (based on CPOIs) and/or covering of sediments/soils within the remedial areas.

3.2 DEVELOPMENT AND EVALUATION OF REMEDIAL ALTERNATIVES

3.2.1 Alternative 1 - No Action

Description of Alternative

Consistent with Alternative C1/FP1 in the FS (Parsons, 2005), under Alternative 1, no action would be taken to address channel sediment or floodplain soil/sediment exceeding PRGs for mercury or other CPOIs. As required within the CERCLA process, this alternative is used as a baseline for comparison purposes.

Overall Protection of Human Health and the Environment (Alternative 1)

This alternative would not reduce or control the risks to human health and the environment or the release and transport of mercury or other CPOIs from sediment at the site (with the exception of the Geddes Brook channel sediment which would be removed as part of the Geddes Brook IRM). Remediation of upstream external sources, (i.e., the LCP Bridge Street Site including the West Flume), is expected to significantly reduce the loading of mercury and other CPOIs to the site. As a result, some natural recovery in depositional areas of the creek and floodplain is likely to occur and may result in reduction of risk to humans and ecological receptors. However, it is unlikely that the RAOs or PRGs (see Section 2) would be met within an acceptable time frame or throughout the entire creek and floodplain as a result of deposition of clean material alone. Therefore, this alternative would not be protective of human health and the environment.

Compliance with ARARs (Alternative 1)

There are no chemical-specific ARARs identified for sediment quality. Sediment screening criteria developed by NYSDEC for mercury and other CPOIs and presented in their Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) are To Be Considered (TBC) values; these criteria are intended for screening purposes and do not represent final cleanup levels that must be achieved by remediation. The TBCs discussed in Section 2 and Appendix B of the FS (Parsons, 2005) would not be met under this alternative.

As discussed in the RI/FS (Exponent, 2001), for surface water, two of the four NY State water quality standards for mercury (based on dissolved total mercury) for Class B/C waters were exceeded in lower Geddes Brook and the West Flume. Remediation of the West Flume (and the former Linden Chemical and Plastics (LCP) Bridge Street Site (OU-1)) and lower Geddes Brook (under the IRM) would be expected to mitigate or eliminate these exceedances for mercury. The water quality standards for dissolved solids, iron, and aluminum are not consistently met in Geddes Brook and Ninemile Creek, even upstream of the site. Meeting these standards is unlikely, given upgradient/upstream anthropogenic sources at the site.

Because no action would be taken under this alternative, action-specific and location-specific ARARs would not be applicable.

Short-Term Effectiveness (Alternative 1)

There would be no additional short-term risks to the community, workers, or the environment from implementation of this alternative. RAOs and PRGs are unlikely to be achieved in the short-term.

Long-Term Effectiveness and Permanence (Alternative 1)

This alternative would be neither effective in the long-term nor permanent because the potential for release and transport of mercury and other CPOIs, and the associated risks to human health and ecological receptors, would not be controlled or eliminated. Some amount of natural recovery would be anticipated due to the remediation of upstream and external sources; however, it is unlikely that the RAOs and PRGs would be met within an acceptable timeframe.

Because this alternative would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA would require under this alternative that the site be reviewed at least once every five years. If justified by the review, remedial actions may be implemented to remove, treat, or contain contaminated soil/sediment.

Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 1)

No treatment would be performed under this alternative; therefore, there would be no reduction of toxicity, mobility, or volume through treatment.

Implementability (Alternative 1)

This alternative is readily implementable because no remedial actions would be conducted.

Cost (Alternative 1)

Excluding costs associated with the Geddes Brook IRM, there are no capital and O&M costs associated with Alternative 1.

3.2.2 Alternative 2 - Removal and Cover

Description of Alternative

This alternative is consistent with Alternative C2(C3)/FP2(B3) in the FS (Parsons, 2005), modified to reflect the new information described in Section 2. Alternative 2 is included in this Supplemental FS as a representative removal and cover alternative. Specific components of this alternative, as shown on Figure 3-1, include:

- Geddes Brook channel: Remove sediment from the existing Geddes Brook channel to clay, consistent with the Geddes Brook IRM. Downstream of the culverts, relocate the Geddes Brook channel west, to provide improved sinuosity, increased length, better connectivity with the floodplain, and ability for channel migration.
- Geddes Brook floodplain: Remove up to 2 ft of floodplain soil/sediment with mercury concentrations exceeding 1.3 mg/kg and other non-mercury CPOIs exceeding PRGs. Place up to 2 ft of vegetated cover in areas where soil/sediment had been removed.
- Ninemile Creek channel: Remove up to 3 ft of channel sediment with mercury concentrations exceeding 1.3 mg/kg and other non-mercury CPOIs exceeding PRGs and deeper sediment as required to meet chemical isolation layer effectiveness (removals up to approximately 4 ft may be required). Place a habitat/cover system, consisting of a chemical isolation layer and a habitat layer (which may incorporate an underlying armoring layer) over areas where sediment had been removed but residual sediment concentrations exceed PRGs. For this alternative, the habitat/armoring layer is assumed to be up to 2-ft thick. The underlying chemical isolation layer, where present, would be 1-ft thick, except in those locations where additional removals and/or a thicker chemical isolation layer is required for cover system effectiveness. Areas where all material in excess of PRGs had been removed would be backfilled, with a habitat layer provided as the upper part of the backfill.
- Ninemile Creek floodplain: Remove up to 2 ft of floodplain soil/sediment with mercury concentrations exceeding 1.3 mg/kg and other non-mercury CPOIs exceeding PRGs. Place up to 2 ft of vegetated cover in areas where soil/sediment had been removed.

Soil/sediment removal volumes, mercury masses, and channel and floodplain habitat areas are presented on Table 3-1. Removal areas for the alternative are shown on Figures 3-4 and 3-5.

Overall Protection of Human Health and the Environment (Alternative 2)

This alternative would achieve the RAOs established for the Geddes Brook/Ninemile Creek site. As shown on Table 3-1, implementation of Alternative 2 would result in the removal of the majority of contamination from the site. Following the removals, channel and floodplain cover systems would be installed to prevent exposure to residual concentrations. For the channel habitat cover system, chemical isolation layer modeling, presented in Appendix E, indicates that this alternative would meet target concentrations for all CPOIs at the point of compliance, which is at the bottom of the habitat layer. As shown in Appendix E, depending on underlying sediment concentration, the chemical isolation layer may need to be as thick as 1.25 ft in Reach BC and 1.75 ft in Reach CD. As described in the FS (Parsons, 2005), 2 ft of cover in the floodplain would prevent ecological exposure to underlying soil/sediment and would be protective because the majority of exposure to floodplain soil/sediment occurs in the 0 to1 ft (i.e., 0 to 30 cm) depth interval. Both the channel and floodplain covers would be designed to create a suitable/enhanced ecological habitat.

This alternative would be protective of benthic macroinvertebrates, because as shown on Table 3-2 for the top 2 ft of soil/sediment, it would:

- meet the two higher sediment toxicity targets for mercury and the two lower sediment toxicity targets for mercury (0.5 and 0.15 mg/kg mercury) in approximately 70% and 58%, respectively, of the channel and floodplain; and
- meet sediment toxicity targets for arsenic, lead, total polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), hexachlorobenzene, and phenol.

