NYSDEC

OPERABLE UNIT 1 OF THE GEDDES BROOK/NINEMILE CREEK SITE ONONDAGA COUNTY, NEW YORK

USEPA Region 2

PROPOSED PLAN

NOVEMBER 19, 2008

Public Involvement

Dates to Remember

Public Comment Period:
November 19, 2008 – January 2, 2009

NYSDEC and EPA will accept comments on the Proposed Plan during the public comment period.

On **December 10, 2008**, NYSDEC and EPA will hold a public meeting at 7 P.M. to present the results of the Remedial Investigation, Feasibility Study, and Proposed Plan and to solicit public comments. The meeting will be held at the Martha Eddy Room in the Art and Home Center at the New York State Fairgrounds.

COMMUNITY ROLE IN THE SELECTION PROCESS

The New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA) rely on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, the Geddes Brook/Ninemile Creek Remedial Investigation and Feasibility Study (RI/FS) reports and this Proposed Plan have been made available to the community (see the text boxes entitled "Public Involvement") for a public comment period which begins on November 19, 2008 and concludes on January 2, 2009.

On December 10, 2008, NYSDEC and EPA will hold a public meeting at 7 P.M. and answer questions regarding the proposed cleanup plan. The meeting will be held to present the conclusions of the RI/FS, to elaborate further on the reasons for recommending the preferred remedy, and to receive public comments. The public meeting will take place at the Martha Eddy Room in the Art and Home Center at the New York State Fairgrounds.

Comments received at the public meeting, as well as written comments, will be documented in the "Responsiveness Summary" section of the Record of Decision (ROD), the document which formalizes the selection of the remedy.

NYSDEC and EPA will accept comments postmarked on/or before January 2, 2009 or sent via e-mail and received on/or before January 2, 2009.

Public Involvement

Submitting Written Comments

Written comments on the Proposed Plan and the RI and FS reports should be postmarked on/or before January 2, 2009 and addressed to:

Timothy Larson
Geddes Brook/Ninemile Creek Site – Public Comments
New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, New York 12233-7016

or sent via e-mail and received on/or before January 2, 2009 at the following address:

DERweb@gw.dec.state.ny.us
(Indicate "Geddes Brook/Ninemile Creek PP Comments" in the subject line of the e-mail.)

Public Involvement

Document Repositories

Onondaga County Public Library
Syracuse Branch at the Galleries
447 South Salina Street
Syracuse, NY 13202-2494
Hours: M, Th, F, Sat, 9:00 a.m. – 5:00 p.m.;
Tu, W, 9:00 a.m. – 8:30 p.m.
Phone: (315) 435-1800

Atlantic States Legal Foundation
658 West Onondaga Street
Syracuse, NY 13204-3711
(315) 475-1170
Please call for hours of availability

NYSDEC Central Office
625 Broadway
Albany, NY 12233-7016
(518) 402-9676
Hours: M – F, 8:30 a.m. – 4:45 p.m.
Please call for an appointment

NYSDEC Region 7 Office
615 Erie Boulevard West
Syracuse, NY 13204-2400
(315) 426-7400
Hours: M – F, 8:30 a.m. – 4:45 p.m.
Please call for an appointment

TABLE OF CONTENTS

Section	Page
Community Role in the Selection Process	1
Summary of Preferred Remedy and Purpose of the Proposed Plan	8
Site Background	11
Site Description	11
Operable Unit Approach	14
Site History	15
Honeywell Facilities and Disposal Areas Near Geddes Brook/Ninemile Creek	17
Site Geology/Hydrogeology	22
Surface Water Hydrology	24
Sediment Transport and Characteristics	25
Soil Characteristics	27
Biota	28
Results of the Remedial Investigation	29
Scope and Role of Response Action	39
Summary of Site Risks	41
Remedial Action Objectives and Preliminary Remediation Goals	48
Description of Alternatives	57
Comparative Analysis of Disposal Options and Remedial Alternatives	74
Preferred Remedy	89
Acronyms and Abbreviations	99
Glossary	102

References 109

Public Comment Form . . . . . Following Figures and Tables

TABLE OF CONTENTS

ATTACHED FIGURES

Title

Figure 1	Location of Geddes Brook, Ninemile Creek, and Onondaga Lake
Figure 2	Geddes Brook/Ninemile Creek and Vicinity
Figure 3	Floodplain Extent for Various Flood Frequencies Based on Hydrologic Modeling Results
Figure 4	Geddes Brook/Ninemile Creek Reaches and Former Channel Locations
Figure 5	Location of Honeywell and Other Referenced Sites Near Geddes Brook/Ninemile Creek
Figure 6a	Mercury Concentrations in Channel and Floodplain, Lower Geddes Brook
Figure 6b	Mercury Concentrations in Channel and Floodplain, Ninemile Creek Reach CD
Figure 6c	Mercury Concentrations in Channel and Floodplain, Ninemile Creek Reach BC
Figure 7	Comparison of Total Mercury Loads in Surface Water of Geddes Brook and Ninemile Creek in 1990
Figure 8	Comparison of Total Mercury Loads in Surface Water of Geddes Brook and Ninemile Creek in 1998
Figure 9	Location of Onondaga Lake NPL Subsites
Figure 10	Alternative 2 Remedial Approach
Figure 11	Alternative 3 Remedial Approach and Geddes Brook IRM
Figure 12	Alternative 4 Remedial Approach
Figure 13	Alternative 2 Removal Areas, Channel
Figure 14	Alternative 2 Removal Areas, Floodplain
Figure 15	Alternative 3 Removal Areas, Channel
Figure 16	Alternative 3 Removal Areas, Floodplain
Figure 17	Alternative 4 Removal Areas, Channel
Figure 18	Alternative 4 Removal Areas, Floodplain

ATTACHED TABLES

Title	
Table 1	Contaminants of Potential Concern for the Geddes Brook/Ninemile Creek HHRA
Table 2	Contaminants and Stressors of Concern Selected for Geddes Brook/Ninemile Creek Media in the BERA
Table 3	Summary of Channel Sediment Data for Select Parameters from Geddes Brook and Ninemile Creek (1998, 2001)
Table 4	Summary of Floodplain Soil/Sediment Data for Select Parameters from Geddes Brook and Ninemile Creek (1998, 2000, 2001, 2002, and 2007)
Table 5	Summary of Surface Water Data for Select Parameters from Geddes Brook and Ninemile Creek (1998)
Table 6	Concentrations of Select Contaminants in Geddes Brook/Ninemile Creek Fish

TABLE OF CONTENTS

TEXT BOXES

Title **Page**

Public Involvement – Dates to Remember 1

Public Involvement – Submitting Written Comments 2

Public Involvement – Document Repositories 2

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – What is a "Potentially Responsible Party?" 17

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – What is Mercury? 18

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – What are Organic Contaminants in the Geddes Brook/Ninemile Creek Site? 19

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – What are Chemical Parameters of Interest? 31

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – What Is Risk and How Is it Calculated? 42

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Toxicity-Based Sediment Effect Concentrations (SECs) Selected as PRGs for Mercury and Other Inorganics 51

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Toxicity-Based Sediment Effect Concentrations (SECs) Selected as PRGs for Organic Contaminants 52

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Preliminary Remediation Goals in Fish Tissue to Protect Human Health 54

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Preliminary Remediation Goals in Fish Tissue to Protect Ecological Receptors 55

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Sediment Quality Values for Channel Sediments to Protect from Bioaccumulation and Direct Contact 56

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Sediment Quality Values for Floodplain Soils/Sediments to Protect from Bioaccumulation and Direct Contact 57

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Isolation Capping Model 63

Understanding the Geddes Brook/Ninemile Creek Proposed Plan – Flood Flow Model 65

SUMMARY OF PREFERRED REMEDY AND PURPOSE OF THE PROPOSED PLAN

This Proposed Plan describes the remedial alternatives considered for Operable Unit 1 (OU1) of the Geddes Brook/Ninemile Creek site, which has been a source of contamination to Onondaga Lake, and identifies the preferred remedy, as well as the rationale for this preference. Geddes Brook, Ninemile Creek, and Onondaga Lake are located in Onondaga County (see Figure 1).