Post-remediation SWACs for mercury, benzo(a)pyrene, and hexachlorobenzene, as shown on Tables 3-3 and 3-4 (assuming a chemical isolation layer thickness of 1.25 ft for Reach BC and 1.5 ft for Reach CD where required), meet all SWAC-based sediment targets for these chemicals indicating that the alternative would be:

- protective of human health (i.e., consumption of fish containing mercury and direct exposure to sediment containing benzo(a)pyrene); and
- protective of ecological receptors (i.e., wildlife consumption of fish and invertebrates containing mercury and wildlife consumption of invertebrates containing hexachlorobenzene).

It should be noted that Table 3-4 shows a slight exceedance of the SWAC-based sediment target for mercury in the Reach BC floodplain; however the exceedance is by less than 10% and is within the precision of the measurement. As a result, residual risk to humans and wildlife is unlikely, which would be confirmed during pre-design sampling.

The alternative would also be protective of human health potentially impacted by consumption of fish containing PCBs and polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDD/PCDFs). PCBs and PCDD/PCDFs are not widespread in Ninemile Creek sediments and the areas where these CPOIs are elevated are generally located within the areas addressed under this alternative. The reduction in PCB and PCDD/PCDF concentrations in sediment as a result of this alternative is expected to result in reduced fish tissue concentrations over time, to the extent that Geddes Brook/Ninemile Creek sediments contribute to the body burden of these contaminants in fish tissue.

Thus, this alternative is considered protective of human health and the environment, as it addresses the majority of targets listed in Table 2-2 for protection of benthic macroinvertebrates, as discussed above, and all targets for protection of human health and wildlife.

Compliance with ARARs (Alternative 2)

This alternative would comply with all chemical-specific ARARs with possible exceptions due to upstream/upgradient anthropogenic sources. As discussed for Alternative 1 (see Section 3.2.1), for surface water, two of the four NY State water quality standards for mercury (based on dissolved total mercury) for Class B/C waters were exceeded in lower Geddes Brook and the West Flume. Remediation of the West Flume (and the former LCP Bridge Street Site (OU-1)) and lower Geddes Brook (under the IRM) would be expected to mitigate or eliminate these exceedances for mercury. The water quality standards for dissolved solids, iron, and aluminum are not consistently met in Geddes Brook and Ninemile Creek, even upstream of the site. Meeting these standards is unlikely, given upgradient/upstream anthropogenic sources at the site. There are no chemical-specific ARARs for sediment.

Sediment removal, handling, dewatering, and consolidation, as well as the installation of the channel and floodplain cover systems, are expected to meet action-specific and location-specific ARARs. Appropriate regulatory approvals or permits would be obtained prior to initiating the alternative.

Short-Term Effectiveness (Alternative 2)

As summarized in Appendix F, the estimated remedial construction duration of Alternative 2 is approximately 28 weeks, occurring over approximately one construction season. Over this duration, a total of approximately 64,000 cy of soil/sediment would be removed from the site, including 35,000 cy from the Geddes Brook channel and floodplain, and 29,000 cy from the Ninemile Creek channel and floodplain.

Potential short-term risks associated with sediment dredging and other activities in the channel include resuspension of channel sediment and related potential impacts to water quality. These risks would be mitigated through the use of best management dredge practices (e.g., the use of environmental buckets where feasible) and silt curtains placed downstream from the dredge site and at the mouth of the creek. Under Alternative 2, the duration of sediment dredging would be approximately 13 weeks.

Other short-term risks associated with sediment dredging, floodplain soil/sediment excavation, and cover system installation include those associated with erosion of floodplain soil/sediment, air emissions from stockpiles and equipment, noise and light from construction equipment, and truck traffic to the upland soil/sediment consolidation area. These types of risks, however, are common to many remedial projects and would be mitigated as feasible using standard construction techniques and prevailing industry practices.

The soil/sediment removals under this alternative would also temporarily impact the existing benthic macroinvertebrate and terrestrial species in the area, and indirect effects may be experienced by fish that forage in the affected area due to temporary disruption of the benthic food web. However, the negative ecological effects would be limited temporarily (studies of benthic recolonization indicate that recovery occurs within one to three years), and offset by the positive long-term effects of clean cover system materials for benthic habitat.

Long-Term Effectiveness and Permanence (Alternative 2)

This alternative would provide long-term effectiveness and permanence by removing or isolating contaminated sediment and thus eliminating the potential human health and ecological exposure pathways associated with contamination in the creek and floodplain. As discussed in Appendix D, a stable habitat/cover system can be installed in Ninemile Creek. In addition to providing long-term effectiveness and permanence through its stability, the habitat/cover system would be coordinated with existing infrastructure. As further described in Appendix D, the habitat component of the habitat/cover system would be composed of graded gravel that would provide improved habitat for fish and benthic macroinvertebrates.

Because this alternative would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA would require under this alternative that the site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contaminated soil/sediment.

Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 2)

As shown on Table 3-1, implementation of Alternative 2 will result in the removal of approximately 64,000 cy of soil/sediment and approximately 1,080 pounds of mercury, significantly reducing the toxicity, mobility, and volume of impacted soil/sediment. The cover systems, installed following the removals, will reduce the mobility of residual concentrations in soil/sediment. Although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal versus treatment, the alternative includes treatment of construction water, which could include precipitation, clarification, and polishing using carbon.

Implementability (Alternative 2)

Floodplain soil excavation, creek sediment dredging, and placing cover materials on floodplains and through surface water have been successfully implemented at similar sites. Construction of temporary haul roads, removal of floodplain soil/sediment, construction and operation of sediment decant piles, construction and operation of a temporary water treatment system, and upland confinement of contaminated sediment is routine work for environmental remediation contractors.

Removal of contaminated sediment in Ninemile Creek would be done by dredging with the use of shore-based excavators or cranes. It is not anticipated that sheet pile would be required to remove sediment and install the cover systems (in general, 0 to 4 ft removals anticipated). The dredging would be moderately difficult to implement due to the challenges of accurate removal, mitigating resuspension of sediment and potential impacts to water quality, and achieving required post-dredge surface sediment concentrations. These three factors are discussed below:

- Accurate dredge cut can be made using modern Real Time Kinematic-Global Positioning System (RTK-GPS), boom angle sensors, and 3-dimensional dredge bucket positioning software.
- Resuspension of sediment and potential impacts to water quality would be mitigated by use of best-management dredge practices (e.g., the use of environmental buckets where feasible) and silt curtains downstream from the dredge site and at the mouth of the creek.
- As described in an assessment of dredging effectiveness at Superfund sediment sites (NRC, 2001), it is difficult to achieve low levels of post-dredging surface concentrations. As the National Research Council (NRC) report states, dredging can be effective for removal of mass, but mass removal alone does not necessarily achieve risk-based goals. There are however, several methods and technologies available to assist with achieving target PRGs. For example, dredging could be done with level-cut environment buckets, which are specifically designed to effectively remove contaminated sediment and minimize the mass of sediment that is disturbed but not removed. In addition, the sequencing of work from upstream to downstream would mitigate the potential for recontamination of dredged and/or covered areas. Finally, consistent with the 2007 NRC study, placement of a cover system following dredging will greatly enhance the likelihood of achieving target PRGs at the point of exposure.