This Proposed Plan was developed by NYSDEC and EPA in consultation with the New York State Department of Health (NYSDOH). NYSDEC and EPA are issuing the Proposed Plan as part of the public participation requirements of Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as well as the New York State Environmental Conservation Law (ECL) and Title 6 New York Code of Rules and Regulations (NYCRR) Part 375.

This Proposed Plan is being provided as a supplement to the Geddes Brook/Ninemile Creek RI report (TAMS/Earth Tech, 2003c), human health and ecological risk assessment reports (TAMS/Earth Tech, 2003a,b), FS report (Parsons, 2005), and Supplemental FS report (Parsons, 2008a) to inform the public of NYSDEC and EPA's preferred remedy and to solicit public comments pertaining to all of the remedial alternatives (including the preferred remedy) evaluated in this Proposed Plan, as well as the RI, FS, and Supplemental FS reports. The alternatives summarized here are described in the Geddes Brook/Ninemile Creek Supplemental FS report, which, along with other RI/FS documents, are contained in the administrative record file for the Site. NYSDEC and EPA encourage the public to review these documents to gain a more comprehensive understanding of the Site and the Superfund-related activities that have been conducted at the Site (see text box entitled "Document Repositories," page 2).

OU1 (see Figures 2 and 3) extends upstream in Ninemile Creek, from a point approximately 3,000 feet (ft) (900 meters [m]) upstream of Onondaga Lake, to a point approximately 600 ft (180 m) upstream of Ninemile Creek's confluence with Geddes Brook, and is divided into two segments within Ninemile Creek (Reach BC and Reach CD). OU1 also includes a portion of Geddes Brook from Geddes Brook's confluence with Ninemile Creek upstream to Geddes Brook's confluence with the West Flume. Additional information related to the definition of the operable units and Reaches BC and CD can be found below in the "Site Description" and "Site History" sections of this Proposed Plan.

NYSDEC and EPA's preferred remedy for OU1 would result in clean sediment/soil existing at the surface throughout the entire site (including both channel sediment and floodplain soil/sediment). Specifically, the preferred remedy consists of the dredging/excavation and removal of an estimated 59,000 cubic yards (cy) (45,000 cubic meters [m^3]) of contaminated channel sediments and floodplain soils/sediments over approximately 15 acres (6 hectares) in Reaches BC and CD of lower Ninemile Creek (see Figure 11).

As part of the preferred remedy, clean materials would be placed throughout the entire site. Depending on location, as described further in this Proposed Plan, these materials would consist of one or more of the following layers, from the surface down: habitat layer, backfill, and, where needed, an isolation cap. The habitat layer would consist of clean material designed to provide the proper conditions for animal and plant communities to grow. This layer would be a minimum of 2-ft (60-centimeters [cm]) thick, unless otherwise noted, and may consist of clean gravel in the stream

bed and clean topsoil in wetland/floodplain areas. Backfill would consist of soils used to bring the sediment or ground surface to an appropriate elevation below the habitat layer. An isolation cap, where needed, would consist of clean sand or other suitable clean material designed to isolate the habitat layer from underlying residual contamination in areas where contaminant transport via sediment porewater is a concern (*i.e.*, the stream channel or wetlands). An armor (erosion protection) layer would be placed above the isolation cap, where needed.

Where dredging/excavating results in removal of all significant contamination in the stream or floodplain, the area would be backfilled to bring the sediment or ground surface up to the designed elevation, if needed, and a habitat layer placed.

The areal "footprint" of the OU1 remedy is bounded by steep banks within the floodplain which limited the extent of sediment/soil contamination. The preferred remedy would address all of the preliminary remediation goals (PRGs) with a combination of removal, capping, backfilling, and habitat layer placement technologies. See pages 48 to 57 for a description of the PRGs.

Under current conditions, a large island splits part of the upper portion of Reach CD (Figure 15) of Ninemile Creek into a north and south channel. As part of the preferred remedy, an estimated 22,000 cy (17,000 m^3) of stream sediment and floodplain soil/sediment would be removed from the upper portion of Reach CD, deepening and widening the southern channel in the vicinity of the large island and removing sediment from the channel upstream of the large island. The northern channel would be backfilled and a habitat layer placed. This would allow the southern channel to carry the entire flow and would allow for the creation of a floodplain/wetland buffer between this part of Ninemile Creek and Wastebeds 9 and 10. In the lower portion of Reach CD (Figure 15), a new stream channel would be created in the current floodplain (requiring the excavation of about 27,500 cy [21,000 m^3] of soil). The existing channel and a portion of the floodplain in this lower portion of Reach CD would be backfilled and a habitat layer placed following removal of an estimated 6,800 cy (5,200 m^3) of contaminated sediments and soils, including material from a hot-spot area in a portion of the channel and floodplain. This channel relocation would also create a floodplain/wetland buffer between this portion of Ninemile Creek and the southern edge of Wastebeds 9 and 10 and reduce the likelihood that an isolation cap would be needed since the stream channel would be relocated to a less contaminated area. Once the removal of sediment and soil was completed in Reach CD, a suitable habitat layer would be installed. Within the engineering/feasibility constraints of these removals, the need for an isolation cap below the habitat layer within Reach CD would be eliminated or minimized.

In Reach BC, approximately 15,400 cy (11,800 m^3) of contaminated sediments would be removed to an estimated average depth of 3 ft (90 cm) and an isolation cap would be installed, with a suitable habitat layer, over the entire reach. Sufficient removals would be conducted prior to installation of the isolation cap and habitat layer for cap effectiveness and to allow for passage of flood flows in accordance with applicable requirements, and to provide sufficient water depth for fish passage and canoe access. In addition, approximately 6,500 cy (5,000 m^3) of Reach BC contaminated floodplain soils, which overlie structural stone (typically within the top 2 ft [60 cm]) between the creek and top of bank, would also be removed and a suitable habitat layer installed.

For the remainder of OU1, approximately 67,000 cy (51,000 m^3) of contaminated sediments and floodplain soils/sediments would be removed over approximately 16 acres (6.5 hectares) from lower

Geddes Brook under a pending Interim Remedial Measure (IRM)[1] (see Figure 11). When the preferred remedy's estimated removal of approximately 535 pounds (242 kilograms [kg]) of mercury mass from the channel and floodplain of Ninemile Creek Reaches BC and CD is combined with the pending IRM's estimated removal of approximately 1,000 pounds (450 kg) of mercury mass from lower Geddes Brook channel and floodplain, it is estimated that greater than 90 percent of the total mercury mass within OU1 would be removed. Residual mercury contamination would be isolated beneath a clean habitat layer underlain by an engineered cap in the Ninemile Creek Reach BC channel and, if needed, Reach CD channel and beneath a clean habitat layer in the floodplain of these reaches.