The thicknesses for the individual layers within the habitat/cover system (i.e. chemical isolation layer and a habitat/armor layer) were estimated as described in Appendices D and E. Actual thicknesses of the individual layers within the habitat/cover system will be determined during design. In addition to the design parameters described in Appendices D and E (e.g. scour assessments, chemical isolation layer effectiveness), placement methods and monitoring requirements will also be considered during design with respect to layer thicknesses. In addition, the incorporation of synthetic materials will also be considered during design, which may also affect the thicknesses of individual layers.

Removal of contaminated sediment under existing bridges in Ninemile Creek Reach BC is anticipated to be difficult to implement. Specialized equipment and/or methods may be required to remove sediment and place cover systems in these discrete areas.

Cost (Alternative 2)

Estimated costs associated with Alternative 2 are as follows:

Alternative 2	Total Capital Costs	O&M Present Value	Total Present Value
Geddes Brook	$9.3 M	$0.6 M	$9.9 M
Ninemile Creek	$9.2 M	$1.1 M	$10.3 M
OU-1 (Geddes Brook/Ninemile Creek)	$18.5 M	$1.7 M	$20.2 M

Cost estimate spreadsheets and other assumptions that form the basis for these estimates are provided in Appendix F.

3.2.3 Alternative 3 – Removal and Cover/Backfill (Integrated Approach)

Description of Alternative

This alternative, which is new, integrates site remediation and habitat development with site features by tailoring the application of the removal, cover, and backfill technologies evaluated in the FS (Parsons, 2005) to areas of the site based on limits defined by physical features (e.g., breaks in grade horizontally, clay or gravel vertically where present in the upper 2 or 3 ft). Effectiveness for this alternative is assessed using a range of mercury PRGs.

A detailed description of this alternative, commensurate with that presented in the FS (Parsons, 2005) for Alternatives 1, 2, and 4, is provided in Appendix G. Specific components of this alternative, as shown on Figure 3-2, are summarized below. Because Alternative 3 tailors the remedial approach to areas of the site based on physical features, the summary below includes separate discussion for different portions of the Ninemile Creek channel and floodplain.

- Geddes Brook channel: Remove sediment from the existing Geddes Brook channel to clay, consistent with the Geddes Brook IRM. Downstream of the culverts, relocate Geddes Brook channel west, to provide improved sinuosity, increased length, better connectivity with the floodplain, and ability for channel migration.
- Geddes Brook floodplain: Remove floodplain soil/sediment vertically to an underlying clay layer that is typically 2 to 4 ft below ground surface, and horizontally to a break in grade that bounds the floodplain, as shown on Figure 3-2. Place approximately 1 ft of vegetated cover in areas where soil/sediment had been removed, resulting in a lower overall elevation, with the intent to establish an emergent wetland.
- Ninemile Creek channel (Upper Reach CD): Remove sediment from the Upper Reach CD channel to allow for channel remediation and habitat development. Install a habitat layer (which may incorporate an underlying armoring layer) in the new channel. For purposes of this Supplemental FS, the habitat/armoring layer is assumed

to be up to 2-ft thick. The nature and vertical extent of contamination in Upper Reach CD may not require the installation of a chemical isolation layer; however, if required based on evaluation of pre-design investigation data, habitat layer would be underlain with a chemical isolation layer. For the purposes of this Supplemental FS, it is assumed that the underlying chemical isolation layer would be 1.75-ft thick for Reach CD; the actual thickness of the chemical isolation layer would be determined during design. Further detail and assumptions regarding the remedy for upstream of the large island and in the vicinity of the large island are presented below:

- Upstream of the Large Island: As shown on Figure 3-2, upstream of the large island, it is assumed that the remediated/restored channel would generally maintain existing grade and channel dimensions. For the purpose of this Supplemental FS, an average removal of 4 ft was assumed; the actual depth of removal will be determined during design.
- Vicinity of Large Island: As shown on Figure 3-2, in the vicinity of the large island, the southern channel would be widened and deepened (if required) to carry the entire creek flow and the northern channel would be backfilled with clean material, to create a floodplain and/or wetland buffer between the wastebed and Ninemile Creek. A preliminary assessment indicates that removals in the southern channel for hydrodynamic purposes beyond the base removal of 3 to 4 ft may range from 0 to 2 ft, for a total required removal in the channel of 3 to 6 ft. An overall average removal of 5 ft was assumed for purposes of the Supplemental FS; the actual depth of removal will be determined during design. As also shown on Figure 3-2, a portion of the channel will be relocated over the large island itself. The depth of removal at this location could range from 6 to 12 ft, with the actual depth to be determined during design.

- Ninemile Creek channel (Lower Reach CD): Relocate Lower Reach CD to the southern portion of the floodplain to create a floodplain and/or wetland buffer between the wastebed and Ninemile Creek, as shown on Figure 3-2. Install a habitat layer (as described above) in the new channel. Similar to Upper Reach CD, if required based on an evaluation of pre-design investigation data, underlie the habitat layer with a chemical isolation layer. Removals in this portion of the floodplain (new channel) are anticipated to range in depth from 6 to 12 ft. For the purpose of this Supplemental FS, an average removal of 11.5 ft was assumed (see Appendix C for further discussion); the actual depth of removal will be determined during design.
- Ninemile Creek channel (Reach BC): Remove approximately 0 to 4 ft of sediment from the Reach BC channel to allow for the installation of a habitat/cover system, to allow for passage of flood flows under existing infrastructure and protection of floodplain areas in accordance with applicable requirements, and to provide sufficient water depth for fish passage and canoe access during low flows. For the purpose of this Supplemental FS, an average removal of 3 ft was assumed; the actual depth of removal will be determined during design. Place a habitat/cover system, consisting of

a chemical isolation layer (assumed to be 1.25 ft-thick for the purposes of the Supplemental FS) and a habitat layer (as described above).

- Ninemile Creek floodplain (Reach CD): Remove 2 ft of floodplain soil/sediment to the break in grade that bounds the floodplain, in the areas shown on Figure 3-2. As described in Appendix G, conduct a hotspot removal in the localized area shown on Figure 3-2. The hotspot removal would consist of a focused removal in the former channel and extending the depth of removal in the adjoining floodplain to remove mercury mass and reduce residual concentrations in the proximity of the new channel, thus enhancing the reliability of the remedy. The extent of hotspot removal would be determined during remedial design based on the results of a pre-design investigation. Backfill the former lower CD channel adjacent to the wastebed. Place 2 ft of vegetated cover on the floodplain, within the limits defined by the break in grade, and restore the area as wetland or upland, with a goal of no net loss of wetland area.
- Ninemile Creek floodplain (Reach BC): Remove floodplain soil/sediment (approximately 0 to 3 ft in depth, 1 ft typical) overlying structural stone between the Ninemile Creek waterline and the break in grade at the top of the bank. Place approximately 1 ft of vegetated cover along the length of Reach BC, from the water line to the break in grade.