As part of the preferred remedy, contaminated sediments and soils removed from the creek and floodplains would be disposed of at Honeywell's Linden Chemicals and Plastics (LCP) Bridge Street subsite containment system, which was designed and constructed, and is being monitored pursuant to the requirements of a September 2000 ROD (the LCP Bridge Street subsite was a source of the contamination in the streams and floodplains). Treatment of water generated by dredging and excavating sediments and soils and corresponding sediment/soil dewatering would be conducted at a location in the vicinity of the Site. The actual location of the treatment plant, discharge requirements, and point of discharge would be determined as part of the remedial design.

It is estimated that the dredging/excavating, capping, backfilling, and habitat layer placement components of the preferred remedy, along with dewatering, water treatment, and transport/disposal of sediments and soils at the LCP Bridge Street subsite, would take two years.

Restoration of the stream bed and banks, wetlands, and habitats would be performed following sediment and soil removal and placement of an isolation cap or backfill, where needed. This would include placement of a habitat layer with appropriate substrate types and thicknesses as well as plantings of appropriate species of wetland and upland vegetation. The details of habitat restoration would be developed during remedial design following issuance of the ROD.

The preferred remedy would result in a long-term reduction in the toxicity, mobility, and volume of the contaminants of concern in Geddes Brook and Ninemile Creek, namely, mercury, arsenic, lead, hexachlorobenzene, phenol, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (PCDD/PCDFs).

The preferred remedy addresses all areas of OU1 such that the top 2 ft (60 cm) of sediments and soils would consist of clean material. The goal for the concentrations of this clean material for mercury, other chemical parameters of interest (CPOIs), and other constituents would be NYSDEC's sediment criteria (including the lowest effects level [LEL] of 0.15 milligrams per kilogram [mg/kg] for mercury) in sediments and 6 NYCRR Part 375 unrestricted use soil cleanup objectives (including the objective of 0.18 mg/kg for mercury) in soils. Clean soil would include imported fill materials from off-site sources. Also, if it is determined by NYSDEC during design that soil excavated during construction of the new Geddes Brook or Ninemile Creek channel alignments is suitable material, this soil may be used for backfill (*e.g.*, for depths below the top 2 ft [60 cm] of habitat layer material). The preferred remedy would also attain a 0.8 mg/kg site-specific

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[1] An IRM is a discrete set of planned actions for both emergency and non-emergency situations, provides a quick solution to a defined problem, and is designed to be a permanent part of the final remedy. It is functionally equivalent to EPA's non-time critical removal action and will meet CERCLA requirements pursuant to EPA's Guidance on Conducting Non-Time Critical Removal Actions (USEPA, 1993). A summary of the IRM is found on page 20.

bioaccumulation-based sediment quality value (BSQV) for mercury in sediments for protection of wildlife consumption of fish and 0.6 mg/kg site-specific BSQV for mercury in floodplain soils for protection of wildlife consumption of terrestrial invertebrates. The preferred remedy is also intended to achieve fish tissue mercury concentrations ranging from 0.1 mg/kg, which is for protection of ecological receptors, to 0.3 mg/kg, which is based on EPA's methylmercury National Recommended Water Quality criterion for the protection of human health from elevated risks due to consumption of organisms.

The remedy described in this Proposed Plan is the preferred remedy for the OU1 portion of the Site. Changes to the preferred remedy, or a change from the preferred remedy to another remedy, may be made if public comments or additional data indicate that such a change would result in a more appropriate remedial action, pursuant to applicable environmental laws. The final decision regarding the selected remedy will be made after consideration of all public comments. NYSDEC and EPA are soliciting public comments on this Proposed Plan and the RI, FS, and Supplemental FS reports because NYSDEC and EPA may select a remedy other than the preferred remedy contained within this Proposed Plan.

Following issuance of the ROD, remedial design, including additional investigations to support design and the development and implementation of a baseline monitoring program, would occur prior to construction of the selected remedy.

SITE BACKGROUND

On June 23, 1989, Onondaga Lake was added to the New York State Registry of Inactive Hazardous Waste disposal sites. On December 16, 1994, Onondaga Lake and its tributaries and the upland hazardous waste sites which have contributed or are contributing contamination to the lake (sub-sites) were added to EPA's National Priorities List (NPL). This NPL listing means that the lake system is among the nation's highest priorities for remedial evaluation and response under the federal Superfund law for sites where there have been a release of hazardous substances, pollutants, or contaminants. This Proposed Plan focuses only on the OU1 portion of the Geddes Brook/Ninemile Creek site (lower Ninemile Creek channel sediments, surface water, and floodplain soils and sediments[2]), which is part of the Onondaga Lake Bottom subsite.

SITE DESCRIPTION

Geddes Brook and Ninemile Creek are located southwest of Onondaga Lake (Figure 1). Geddes Brook, a Class C stream below the Old Erie Canal and C(T) upstream, originates in the Town of Camillus (located southwest of Syracuse, New York) and flows approximately 3 miles (mi) (5 kilometers [km]) northeast to its confluence with the West Flume, a drainage ditch that passes through the LCP Bridge Street subsite of the Onondaga Lake site, and an additional 0.3 mi (0.5 km) north to Ninemile Creek on the perimeter of the New York State Fairgrounds in Syracuse, New York (Figure 2). The West Flume has been remediated by Honeywell as part of the LCP

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[2] The channel sediments, surface water, and floodplain soils/sediments of lower Geddes Brook are also part of the OU1 portion of the Geddes Brook/Ninemile Creek site. However, alternatives for lower Geddes Brook are not discussed in this Proposed Plan since lower Geddes Brook is being remediated pursuant to a pending IRM.

Bridge Street subsite remedial program per NYSDEC's September 2000 ROD. Before entering Ninemile Creek, Geddes Brook flows through or adjacent to areas formerly used for commercial and/or industrial purposes. Upstream of the West Flume, Geddes Brook flows through residential and commercial areas of Geddes, New York. Ground surface elevations range from approximately 430 ft (130 m) above mean sea level (AMSL) at the most upstream section of Geddes Brook addressed in this study, to approximately 370 ft (113 m) AMSL at the confluence of Geddes Brook and Ninemile Creek.

Ninemile Creek, a Class C stream below the former Honeywell water intake and C(T) upstream, originates at Otisco Lake and flows approximately 16 mi (26 km) northeast to its mouth at Onondaga Lake. Ninemile Creek receives surface inflow from Beaver Meadow Brook and Geddes Brook at approximately 2.8 mi (4.5 km) and 1.3 mi (2.1 km), respectively, upstream from Onondaga Lake (Figure 2). Between Amboy Dam and Onondaga Lake, Ninemile Creek flows adjacent to Solvay Wastebeds 1 through 8, 9 through 11, and 12 through 15. During the time that Honeywell utilized the Solvay process for the production of soda ash (1881 to 1986), wastes from this process were disposed of in numerous wastebeds along the lake, Geddes Brook, and Ninemile Creek. Wastebeds 1 through 8 were used until 1944 and Wastebeds 9 through 15 were used from 1944 until 1986. Upstream of the dam, Ninemile Creek flows through woodlands, farmlands, and some light industrial/commercial areas. Ground surface elevations range from approximately 400 ft (122 m) AMSL at the most upstream section of Ninemile Creek addressed in this study, to approximately 363 ft (111 m) AMSL where the creek enters Onondaga Lake.

The Site is defined as the channel sediments, floodplain soils/sediments, and surface water of Geddes Brook and Ninemile Creek that have been impacted or have the potential to be impacted by the disposal of hazardous and industrial wastes by Honeywell. This definition was based on the understanding at the time of the RI/FS work plan (1998) that contaminants from Honeywell sites (*e.g.*, LCP Bridge Street, Solvay Wastebeds) were discharged (directly or indirectly) to Geddes Brook and Ninemile Creek, where they settled into the stream beds, banks, and floodplains.

The RI concentrated on the lower reaches of Geddes Brook and Ninemile Creek because historical information (USEPA [1973] which suggested that wastebed overflows in 1972 [after pollution controls were installed] could not have contributed to the high concentrations of mercury seen in the sediments currently), and other investigations (BBL, 1999, which showed that groundwater and runoff of sediment from the Solvay Wastebeds could not have contributed to the high concentrations of mercury seen in the sediments currently) indicated that the disposal and transport of hazardous wastes and substances likely affected those sections of the stream and not the upper reaches. Data collected for the RI indicated that high concentrations of mercury in the sediments and soils are consistent with the LCP Bridge Street subsite as the only significant source of mercury and other CERCLA contaminants to the Site via the West Flume, and that surface water loading also indicated that the West Flume and the current sediments downstream of the West Flume are the only significant sources of mercury to surface water. Data collected during the RI/FS and Supplemental FS confirmed that the CERCLA contamination from Honeywell operations was confined to the lower reaches of those streams, and that concentrations of mercury in the upper reaches (*i.e.*, Geddes Brook upstream of the West Flume and Ninemile Creek upstream of Reach CD) were generally consistent with non point sources, thus not warranting remediation. Those studies did confirm the contribution of ionic waste constituents (non-CERCLA contaminants) from the Solvay wastebeds into Ninemile Creek upstream of Reach CD, as well as within OU1.

Specifically, the reaches of Geddes Brook/Ninemile Creek studied during the RI/FS included the following:

- Geddes Brook sediments and surface water from approximately 2,500 ft (760 m) upstream from its intersection with Gerelock Road to the point of discharge into Ninemile Creek and associated floodplain soils/sediments from its intersection with the West Flume to the point of discharge into Ninemile Creek.

- Ninemile Creek sediments and surface water from Amboy Dam to the point of discharge into Onondaga Lake and associated floodplain soils/sediments from its intersection with Geddes Brook to the point of discharge into Onondaga Lake.

- State and federal wetlands associated with the Geddes Brook/Ninemile Creek site (*i.e.*, Wetland Syracuse West [SYW]-18 and Wetland SYW-10 east of Interstate-690 [I-690]). Wetland SYW-10 west of I-690 was evaluated as part of the Maestri 2 site.[3]

The areal extent (footprint) of water-borne contamination would be bounded by flood levels since the time that Honeywell (formerly AlliedSignal) commenced operations. The predicted footprint of the 50-year floodplain, as modeled in the FS report, is similar to the documented footprint from the 1972 flood, which is the largest flood over the period of record. The flood footprint is contained within steep banks in and along the Site. Based on site data, areas of elevated mercury contamination in floodplain soils are generally found within the 50-year flood footprint.

Based on data from the RI (see RI report Figure 5-2) and supplemental investigations, mercury concentrations above these steep banks are generally less than 0.2 mg/kg. Geddes Brook below the West Flume and portions of Reach CD of Ninemile Creek below Geddes Brook are underlain by a natural clay layer which existed long before settlement of the area. The top of clay represents a distinct change in soil type, which typically provides a vertical boundary through which contamination from the Site has not penetrated, according to site data. Farther downstream in Reach BC, the gravel/rip-rap that was placed when the stream was relocated during construction of State Highway Route 695 in the late 1960s is also believed to represent a vertical boundary below which contamination would not be found. These physical features, including areas of steep banks found throughout the Site and the top of clay found in portions of the Site (mainly the lower Geddes Brook floodplain), and analytical data, including mercury concentrations from sediment and soil samples, have been used to delineate the site boundaries (areas and depths) where remedial action is warranted.

The accumulated contaminated sediments and floodplain soils/sediments of Geddes Brook and Ninemile Creek are sources of contaminants to the surface water and biota of Geddes Brook, Ninemile Creek, and Onondaga Lake. As discussed below under “Results of the Remedial Investigation,” active remediation of groundwater is not proposed.

As discussed above, although a portion of upper Geddes Brook upstream of the West Flume and upper Ninemile Creek channel sediments from Amboy Dam downstream to just above the

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[3] The Maestri 2 site consists of a 4.5-acre (1.8-hectare) area in a wetland that was filled with mill scale and other wastes from the Crucible Materials Corporation facility, as well as automotive wastes. The wetland adjacent to the Maestri 2 site drains into Ninemile Creek near its mouth. An RI/FS was performed by the potentially responsible parties (PRPs) at the site and a ROD was issued by NYSDEC in 2008. The Maestri 2 RI (Stearns & Wheler LLC, 2004) indicates that the site has not impacted Ninemile Creek.

confluence with Geddes Brook (and the upstream limit of Reach CD) are part of the Geddes Brook/Ninemile Creek site, remedial alternatives to address mercury and other CPOIs were not developed for these upper reaches of Geddes Brook and Ninemile Creek since the site conditions, documented in the RI and FS reports, do not warrant remediation.

OPERABLE UNIT APPROACH

Since many Superfund sites are complex and have multiple contamination problems and/or areas, they are often divided into several operable units for the purpose of managing the site-wide response actions. The NCP (Section 300.5) defines an operable unit as "a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site."

The stretch of Ninemile Creek downstream of the area just above the confluence with Geddes Brook has been designated as "lower Ninemile Creek," which has been further subdivided into three reaches (AB, BC, and CD). Major physical features within and near the Geddes Brook/Ninemile Creek site, the approximate limits of the respective operable units, and the approximate limits of lower Ninemile Creek Reaches AB, BC, and CD are shown in the aerial photograph presented as Figure 2 and in Figure 3.

OU1 includes the channel sediments, surface water, and floodplain soils/sediments of lower Geddes Brook downstream from the discharge point of the West Flume, which is part of Honeywell's LCP Bridge Street subsite, and lower Ninemile Creek from approximately 600 ft (180 m) upstream of the discharge point of Geddes Brook to just downstream of the I-690 overpass near the Wastebeds 1 through 8 site. OU2 includes the channel sediments, surface water, and floodplain soils/sediments of the section of lower Ninemile Creek from the downstream end of OU1 to Onondaga Lake. This section of lower Ninemile Creek flows adjacent to the Wastebeds 1 through 8 site.

The lowest reach of Ninemile Creek (Reach AB) is adjacent to the western edge of the Wastebeds 1 through 8 site (see Figures 2 and 3). An RI/FS for the Wastebeds 1 through 8 site is currently being performed by Honeywell (O'Brien & Gere, 2006), and preliminary findings indicate that the Wastebeds 1 through 8 site may influence the remediation of Reach AB of lower Ninemile Creek. A source of contamination containing elevated levels of benzene, toluene, ethylbenzene, and xylenes (BTEX) has been located on the Wastebeds 1 through 8 site below (beneath) the Solvay waste. Based on these conditions and the ongoing RI/FS for the Wastebeds 1 through 8 site, the remediation of groundwater and surficial soils/waste will be evaluated for the Wastebeds 1 through 8 site.