Soil/sediment removal volumes, mercury masses, and channel and floodplain habitat areas are presented on Table 3-1. Removal areas for the alternative are shown on Figures 3-6 and 3-7.

Overall Protection of Human Health and the Environment (Alternative 3)

This alternative would achieve the RAOs established for the Geddes Brook/Ninemile Creek site. As shown on Table 3-1, implementation of Alternative 3 would result in the removal of the majority of contamination from the site. Following the removals, channel and floodplain habitat/cover systems would be installed to prevent exposure to residual concentrations. For the channel habitat cover system, chemical isolation layer modeling, presented in Appendix E, indicates that with a 1.75-ft thick chemical isolation layer in Reach CD and a 1.25-ft thick chemical isolation layer in Reach BC, this alternative would meet target concentrations for all CPOIs at the point of compliance, which is at the bottom of the habitat layer. As described in the FS (Parsons, 2005), 2 ft of cover in the floodplains would prevent ecological exposure to underlying soil/sediment and would be protective. Both the channel and floodplain habitat/cover systems would be designed to create an enhanced ecological habitat.

This alternative would be protective of benthic macroinvertebrates, because as shown on Table 3-2 for the top 2 ft of soil/sediment, it would:

- meet the two higher sediment toxicity targets for mercury and the two lower sediment toxicity targets for mercury (0.5 and 0.15 mg/kg mercury) in approximately 99% and 96%, respectively, of the channel and floodplain. When the upper 1 ft is considered, all four sediment toxicity targets for mercury are met.

- meet sediment toxicity targets for arsenic, lead, total PAHs, PCBs, hexachlorobenzene, and phenol.

Post-remediation SWACs for mercury, benzo(a)pyrene, and hexachlorobenzene, as shown on Tables 3-3 and 3-4, assuming a chemical isolation layer thickness of 1.25 ft for the Reach BC channel and 1.75 ft for the Reach CD channel, meet all SWAC-based sediment targets for these chemicals, indicating that the alternative would be:

- protective of human health (i.e., consumption of fish containing mercury and direct exposure to sediment containing benzo(a)pyrene); and
- protective of ecological receptors (i.e., wildlife consumption of fish and invertebrates containing mercury and wildlife consumption of invertebrates containing hexachlorobenzene).

As discussed for Alternative 2, this alternative would also be protective of human health potentially impacted by consumption of fish containing PCBs and PCDD/PCDFs. PCBs and PCDD/PCDFs are not widespread in Ninemile Creek sediments and the areas where these CPOIs are elevated are generally located within the areas addressed under this alternative. The reduction in PCB and PCDD/PCDF concentrations in sediment as a result of this alternative is expected to result in reduced fish tissue concentrations over time, to the extent that Geddes Brook/Ninemile Creek sediments contribute to the body burden of these contaminants in fish tissue.

Thus, this alternative is considered protective of human health and the environment.

Compliance with ARARs (Alternative 3)

Alternative 3 would comply with all chemical-specific ARARs with possible exceptions due to upstream/upgradient anthropogenic sources. As discussed for Alternatives 1 and 2, for surface water, two of the four NY State water quality standards for mercury (based on dissolved total mercury) for Class B/C waters were exceeded in lower Geddes Brook and the West Flume. Remediation of the West Flume (and the former LCP OU-1) and lower Geddes Brook (under the IRM) would be expected to mitigate or eliminate these exceedances for mercury. The water quality standards for dissolved solids, iron, and aluminum are not consistently met in Geddes Brook and Ninemile Creek, even upstream of the site. Meeting these standards is unlikely, given upgradient/upstream anthropogenic sources at the site. There are no chemical-specific ARARs for sediment.

Sediment removal, handling, dewatering, and consolidation, as well as the installation of the channel and floodplain habitat/cover systems, are expected to meet action-specific and location-specific ARARs. Appropriate regulatory approvals or permits would be obtained prior to initiating the alternative.

Short-Term Effectiveness (Alternative 3)

As summarized in Appendix F, the estimated construction duration of Alternative 3 is approximately 62 weeks, occurring over approximately two construction seasons. Over this duration, a total of approximately 126,000 cy of soil/sediment would be removed from the site, including approximately 67,000 cy from the Geddes Brook channel and floodplain, and 59,000 cy from the Ninemile Creek channel and floodplain. These volumes do not include approximately 22,000 cy of material excavated during new channel construction that has been assumed to be suitable for reuse on site.

This alternative has many of the same short-term effectiveness risks as Alternative 2 (Section 3.2.2), although in general, these issues could be potentially more pronounced where dredging occurs due to the larger volumes of materials removed and the potentially deeper channel removals. Similar to Alternative 2, these risks would be mitigated as feasible using standard construction techniques and prevailing industry practices. For Alternative 3, it would take approximately 13 weeks to install and remove diversion berms and about 14 weeks to perform dredging in Reach CD upstream of the large island and in Reach BC.

Long-Term Effectiveness and Permanence (Alternative 3)

This alternative would provide long-term effectiveness and permanence by removing or isolating contaminated sediment and thus eliminating the potential human health and ecological exposure pathways associated with contamination in the creek and floodplain. Residual concentrations of constituents in soil/sediment that are not removed would be isolated by channel and floodplain habitat/cover systems, which for Alternative 3, would comprehensively cover the entire site. As discussed in Appendix D, a stable habitat/cover system can be installed in Ninemile Creek. In addition to providing long-term effectiveness and permanence through its stability, the channel realignments and habitat/cover system would be designed to meet requirements for protection of existing infrastructure and floodplain areas. As further described in Appendix D, the habitat component of the habitat/cover system would be composed of graded gravel that would provide improved habitat for fish and benthic macroinvertebrates.

Because this alternative would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA would require under this alternative that the site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain contaminated soil/sediment.

Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 3)

As shown on Table 3-1, implementation of Alternative 3 will result in the removal of approximately 126,000 cy of soil/sediment and approximately 1,540 pounds of mercury, significantly reducing the toxicity, mobility, and volume of impacted soil/sediment. The habitat/cover systems, installed following the removals, will comprehensively cover the site and reduce the mobility of residual concentrations in soil/sediment. Although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal versus treatment, the alternative includes treatment of construction water, which could include precipitation, clarification, and polishing using carbon.

Implementability (Alternative 3)

Floodplain soil/sediment excavation, creek sediment dredging, and placing cover materials on floodplains and through surface water have been successfully implemented at similar sites. Construction of temporary haul roads, removal of floodplain soil/sediment, construction and operation of sediment decant piles, construction and operation of a temporary water treatment system, and upland confinement of contaminated sediment is routine work for environmental remediation contractors.

Removal of contaminated sediment from Geddes Brook and a significant portion of Ninemile Creek would be performed by excavation after the creek surface water has been diverted, as summarized below:

- For Geddes Brook, the new channel would be excavated while the creek flow was in the original channel. Once the new channel had been constructed, flow would be transferred to the new channel and the original channel would be excavated. (Same as for Alternatives 2 and 4.)
- For the large island segment of Reach CD in Ninemile Creek, the flow would be diverted through the north channel, while the south channel was widened. Remediation in the north channel would be completed after flow had been permanently diverted to the south channel. (Specific to Alternative 3.)
- For the small island segment of Ninemile Creek Reach CD, flow would remain in the existing channel, while the new channel was constructed. Remediation in the existing channels would be completed after flow had been diverted to the new channel. (Specific to Alternative 3.)
- The deep excavations associated with the construction of the new channel alignment would be performed by sloping of the excavation side walls, mitigating or eliminating the need for extensive sheeting. Sheeting would be needed for stream diversions/construction sequencing for Alternative 3; however, the extent of sheeting would be limited.

Diversion of creek water and excavation of new or widened channels would be moderately difficult to implement due to the challenges of working in a shallow-water creek, excavation below the elevation of the creek water and groundwater, and working on soft sediment. The creek water diversions would be constructed with earthen berms or sheet pile using methods that have been used at other sites. Likewise, groundwater control measures and excavation of soft sediments has been done at other sites with similar conditions.

Sediment removal by dredging would be limited to Reach CD upstream of the large island and in Reach BC. As discussed for Alternative 2 in Section 3.2.2, dredging would be moderately difficult to implement. As with Alternative 2, however, it is not anticipated that sheet pile would be required to complete the channel removals required to remove sediment and install the cover systems (in general, 0 to 4 ft removals anticipated).

As with Alternative 2, the thickness of the chemical isolation layer will consider practical limitations regarding placement. Also as with Alternative 2, removal of contaminated sediment under existing bridges in Ninemile Creek Reach BC is anticipated to be difficult to implement. Specialized equipment and/or methods may be required to remove sediment and place cover systems in these discrete areas.

Cost (Alternative 3)

Estimated costs associated with Alternative 3 are as follows:

Alternative 3	Total Capital Costs	O&M Present Value	Total Present Value
Geddes Brook	$12.8 M	$0.4 M	$13.2 M
Ninemile Creek	$18.9 M	$1.3 M	$20.2 M
OU-1 (Geddes Brook/Ninemile Creek)	$31.7 M	$1.7 M	$33.4 M

Cost estimate spreadsheets and other assumptions that form the basis for these estimates are provided in Appendix F.

3.2.4 Alternative 4 - Removal and Backfill

Description of Alternative

This alternative is consistent with Alternative C3(E)/FP3(E) in the FS (Parsons, 2005), modified to reflect the recent information described in Section 2. Specific components of this alternative, as shown on Figure 3-3, include:

- Geddes Brook channel: Remove sediment from the existing Geddes Brook channel to clay, consistent with the Geddes Brook IRM. Downstream of the culverts, relocate the Geddes Brook channel west, to provide improved sinuosity, increased length, better connectivity with the floodplain, and ability for channel migration.
- Geddes Brook floodplain: Remove floodplain soil/sediment with mercury concentrations exceeding 0.15 mg/kg and other non-mercury CPOIs exceeding PRGs. It is anticipated that the removal would range in depths from approximately 1-5 ft and average 3 ft. Place approximately 1 ft of vegetated cover in areas where soil/sediment

had been removed, resulting in a lower overall elevation, with the intent to establish an emergent wetland.

- Ninemile Creek channel: Remove sediment with mercury concentrations exceeding 0.15 mg/kg and other non-mercury CPOIs exceeding PRGs. It is anticipated that the removal would average 6 ft, with a maximum of 16 ft. Backfill areas of removal, providing a habitat layer as the upper part of the backfill.
- Ninemile Creek floodplain: Remove floodplain soil/sediment with mercury concentrations exceeding 0.15 mg/kg and other non-mercury CPOIs exceeding PRGs. It is anticipated that the removal would range in depths from approximately 1-4 ft and average 2 ft. Backfill the removal to previous ground surface or a shallower depth to provide terrestrial or wetland habitat.

Soil/sediment removal volumes, mercury masses, and channel and floodplain habitat areas are presented on Table 3-1. Removal areas for the alternative are shown on Figures 3-8 and 3-9.

Overall Protection of Human Health and the Environment (Alternative 4)

This alternative would achieve the RAOs established for the Geddes Brook/Ninemile Creek site. As shown on Table 3-1, implementation of Alternative 4 would result in the removal of approximately 100% of the contamination from the site. Following the removals, channel and floodplain areas would be backfilled with clean soil. Similar to Alternative 3, Alternative 4 would be protective of benthic macroinvertebrates because as shown on Table 3-2 for the top 2 ft of soil/sediment, it would:

- meet all four sediment toxicity targets for mercury;
- meet sediment toxicity targets for arsenic, lead, total PAHs, PCBs, hexachlorobenzene, and phenol.

Post-remediation SWACs for mercury, benzo(a)pyrene, and hexachlorobenzene, as shown on Tables 3-3 and 3-4 meet all SWAC-based sediment targets for these chemicals, indicating that the alternative would be:

- protective of human health (i.e., consumption of fish containing mercury and direct exposure to sediment containing benzo(a)pyrene); and
- protective of ecological receptors (i.e., wildlife consumption of fish and invertebrates containing mercury and wildlife consumption of invertebrates containing hexachlorobenzene).

As discussed for Alternatives 2 and 3, this alternative would also be protective of human health potentially impacted by consumption of fish containing PCBs and PCDD/PCDFs. PCBs and PCDD/PCDFs are not widespread in Ninemile Creek sediments and the areas where these CPOIs are elevated are generally located within the areas addressed under this alternative. The reduction in PCB and PCDD/PCDF concentrations in sediment as a result of this alternative is expected to result in reduced fish tissue concentrations over time, to the extent that Geddes

Brook/Ninemile Creek sediments contribute to the body burden of these contaminants in fish tissue.

Thus, this alternative is considered protective of human health and the environment.

Compliance with ARARs (Alternative 4)

Alternative 4 would comply with all chemical-specific ARARs with possible exceptions due to upstream/upgradient anthropogenic sources. As discussed for Alternatives 1, 2, and 3, for surface water, two of the four NY State water quality standards for mercury (based on dissolved total mercury) for Class B/C waters were exceeded in lower Geddes Brook and the West Flume. Remediation of the West Flume (and the former LCP OU-1) and lower Geddes Brook (under the IRM) would be expected to mitigate or eliminate these exceedances for mercury. The water quality standards for dissolved solids, iron, and aluminum are not consistently met in Geddes Brook and Ninemile Creek, even upstream of the site. Meeting these standards is unlikely, given upgradient/upstream anthropogenic sources at the site. There are no chemical-specific ARARs for sediment.

Sediment removal, handling, dewatering, and consolidation as well as backfill are expected to meet action-specific and location-specific ARARs. Appropriate regulatory approvals or permits would be obtained prior to initiating the alternative.