Active remedial measures along the western edge of the Wastebeds 1 through 8 site (Figure 3), which may be needed to address contamination from and/or erosion of the Wastebeds 1 through 8 site, may affect the floodplain and possibly channel portions of Reach AB of lower Ninemile Creek. Therefore, remedy selection for Reach AB channel sediments and floodplain soils/sediments will be coordinated with the NYSDEC and Honeywell evaluation of site conditions

in the western portion of the Wastebeds 1 through 8 site based on an ongoing FS. This evaluation is anticipated to take place by Spring 2009. Therefore, it was decided that Reach AB of lower Ninemile Creek would be separated from the rest of the Site as a second operable unit (OU2) to avoid delaying remediation of lower Geddes Brook and Reaches BC and CD of Ninemile Creek (OU1). The ROD for OU1 is scheduled to be issued in April 2009 following public review of this Proposed Plan for OU1. The Proposed Plan for OU2 (Reach AB of lower Ninemile Creek) is scheduled to be released in May 2009. The ROD for OU2 is scheduled to be released in October 2009 following public review of the Proposed Plan for OU2. This timing would allow the remediation of the Geddes Brook/Ninemile Creek site to be coordinated with the Onondaga Lake remediation which is scheduled to begin in May 2012.

As discussed below in the "Summary of Site Risks" section of this Proposed Plan, the human health risk assessment (HHRA) and baseline ecological risk assessment (BERA) for the Site indicated unacceptable risks associated with the Site for human and ecological receptors. Although both risk assessments were conducted for the Site as a whole, the exposure assessments utilized varying subareas of the Site, depending on the route of exposure and the receptor being assessed. The HHRA and BERA are applicable to both OU1 and OU2 because the separation of the Site into operable units, which was done after the completion of the RI and risk assessments, is not based on different cleanup strategies or different criteria for the protection of human health and the environment. Rather, as discussed above, the separation is based on scheduling and implementation concerns since Reach AB is anticipated to be impacted by remedial evaluations for the Wastebeds 1 through 8 site. The entire Geddes Brook/Ninemile Creek site (with the exception of the channel sediments and floodplain soils/sediments of lower Geddes Brook which would be completely removed down to the underlying clay layer as part of the pending Geddes Brook IRM) is anticipated to be remediated in a consistent manner with the same considerations being applied to both OU1 and OU2.

SITE HISTORY

Prior to 1926, most of the Geddes Brook and Ninemile Creek watershed was primarily rural and bordered by farms. Since that time, the stream channels have been impacted and modified by commercial and industrial development. These impacts and modifications included discharges from Honeywell (formerly Allied Chemical/AlliedSignal) operations (*e.g.*, the LCP Bridge Street facility) and re-routing of the streams. A brief history of the streams and their modifications is presented by reach below. The original streambed is shown in Figure 4 along with the current channel locations and designation of the reaches used in this Proposed Plan.

Lower Ninemile Creek

For the purposes of the RI/FS and this Proposed Plan, the stretch of Ninemile Creek downstream of the area just above the confluence with Geddes Brook has been designated as "lower Ninemile Creek," which has been further subdivided into three reaches.

Reach AB

In 1926, the lowest reach of Ninemile Creek (*i.e.*, Reach AB) was re-routed to accommodate Wastebeds 1 through 8. At this time, the outlet to Onondaga Lake was moved to its current location, as shown in Figure 4, about 1,600 ft (500 m) west of its original location.

In the late 1960s, sediments in Onondaga Lake near the mouth of Ninemile Creek were dredged to remove a portion of a delta that had built up over the years. Based on sediment probing in Ninemile Creek adjacent to Wastebeds 1 through 8, it is likely that the dredging continued up Ninemile Creek as far as the second major bend in the stream (*i.e.*, the entire length of Reach AB). The dredging at the delta of Ninemile Creek was part of a larger project along the northwest shore of the lake to fill the marshland to establish parkland and to ease the flow of water from Ninemile Creek to Onondaga Lake. These dredge spoil areas, located west of Wetland SYW-10 and the Reach AB portion of the Site, underwent a preliminary investigation in 2000 during the Onondaga Lake RI (TAMS/Earth Tech, 2002) and a preliminary site assessment (PSA) was conducted by Honeywell under a consent order with NYSDEC.

Reach BC

Between approximately 1940 and 1951, Reach BC, south of State Fair Boulevard, appears to have been straightened or re-channelized. This portion of lower Ninemile Creek consisted of two channels – a western channel located very close to the foot of Wastebed 9 and an eastern channel.

The downstream section of Reach BC was slightly relocated in 1954 during the construction of I-690. The area from approximately 50 ft (15 m) north of the northbound lane to about 100 ft (30 m) south of the southbound lane of I-690 was straightened and the banks were relocated approximately 6 to 10 ft (2 to 3 m) either east or west in several locations.

In the late 1960s, Reach BC of Ninemile Creek was excavated and/or re-routed to accommodate the construction of State Highway Route 695. The new (current) channel was located approximately 100 ft (30 m) west of the former eastern channel. The western channel (*i.e.*, the channel nearest Wastebeds 9 through 11) was eliminated.

Reach CD

In contrast to Reaches AB and BC, Reach CD of lower Ninemile Creek has remained essentially unaltered since at least the 1930s (*e.g.*, two channels remain separated by islands).

Upper Ninemile Creek

Upper Ninemile Creek includes the area of the stream just upstream of its confluence with Geddes Brook to Amboy Dam. Around 1944, a portion of upper Ninemile Creek was re-routed to accommodate the construction of Wastebeds 9 through 11.

Upper and Lower Geddes Brook

The upper Geddes Brook portion of the Site extends from the confluence with the West Flume to a point approximately 2,500 ft (760 m) upstream of Gerelock Road. Part of Geddes Brook experienced re-routing to accommodate the construction of Route 695 in the late 1960s. The first 200 ft (60 m) of Geddes Brook above the confluence of the West Flume was re-routed approximately 200 ft (60 m) east to its current location some time between 1967 and 1978 during the construction of Route 695. At some time in the past, lower Geddes Brook (reach downstream of the West Flume) was likely artificially modified, given the straight and deeply-cut channel. However, no record of this modification is available.

HONEYWELL FACILITIES AND DISPOSAL AREAS NEAR GEDDES BROOK/NINEMILE CREEK

This section of the Proposed Plan summarizes the industrial pollution of Geddes Brook/Ninemile Creek and key historical information regarding Honeywell International and its predecessor companies' manufacturing operations (*e.g.*, Allied Chemical Corporation), and is based on the RI/FS reports. For clarity, and as stated in the text box entitled "What is a Potentially Responsible Party" (page 17), "Honeywell" is used throughout the Proposed Plan to refer to Honeywell International, Inc. and its predecessor companies. Honeywell has been named a potentially responsible party (PRP) as a major contributor of contamination to this site and Onondaga Lake. Honeywell consented to investigate this site and the lake pursuant to the terms of a New York District Court Consent Decree dated March 16, 1992 (89-CV-815) ("Consent Decree").

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

What is a "Potentially Responsible Party?"