Short-Term Effectiveness (Alternative 4)

As summarized in Appendix F, the estimated construction duration of Alternative 4 is approximately 101 weeks, occurring over approximately three construction seasons. Over this duration, a total of approximately 146,000 cy of soil/sediment would be removed from the site, including 73,000 cy from the Geddes Brook channel and floodplain, and 73,000 cy from the Ninemile Creek channel and floodplain.

This alternative has many of the same short-term effectiveness risks as Alternatives 2 and 3 (Sections 3.2.2 and 3.2.3), although in general, these issues would be significantly more pronounced due to the larger volumes of materials removed, longer duration of construction work, and the deeper channel removals. Similar to Alternatives 2 and 3, these risks would be mitigated as feasible using standard construction techniques and prevailing industry practices.

Installation and removal of sheet pile would result in resuspension of contaminated sediment because the near-surface sediment is soft and can become re-suspended by physical disturbance. This impact is significant for Alternative 4 because of the large volume of sheet pile needed and the long duration of driving and removing. For example, installation of sheet piles for one 600-ft long section would require approximately 1,300 linear feet of wall, which would take approximately 10 weeks to install with two crews. It would take approximately 6 weeks to remove. For this alternative, there would be over 7,000 linear feet of sheet pile; the installation and removal of sheet pile with the associated sediment removal would require approximately 80 weeks to complete. In addition to the required schedule for sheet pile, there would be approximately 9 weeks of dredging in Reach CD upstream of the large island and in Reach BC downstream of State Fair Blvd.

Long-Term Effectiveness and Permanence (Alternative 4)

This alternative would provide long-term effectiveness and permanence by removing contaminated sediment and thus eliminating the potential human health and ecological exposure pathways associated with contamination in the creek and floodplain.

Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 4)

As shown on Table 3-1, implementation of Alternative 4 will result in the removal of approximately 146,000 cy of soil/sediment and approximately 1,670 pounds of mercury, significantly reducing the toxicity, mobility, and volume of impacted soil/sediment. Although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal versus treatment, the alternative includes treatment of construction water, which could include precipitation, clarification, and polishing using carbon.

Implementability (Alternative 4)

Floodplain soil/sediment excavation, creek sediment dredging, and placing cover materials on floodplain and through surface water have been successfully implemented at similar sites. Construction of temporary haul roads, removal of floodplain soil/sediment, construction and operation of sediment decant piles, construction and operation of a temporary water treatment system, and upland confinement of contaminated sediment is routine work for environmental remediation contractors.

Removal of contaminated sediment from Ninemile Creek to reach the Alternative 4 target PRG would require removals to depths averaging 6 ft, and up to 16 ft. Removals to such depths would require structural support to prevent failure of the creek banks and adjacent infrastructure. For structural support, deep sheeting (e.g., 40-ft sheets) would be required, as summarized below:

- For Reach CD in Ninemile Creek, sheet pile would be installed along the shoreline and along the center of the channel or along the existing islands. Creek water flow would be diverted through one half of the creek channel, while the other half was remediated.
- For Reach BC in Ninemile Creek, sheet pile would be installed along the shoreline and along the center of the channel. Creek water flow would be diverted through one half of the creek channel while the other half was remediated, except where the existing low bridges are located.

Installation and removal of 40-ft sheet piles in the creek, diversion of creek water and excavation within the channels would be moderately difficult to implement due to the challenges of working in a shallow-water creek, excavation below the elevation of the creek water and working on soft sediments. The work would be constructed with methods that have been used at other sites.

As with Alternatives 2 and 3, removal of contaminated sediment under existing bridges in Ninemile Creek Reach BC is anticipated to be difficult to implement. Specialized equipment and/or methods may be required to remove sediment and place cover systems in these discrete areas.

Cost (Alternative 4)

Estimated costs associated with Alternative 4 are as follows:

Alternative 4	Total Capital Costs	O&M Present Value	Total Present Value
Geddes Brook	$13.3 M	$0.4 M	$13.7 M
Ninemile Creek	$29.2 M	$0.8 M	$30.0 M
OU-1 (Geddes Brook/Ninemile Creek)	$42.5 M	$1.2 M	$43.7 M

Cost estimate spreadsheets and other assumptions that form the basis for these estimates are provided in Appendix F.

3.3 COMPARATIVE EVALUATION OF ALTERNATIVES

All alternatives, with the exception of Alternative 1 – No Action, can be implemented to effectively meet the RAOs established for the Geddes Brook/Ninemile Creek site. Alternatives 2, 3 and 4 all include the realignment of the Geddes Brook channel which will improve connectivity with the floodplain and provide greater habitat value following remediation. Alternative 3 relocates Reach CD in Ninemile Creek away from the wastebeds, which facilitates remedy implementation and provides opportunities for habitat enhancement not provided by Alternatives 2 or 4, including creating a broader area on the north side of the channel for riparian habitat (e.g., vernal pools, forested floodplains) and a sloped transition between the creek and adjacent upland areas. Public use and access (e.g., the canoe launch) to Ninemile Creek will be preserved under each alternative.

Overall Protection of Human Health and the Environment

All alternatives, with the exception of Alternative 1 – No Action, would achieve the RAOs established for the Geddes Brook/Ninemile Creek site. Alternatives 2, 3, and 4 meet all SWAC-based sediment targets for protection of bioaccumulation and direct contact (by humans). Alternatives 2, 3, and 4 are all also expected to result in reduced contaminant concentrations in fish and, consequently, reduced risk to humans and ecological receptors from fish consumption.

Further comparative evaluation, especially with respect to meeting mercury targets for protection of benthic macroinvertibrates, is presented below.

Geddes Brook Channel

All of the alternatives, with the exception of Alternative 1 – No Action, would be equally protective in the Geddes Brook channel, because each will remove sediment down to clay in the channel, consistent with the IRM, thus effectively reducing risk associated with direct contact or bioaccumulation.

Geddes Brook Floodplain

In the Geddes Brook floodplain, Alternative 2 provides protectiveness by removal of up to 2 ft of material with concentrations that exceed 1.3 mg/kg mercury and/or point-by-point targets for other CPOIs and replacement with up to 2 ft of clean soil. This alternative would also address 75% and 66% of the Geddes Brook floodplain that exceeds 0.5 and 0.15 mg/kg mercury, respectively (Table 3-2).

Alternative 3 provides protectiveness by removal of sediment to the clay layer; as a result, 100% of the floodplain that exceeds the two higher mercury targets and over 90% that exceeds the two lower mercury targets is addressed. Alternative 4 removes sediment to 0.15 mg/kg mercury (i.e., essentially to concentrations below background). Remediated areas under either Alternative 3 or Alternative 4 will be covered with approximately 1 ft of clean soil to establish habitat.

Ninemile Creek OU-1 Channel

In the Ninemile Creek channel, Alternative 2 provides protectiveness by removal of 3 ft (possibly 4 ft, depending on chemical isolation requirements) of material with concentrations that exceed 1.3 mg/kg mercury and/or point-by-point targets for all other CPOIs and replacement with a cover system that includes a chemical isolation layer (if required) and a habitat layer. This alternative would also address 76% and 69% of the Ninemile Creek surface that exceeds 0.5 and 0.15 mg/kg mercury, respectively (Table 3-2).

Alternative 3 removes approximately 3 to 4 ft of sediment bank to bank from the Upper Reach CD channel to allow for channel remediation and habitat development, including a habitat layer and a chemical isolation layer (if required). In the vicinity of the large island, the northern channel would be filled and all flow would be routed through a widened and deepened (if required) southern channel, where overall removals greater than 3 to 4 ft may be required. In Lower Reach CD, Alternative 3 would relocate the channel to the southern portion of the floodplain and install a habitat layer and a chemical isolation layer (if required), thus addressing the entire area of Lower Reach CD. Alternative 3 also removes approximately 0 to 4 ft of sediment from the entire Reach BC channel where required to allow for the installation of a habitat and chemical isolation cover system. Alternative 4 removes sediment to 0.15 mg/kg mercury (i.e., essentially to concentrations below background) and backfills to the original grade, including a habitat layer in the upper portion of the backfill. Alternatives 3 and 4 thus address all point-by-point sediment targets for mercury in the channel (Table 3-2).

Ninemile Creek Floodplain

In the Ninemile Creek floodplain, Alternative 2 provides protectiveness by removal of up to 2 ft of material with concentrations that exceed 1.3 mg/kg mercury and/or point-by-point targets for other CPOIs and replacement with up to 2 ft of clean soil. This alternative would also address 54% and 35% of the floodplain that exceeds 0.5 and 0.15 mg/kg mercury, respectively (Table 3-2).

Alternative 3 addresses the Ninemile Creek Reach CD floodplain by removal of 2 ft of soil/sediment within the breaks in grade that bound the floodplain in Reach CD (and some deeper hotspots in this area) and installation of 2 ft of cover. Alternative 3 addresses the Reach BC floodplain through removal of soil/sediment overlying structural stone and backfill with 1 ft of soil. Alternative 4 removes soil/sediment to 0.15 mg/kg mercury (i.e., essentially to concentrations below background) and backfills with clean soil. Through removal and cover, Alternatives 3 and 4 address 100% of the floodplain exceeding point-by-point sediment targets.

Although not targets, NYSDEC's lowest effect level (LEL) sediment screening criteria for arsenic (6 mg/kg), lead (31 mg/kg) and total PAHs (4 mg/kg) were considered during this comparative evaluation. As shown on Table 3-2 for the top 2 ft of soil/sediment, the alternatives are similarly effective in addressing these screening criteria. Alternative 2 would address 87%, 95%, and 96% of the channel and floodplain exceeding these three criteria, respectively; Alternative 3 would address 89%, 100%, and 98% of the area exceeding these three criteria, respectively; and Alternative 4 would address 100% of the area exceeding these criteria. As discussed in Appendix A, concentrations as low as these screening criteria may not be achievable in the long-term because they are influenced by sources other than just the Geddes Brook/Ninemile Creek site.

In summary, Alternatives 2, 3, and 4 are protective of human health and the environment, with the only potential difference being with respect to risk to benthic macroinvertebrates. Alternative 3 addresses risk to benthic macroinvertebrates through removal and provision of clean cover or backfill in the entire channel and floodplain whereas Alternatives 2 and 4 rely on screening values to define areas of remediation. As such, the area of the site remediated by Alternative 2 is less than either Alternative 3 or 4, which are roughly equivalent.

The construction required by Alternatives 2, 3, and 4 will take approximately one, two, and three construction seasons to complete, respectively. The longer duration for Alternative 4 is largely related to the installation and removal of deep sheet pile to allow for removal of deeper sediments and greater volume. The additional effort to effect the removals required by

Alternative 4 would be disproportionate to any potential marginal increases in protectiveness, if any, compared to Alternative 3, and would result in greater short-term impacts, longer schedule duration, and increased implementation risks that could exacerbate construction schedule.

Compliance with ARARs

With the exception of Alternative 1 – No Action, all alternatives would comply with all chemical-specific ARARs, with possible exceptions due to upstream/upgradient anthropogenic sources. Specifically, two surface water quality standards for mercury and surface water quality standards for iron, aluminum, and dissolved solids, as discussed for Alternative 1 (see Section 3.2.1), may not be met. Removal of contaminated sediment and placement of clean cover material will limit the impact of the site on exceedances of surface water quality standards; however, upstream/upgradient anthropogenic sources are likely to continue to result in exceedances at the site. There are no chemical-specific ARARs for sediment.

Sediment removal, handling, dewatering, and consolidation, as well as installation of cover systems or backfill, are expected to meet action-specific and location-specific ARARs. Appropriate regulatory approvals or permits would be obtained prior to initiating any of the alternatives.

Short-Term Effectiveness

The three action alternatives provide the following estimated removals with associated durations:

	Total Volume Removed (cy)	**Duration (Construction Seasons)**
Alternative 2	64,000	1
Alternative 3	126,000*	2
Alternative 4	146,000	3

* Does not include 22,000 cy of soil excavated to construct new channel that is assumed to be suitable for re-use on site.

As shown above, the construction required by Alternatives 2, 3, and 4 will take approximately one, two, and three construction seasons to complete, respectively. The longer duration for Alternative 4 when compared to Alternative 3 for a similar volume of material is largely related to the installation and removal of deep sheet pile to allow for removal of deeper sediments and greater volume.

In general, short-term effectiveness risks are exacerbated by larger volumes and longer schedule durations. For all of the alternatives, potential short-term risks associated with sediment dredging and other activities in the channel include resuspension of channel sediment and related potential impacts to water quality. These risks would be mitigated through the use of best management dredge practices (e.g., the use of environmental buckets where feasible) and silt curtains placed downstream from the dredge site and at the mouth of the creek. For Alternative 3, additional mitigation is derived from conducting portions of the work in areas of relocated channel. Other short-term risks associated with sediment dredging, floodplain soil/sediment excavation, and cover system installation include those associated with erosion of floodplain soil/sediment, air emissions from stockpiles and equipment, noise and light from construction equipment, and truck traffic to the upland soil/sediment consolidation area. These types of risks, however, are common to many remedial projects, and would be mitigated as feasible using standard construction techniques and prevailing industry practices.

Negative ecological effects associated with implementing each of the alternatives (with the exception of Alternative 1) would be temporary (studies of benthic recolonization indicate that recovery occurs within one to three years), and offset by the positive long-term effects of the placement of clean and suitable materials for benthic habitat. However, the longer it takes to implement the remedy, the longer it will take for the benthic macroinvertebrate and terrestrial species in the area to recover and for any indirect effects experienced by fish that forage in the affected areas to dissipate.