A PRP is an entity that is potentially responsible for the contamination, and therefore the cleanup, of a contaminated site. In the case of the Geddes Brook/Ninemile Creek site, Honeywell International has been named as a potentially responsible party (PRP) as a major contributor of contamination to the lake. Honeywell agreed to investigate contamination at this site pursuant to the terms of a Consent Decree. Honeywell International, Inc., and its predecessor companies, operated manufacturing facilities in Solvay, New York, from 1881 until 1986. When Honeywell merged (December 1, 1999) with its predecessor companies (shown below), it became liable for the contamination those companies introduced into the environment. "Honeywell" represents Honeywell International, as well as its predecessor companies which include:

Allied Chemical and Dye Corp. (incorporated December 17, 1920)
General Chemical
Barrett Company
National Aniline and Chemical Company
Solvay Process Company
Semet Solvay Company
⇓
Allied Chemical Corporation (April 28, 1958)
⇓
Allied Corporation (April 27, 1981)
⇓
AlliedSignal, Inc. (September 18, 1985)
⇓
Honeywell International (Present)

The availability of natural deposits of salt and limestone in greater Onondaga County was the primary reason for locating the Solvay Process Company in Solvay, New York. Founded in 1881, the company initially used brine collected locally, but, in 1889, it started utilizing the salt formations in the Tully Valley about 20 mi (33 km) away. The Solvay Process Company used the ammonia soda process (subsequently known as the Solvay Process) to produce soda ash, a product used to manufacture neutralizing agents, detergent, industrial chemicals, and glass. Honeywell subsequently expanded its operation to three locations – the Main Plant, the Willis Avenue plant, and the Bridge Street plant – which were collectively known as the Syracuse Works. The locations of these and other sites discussed in the RI report are shown in Figure 5. These processes resulted in releases of mercury as well as organic and calcite-related contaminants (see the text boxes entitled "What is Mercury?" [page 18] and "What are Organic Contaminants in the Geddes Brook/Ninemile Creek Site?" [page 19]).

The Main Plant at the Syracuse Works manufactured soda ash and related products from 1884 to 1986 and benzene, toluene, xylenes, and naphthalene from 1917 to 1970. The Willis Avenue plant manufactured chlorinated benzenes and chlor-alkali products from 1918 to 1977. Chlor-alkali production by the diaphragm cell process was in operation at the Willis Avenue plant from 1918 until 1977. The mercury cell process was used at the Willis Avenue plant for chlor-alkali production

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

What is Mercury?

One of the main contaminants at the Geddes Brook/Ninemile Creek site is mercury. Honeywell used mercury in the production of chlorine and caustic soda at the mercury-cell chlor-alkali plants.

Most of the mercury in water, sediments, plants, and animals is in the form of inorganic mercury salts and organic forms of mercury (*e.g.*, methylmercury). Methylation of mercury is a key step in the entrance of mercury into food chains. The biotransformation of inorganic mercury to methylated organic forms in water bodies can occur in the sediments and the water column.

Mercury accumulates in the food chain up to the top of the aquatic food web. Nearly all of the mercury that accumulates in fish tissue is methylmercury. Inorganic mercury, which is less efficiently absorbed and more readily eliminated from the body than methylmercury, does not tend to bioaccumulate. Accordingly, mercury exposure and accumulation is of particular concern for animals at the highest trophic levels in aquatic food webs and for animals and humans that feed on these organisms.

Mercury is a known human and ecological toxicant. Methylmercury-induced neurotoxicity is the effect of greatest concern when exposure occurs to the developing fetus. Dietary methylmercury is almost completely absorbed into the blood and distributed to all tissues including the brain; it also readily passes through the placenta to the fetus and fetal brain. Neurotoxic effects include subtle decrements in motor skills and sensory ability at comparatively low doses to tremors, inability to walk, convulsions, and death at extremely high exposures. Other adverse effects of mercury include reduced reproductive success, impaired growth and development, and behavioral abnormalities.

Mercury is known to adversely affect aquatic organisms through inhibition of reproduction, reduction in growth rate, increased frequency of tissue histopathology, impairment in ability to capture prey and olfactory receptor function, alterations in blood chemistry and enzyme activities, disruption of thyroid function, chloride secretion, and other metabolic and biochemical functions. In general, the accumulation of mercury by aquatic biota is rapid and depuration is slow. It is emphasized that organomercury compounds, especially methylmercury, are significantly more effective than inorganic mercury compounds in producing adverse effects and accumulation.

from approximately 1947 (or possibly earlier) until 1977. Starting in 1953, the Bridge Street plant produced chlor-alkali products, as well as hydrogen peroxide, using the mercury cell electrolytic process. Diaphragm cells were added to the Bridge Street operation in 1968. The plant was sold to LCP of New York in 1979 and operated until 1988.

What are Organic Contaminants in the Geddes Brook/Ninemile Creek Site?

Honeywell released the major organic contaminants found at the Geddes Brook/Ninemile Creek site from its Syracuse facilities. Releases of hexachlorobenzene, phenol, and polycyclic aromatic hydrocarbons (PAHs) began at least as early as 1918, and PCBs and mercury were used in the 1940s and possibly even the late 1930s. (Mercury is an inorganic contaminant and is discussed in the text box entitled "What is Mercury?") Although the Willis Avenue and Main Plant sites are not located in the Geddes Brook/Ninemile Creek watershed, wastes from these facilities were disposed of in the wastebeds within the Geddes Brook/Ninemile Creek watershed. Wastewater from the Main Plant was discharged to the West Flume, which runs through the LCP Bridge Street subsite and discharges to Geddes Brook.

Hexachlorobenzene: Hexachlorobenzene is a hazardous substance that is part of the chlorinated benzenes group. Chlorinated benzenes were produced by Honeywell's Willis Avenue Plant, which was in operation from 1918 until 1977. Hexachlorobenzene was widely used as a pesticide and fungicide for onions and wheat and other grains until 1965, and it was also used in the manufacture of fireworks, ammunition, electrodes, dye, and synthetic rubber, and as a wood preservative. Hexachlorobenzene is resistant to chemical and biological degradation and tends to accumulate in the fat-containing tissues of animals and humans. Studies in animals show that chronic ingestion of hexachlorobenzene can damage the liver, thyroid, nervous system, bones, kidneys, blood, and immune and endocrine systems. Chlorinated benzenes such as hexachlorobenzene can bioaccumulate in humans and cause adverse health effects, and maternal chronic exposure has led to teratogenic effects including cleft palate, changes in rib development, and kidney malformation.

Phenol: Phenol is a manufactured substance found in a number of consumer products. A side product of the BTEX process at Honeywell, phenol was also produced as a saleable product during the 1940s. Phenol is generally not persistent in the environment, but large or repeated releases can remain in the air, water, and soil for long periods of time. Phenol is highly toxic to fish, frogs, and other aquatic organisms. With respect to animals, effects reported in short-term studies include neurotoxicity, liver and kidney damage, respiratory effects, and growth retardation. Human exposure to high levels of phenol has resulted in liver damage, diarrhea, dark urine, and hemolytic anemia.

Polycyclic Aromatic Hydrocarbons: PAHs is the general term applied to a group of compounds, including naphthalene, comprised of several hundred organic substances with two or more benzene rings. They are released to the environment mainly as a result of incomplete combustion of organic matter and are major constituents of petroleum and its derivatives. Naphthalene and other PAHs were produced by Honeywell in conjunction with the benzene, toluene, and xylenes product line and other industrial activities. PAHs, in particular naphthalene, were also part of Honeywell's waste streams, were released to the environment by Honeywell, and are hazardous substances. Exposure to PAHs may result in a wide range of effects on biological organisms. While some PAHs are known to be carcinogenic, others display little or no carcinogenic, mutagenic, or teratogenic activity. Several PAHs exhibit low levels of toxicity to terrestrial life forms, yet are highly toxic to aquatic organisms.