Long-Term Effectiveness and Permanence

Alternatives 2, 3, and 4 all provide long-term effectiveness and permanence. All cover systems used in Alternatives 2 and 3 would be designed to effectively isolate underlying contamination. Adequate engineering controls are readily available and can be used during the removal of sediment and during cover system placement/installation to provide for the long-term effectiveness of the cover system. Proven techniques are available to provide for the adequacy and reliability of each remedy through implementation of a long-term operation and maintenance program. Because Alternative 4 does not include cover systems, operation and maintenance activities will be less intensive and potentially of shorter duration than for Alternatives 2 and 3.

Reduction of Toxicity, Mobility, or Volume Through Treatment

As shown on Table 3-1, implementation of Alternative 2, 3, or 4 would result in the removal of various masses of mercury, significantly reducing the toxicity, mobility, and volume of impacted soil/sediment. The habitat/cover systems installed following the removals would reduce the mobility of residual concentrations in soil/sediment. Although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal and/or cover versus treatment, each alternative includes treatment of construction water, which could include precipitation, clarification, and polishing using carbon.

Implementability

Remediation of floodplain soil/sediment and channel sediment under site conditions similar to those that exist at Geddes Brook and Ninemile Creek has been successfully performed by experienced remediation contractors. Based on this experience, floodplain remediation will be moderately difficult to implement under the three action alternatives and channel remediation will be moderately to very difficult to implement depending on the alternative. Alternative 3 takes advantage of the opportunity to divert the flow of Ninemile Creek in portions of Reach CD to allow for channel remediation to be conducted “in the dry.” Alternative 4 would be more difficult to implement than either Alternative 2 or 3 because of the need to install and remove large quantities of sheet pile in a flowing creek.

Cost

Estimated costs associated with the three action alternatives, including the Geddes Brook IRM costs, are as follows:

	Capital Costs	O&M Costs (Average Annual)	O&M Costs (Present Worth)	Total Cost (Present Worth)
Alternative 2	$18.5 M	$140 K	$1.7 M	$20.2 M
Alternative 3	$31.7 M	$140 K	$1.7 M	$33.4 M
Alternative 4	$42.5 M	$100 K	$1.2 M	$43.7 M

SECTION 4

RECOMMENDED REMEDIAL ALTERNATIVE FOR OPERABLE UNIT 1 OF THE GEDDES BROOK/NINEMILE CREEK SITE

Alternative 3 is Honeywell's recommended alternative[1] for OU-1 of the Geddes Brook/Ninemile Creek site. Alternative 3 provides the best balance of the seven CERCLA evaluation criteria as determined through the comparative analysis of alternatives in Section 3. Alternative 3 would achieve the RAOs and PRGs established for the Geddes Brook/Ninemile Creek site. As described in Section 3, it would be protective of human health, benthic macroinvertebrates, and other ecological receptors. Each of the Alternatives 2, 3 and 4 is considered protective of human health and the environment with the only potential difference being with respect to risk to benthic macroinvertebrates. Alternative 3 addresses risk to benthic macroinvertebrates through removal and provision of clean cover in the entire channel and floodplain, whereas Alternatives 2 and 4 rely on screening values to define areas of remediation. As such, the area of the site remediated by Alternative 2 is less than either Alternative 3 or 4, which are roughly equivalent.

Alternative 3 is comprehensive in that it is a physically-defined remediation, wherein the entire site within the breaks in grade (horizontally) and clay or gravel (vertically, where present in the upper 2 or 3 ft) is addressed. Alternative 3 includes channel relocations and removals to depths that do not require extensive use of sheeting to enhance implementability, and the comprehensive installation of cover systems to enhance reliability. Alternative 3 will result in the removal of approximately 90% of the mercury from the site. Following the removals, channel and floodplain habitat/cover systems would be designed and installed to create a suitable/enhanced ecological habitat and prevent exposure to residual concentrations.

In comparison, although Alternative 4 would also address the entire site within the breaks in grade because it requires removal of all sediment where mercury concentrations exceed 0.15 mg/kg (which could be below background), this alternative would require installation of deep sheeting (e.g., 40-ft sheets) to prevent failure of the creek banks during implementation. It is estimated that Alternative 3 can be completed in two construction seasons, while Alternative 4 would require three construction seasons. Alternative 4 would result in the removal of approximately 10% more mercury than that removed by Alternative 3. However, it would take at least a year longer to implement, would cost an additional $10.3 million, and would not increase protection of human health and the environment.

[1] Honeywell's recommended alternative is described in Section 3. New York State and USEPA will identify which alternative they will propose as a preferred remedy in the Proposed Plan. Following receipt of public comments on the Proposed Plan, New York State and USEPA will select a remedy in the Record of Decision (ROD). The remedy ultimately selected by New York State and USEPA may or may not be that proposed by Honeywell as described herein.

Alternative 3, thus, provides the best balance of the seven CERCLA evaluation criteria, by tailoring the remedial approach to site-specific features and integrating remediation with habitat development and enhancement. Implementation of Alternative 3 would result in a remedy that:

- is protective, meeting all RAOs and PRGs, and implementable in a reasonable period of time;
- coordinates the remedy with site infrastructure, and relocates Ninemile Creek away from the wastebeds, allowing opportunities to create diverse habitats (e.g., vernal pools, forested floodplains);
- improves the connectivity of Geddes Brook and Ninemile Creek with their floodplains, and allows for the creation of wildlife corridors by providing easier transitions (shallower slopes) from the channels to the floodplains to adjacent upland areas;
- provides an improved emergent wetland community in the Geddes Brook floodplain; and
- improves substrate conditions in the channels for benthic and fish communities through the habitat/cover systems, and allows for the establishment of native vegetation to increase allochthonous inputs (e.g., leaf litter) and help to reduce water temperature.

Based on the above, Alternative 3 is the recommended alternative for the Geddes Brook/ Ninemile Creek site.

SECTION 5

REFERENCES

Exponent. 2001. Geddes Brook/Ninemile Creek Remedial Investigation/Feasibility Study. Human Health Risk Assessment. Prepared for Honeywell International, Inc. Syracuse, NY. November. (Document rewritten by TAMS Consultants for NYSDEC. See TAMS, 2003.)

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Parsons. 2005. *Final Draft Geddes Brook/Ninemile Creek Feasibility Study Report* . Prepared for Honeywell, Inc. by Parsons, May 2005.

TAMS. 2003. Geddes Brook/Ninemile Creek Human Health Risk Assessment. Prepared for New York State Department of Environmental Conservation, Division of Environmental Remediation, Albany, NY. TAMS Consultants, Inc., New York, NY and YEC, Inc., Valley Cottage, NY. July 2003.

APPENDIX A

UPDATES TO ARARs AND TARGET CONCENTRATIONS

APPENDIX B

2007 SUPPLEMENTAL SITE INVESTIGATION DATA SUMMARY REPORT

APPENDIX C

AREAS, VOLUMES, MERCURY MASSES, AND SWACs

APPENDIX D

HYDRODYNAMIC MODELING/GEOMORPHIC ANALYSIS

APPENDIX E

CHEMICAL ISOLATION LAYER MODELING

APPENDIX F

COST ESTIMATES FOR REMEDIAL ALTERNATIVES

APPENDIX G

DESCRIPTION OF ALTERNATIVE 3