Polychlorinated Biphenyls: PCBs are mixtures of up to 209 different compounds (referred to as "congeners") that include a biphenyl and from one to 10 chlorine atoms. They have been used commercially since 1930 as dielectric and heat-exchange fluids and in a variety of other applications. PCBs have been used at and released to the environment from the Honeywell facilities. They are persistent and accumulate in food webs. PCBs bioaccumulate in the fatty tissues of humans and other animals. PCBs are considered probable human carcinogens and are linked to other adverse health effects such as developmental effects, reduced birth weights, and reduced ability to fight infection.

Polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans: PCDD/PCDFs are composed of a triple-ring structure consisting of two benzene rings connected to each other by either two (dioxins) or one (furans) oxygen atoms. Dioxins and furans are byproducts of chemical manufacturing or the result of incomplete combustion of materials containing chlorine atoms and organic compounds. Based on evidence collected by Honeywell from their sites, PCDD/PCDFs were apparently generated as the result of a fire in the chlorination building at the Willis Avenue Plant in the 1930s and as trace contaminants during the various manufacturing operations and thus were released into the environment. PCDD/PCDFs tend to be very insoluble in water; adsorb strongly onto soils, sediments, and airborne particulates; and bioaccumulate in biological tissues. These substances have been associated with a wide variety of toxic effects in animals, including acute toxicity, enzyme activation, tissue damage, developmental abnormalities, and cancer.

Geddes Brook Interim Remedial Measure

Honeywell entered into a separate consent order with NYSDEC (Index No. D7-0003-01-09), effective April 16, 2002, to perform an IRM to address contaminated channel sediments and floodplain soils/sediments associated with lower Geddes Brook (NYSDEC, 2002).

The basis for the IRM is to mitigate the potential risks to human health and ecological receptors identified during the preparation of the human health and ecological risk assessments, which were finalized in 2003 (TAMS/Earth Tech, 2003a and 2003b) and are described in the Streamlined Risk Evaluation in Appendix A of the Geddes Brook IRM Engineering Evaluation/Cost Analysis (EE/CA) (Parsons, 2008b). The risk assessments identified a number of contaminants of potential concern, including mercury and other metals, PAHs, PCBs, and PCDD/PCDFs. Unacceptable risks were identified for human consumption of fish and for all trophic levels in the environment, based on several lines of evidence. Affected media include lower Geddes Brook channel sediment, surface water, floodplain soil, and fish.

The objectives of the Geddes Brook IRM are to:

- Eliminate, to the extent practicable, within the scope of the IRM, the transport of mercury into Ninemile Creek from lower Geddes Brook channel sediments and floodplain soils/sediments.

- Eliminate, to the extent practicable, within the scope of the IRM, potential impacts to human health and fish and wildlife resources associated with site-related impacts.

Pursuant to the consent order and EPA's Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA (USEPA, 1993), an EE/CA to identify and evaluate alternatives for disposal of contaminated sediments and soils that will be generated from the implementation of the IRM is currently undergoing public review (Parsons, 2008b). The Preliminary (50%) Design related to sediment removal was submitted to the agencies on August 18, 2003 (Parsons, 2003) and was revised in accordance with agency comments dated December 23, 2003. Additional design documents are to be submitted following the approval of the EE/CA.

Approximately 4,700 cy (3,600 m^3) of sediments will be removed from the channel as part of the Geddes Brook IRM. The estimated depths of sediment removal range from approximately 2 to 6 ft (0.6 to 1.8 m) and will result in removal of the sediments down to the underlying clay layer beneath lower Geddes Brook. Sediments will first be removed from the upstream portion of lower Geddes Brook at the confluence with the West Flume (which has been remediated) and removal will proceed downstream by section to reduce the potential for recontaminating remediated areas. Sediments will also be removed from two 60-inch (1.5-m) culverts that channel lower Geddes Brook beneath the Conrail railroad tracks and an existing access road. The removal of sediments within these culverts will take place once upstream sediments and soils have been removed.

In addition to sediment removal, contaminated lower Geddes Brook floodplain soils/sediments will also be remediated. Approximately 62,000 cy (47,000 m^3) of floodplain soil/sediment will be excavated within the floodplain footprint down to an underlying clay layer that is typically 2 to 4 ft (0.6 to 1.2 m) below ground surface, as shown in Figure 11. The final depths of excavation will be determined during design of the IRM based on additional sampling to confirm the depth of clay in select areas.

The bermed areas in the floodplain immediately adjacent to lower Geddes Brook, which are comprised of previously excavated contaminated sediments, will be removed. Remedial actions for the inactive utility berm that bisects the floodplain will be determined during design, and could include full or partial removal and covering with clean soil, and will consider habitat and public use.

Stream and wetland restoration will follow the removal of sediments from lower Geddes Brook and from the adjacent floodplain. Restoration will include the relocation of the portion of the stream between the culvert and Ninemile Creek to the west in the remediated floodplain area, to provide sinuosity, better connectivity with the floodplain, and ability for channel migration. The wetland restoration will consist of the establishment of wetland conditions at a generally lower topography than existing conditions so that a diverse emergent wetland can be established. In general, the wetland will be restored with approximately 1 ft (30 cm) of clean material. However, the actual depth may vary to allow for the establishment of variable microtopography and a diversity of wetland habitats.

Channel and floodplain areas that undergo removal will be restored consistent with a restoration plan to be developed for the Geddes Brook IRM. The objective is to restore wetland areas disturbed by the removal of channel sediments and floodplain soils/sediments and to create wetlands in the current Geddes Brook channel.

The total remedial/restoration area of this IRM is estimated to be about 16 acres (6.5 hectares). The remediation pursuant to this IRM is expected to remove nearly 100 percent of the mass of mercury within the remedial boundaries of the lower Geddes Brook IRM area (estimated to be about 1,000 pounds [450 kg]).

Based on the EE/CA, the proposed disposal option for the approximately 67,000 cy (51,000 m^3) of sediments and soils is on-site containment at Honeywell's LCP Bridge Street subsite.

LCP Bridge Street Subsite

The LCP Bridge Street subsite, which includes the West Flume, was a source of mercury and other contaminants to Geddes Brook. Geddes Brook receives discharges from the West Flume, a drainage ditch that passes through the LCP Bridge Street facility. The remediation of the LCP Bridge Street subsite included the removal of contaminated sediments from the West Flume.

The LCP Bridge Street subsite consists of 20 acres (8 hectare) of land used for various industrial activities (including a chlor-alkali production facility that operated from 1953 to 1988). The wastes from the LCP Bridge Street plant were discharged into the West Flume. A ROD was issued in September 2000. The buildings at the subsite were demolished as part of two IRMs. The LCP Bridge Street subsite remediation was substantially completed in 2007 (described below in the section entitled "Scope and Role of Response Action"). This remediation includes a temporary cap which would be replaced with a final cap following the placement of material from either the remediation of Geddes Brook and Ninemile Creek or another source, pending the selection of the remedy for Geddes Brook/Ninemile Creek.

Solvay Wastebeds

The primary method of waste disposal at the Syracuse Works was to pump wastes to wastebeds located along the lake shore and along Ninemile Creek. The wastes, which were primarily made up of Solvay waste from the manufacturing of soda ash, were pumped in a slurry of about 5 percent

solids. These solids settled out in the beds, and the remaining wastewater overflowed into the lake or Ninemile Creek. Wastebeds 1 through 15 are located along Ninemile Creek (see Figure 2) and were utilized as follows:

- From the 1920s to 1944, Wastebeds 1 through 8 were used to dispose of Honeywell's wastes. The mouth of Ninemile Creek was re-routed to allow for the construction of these wastebeds. The ownership of Wastebeds 1 through 8 were subsequently transferred by Allied to New York State and Onondaga County. Groundwater from Wastebeds 1 through 8 discharges predominantly into Onondaga Lake.

- From 1944 to 1986, wastes were disposed of in Wastebeds 9 through 11 and 12 through 15. Ninemile Creek was re-routed to allow for the construction of these wastebeds. Groundwater, leachate seeps, and surface water from Wastebeds 9 through 15 discharges to Ninemile Creek and serves as a migration pathway for wastebed constituents.

- Other uses were as landfills for slag and wastewater treatment sludges from the Crucible Materials Corporation (a portion of Wastebed 5); for Metropolitan Syracuse Sewage Treatment Plant (Metro) sewage sludge disposal (portions of Wastebeds 5 and 12 through 15); and as sites for construction of parking lots for the New York State Fairgrounds (portions of Wastebeds 5, 7, and 8). In addition, I-690 and Route 695 were constructed over portions of Wastebeds 7 and 8.

Honeywell is currently performing an RI/FS for Wastebeds 1 through 8 under the direction of NYSDEC. Closure of Wastebeds 9 through 15 is currently being evaluated by NYSDEC's Solid Waste Program. The sources and potential sources of contaminants influencing the Geddes Brook/Ninemile Creek site, including these wastebeds, are discussed in more detail below in the section entitled "Results of the Remedial Investigation."

SITE GEOLOGY/HYDROGEOLOGY

Most of the Onondaga Lake drainage basin, including Geddes Brook and Ninemile Creek, is located in the Limestone Belt of central New York State. Exposed surfaces in some areas of the Limestone Belt consist of glacial till and lacustrine deposits, and in other areas they consist of outcrops of limestone (particularly Onondaga Limestone) and alkaline shales. Because of this geologic influence, concentrations of calcium, magnesium, bicarbonate, and alkalinity are higher in streams and lakes influenced by the Limestone Belt than in those influenced by the Northern Allegheny Plateau to the south and the Ontario-Oneida-Champlain Lake Plain to the north.

The bedrock geology beneath the Site consists of 500 to 600 ft (150 to 180 m) of sedimentary rocks of the Vernon Shale formation. The Vernon Shale consists of soft and erodible mudstones with some localized, discontinuous gypsum seams. In the upper reaches of Geddes Brook, the Upper Silurian Syracuse Formation overlays the older Vernon Formation. The Syracuse formation is approximately 600 ft (180 m) thick and consists of shales, dolostones, and salt.

The sedimentary geology at the Site is primarily a result of glaciation that deposited a thin layer of glacial till over the bedrock surface. The glacial till consists of a poorly sorted mixture of clays, silts,

sands, and boulders. The glacial till is generally 10 to 15 ft (3 to 5 m) thick and is overlain by glaciolacustrine deposits. The glaciolacustrine deposits were formed in lake waters which were formed from glacial meltwater several thousand years ago, and consist of clays, silts, and sands with gravels present at increasing depth.

Regional groundwater flow in the area is from south to north. In the vicinity of the Site, groundwater flow occurs both in the bedrock and unconsolidated Ninemile Creek valley fill deposits, with movement between the two strata. The unconsolidated valley fill deposits are generally heterogeneous, with a relatively less permeable layer close to the ground surface. As described in detail below, groundwater recharge to the subsurface occurs primarily along the Ninemile Creek valley walls. However, in the lower reaches of the valley near Onondaga Lake, the deeper bedrock flow system discharges into the overlying material in the center of the valley. Discharge from the bedrock flow system is limited to areas with little overlying glacial till.

Bedrock underlying the Ninemile Creek area consists of Vernon Shale, which underlies most of the valley fill in the study area. The formation produces water fairly consistently, with yields ranging from one to 450 gallons per minute (gal/min) with a median of 12 gal/min. Water flow in this formation is largely through voids and channels created by groundwater that has dissolved various salts commonly found in this formation.

In the upper reaches of Geddes Brook, the Syracuse Formation overlies the Vernon Shale. The median yield is 30 gal/min – much higher than that of the underlying shale – because this formation has larger fractures and other openings in the rock.

Groundwater flow tends to follow the elevation of the ground surface in the Ninemile Creek valley fill deposits. Two distinct groundwater flow systems in the valley fill deposits (*i.e.*, shallow and deep) have been identified. Groundwater migration in the shallow flow system is generally towards the creek, however, in the vicinity of the wastebeds, the groundwater is mounded (higher in elevation). The mounding is attributed to the height and the relatively low permeability of the wastebed materials, and causes groundwater to flow away from the wastebeds in all directions. Groundwater migration in the deeper flow system heads northeast, which is more consistent with the orientation of the valley.

Concentrations of total dissolved solids (TDS) in Ninemile Creek above Amboy Dam (*i.e.*, above the area of influence of the wastebeds and former Honeywell operations) range from 720 to 809 milligrams per liter (mg/L), and exceed the state surface water quality standard of 500 mg/L for a Class C water body. As discussed in the RI report, discharge from Wastebeds 9 through 11 is evident in Ninemile Creek by the increase of ionic loading downstream of the wastebeds. Between Station NM3 (located near the upstream limit of Wastebed 11) and Station NM4 (located near Wastebeds 9 and 10), TDS increased from 1,430 to 2,810 mg/L, total chloride increased from 288 to 674 mg/L, and calcium increased from 216 to 354 mg/L in samples from July 1998. Wastebeds 1 through 8 are located along Onondaga Lake southeast of the mouth of Ninemile Creek, with only Wastebed 5 directly bordering Ninemile Creek. Compared to Wastebeds 9 through 15, Wastebeds 1 through 8 are considered a minor source of groundwater to Ninemile Creek, based on relatively small increases in TDS in this section of the creek from upstream to downstream.

Groundwater in the vicinity of the Geddes Brook/Ninemile Creek site is designated as Class GA groundwater under 6 NYCRR Part 701.15. However, groundwater is not and has not been used

for potable water supply purposes. High concentrations of chloride and TDS in the surface aquifer preclude its use as potable water.

SURFACE WATER HYDROLOGY

Geddes Brook and Ninemile Creek are the major surface water features at the Site and also serve as major drainage features in the region. Ninemile Creek empties into Onondaga Lake north of the New York State Fairgrounds. Geddes Brook is the largest tributary to Ninemile Creek. Beaver Meadow Brook is a minor tributary that joins Ninemile Creek across from Wastebed 13. The West Flume which flows through the LCP Bridge Street subsite, and an unnamed tributary which carries drainage from Wastebeds 12 through 15, are minor contributors of flow to Geddes Brook. These three minor tributaries (Beaver Meadow Brook, West Flume, and the unnamed tributary) are not part of the Site.

The State of New York has classified the lower reaches of Geddes Brook, Beaver Meadow Brook, and Ninemile Creek from Otisco Lake (where it originates) to Onondaga Lake as Class C water. According to 6 NYCRR Part 701.8, the best usage of Class C waters is "fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes."

The designation of C(T) standards apply to Geddes Brook, upstream of the Old Erie Canal, and Ninemile Creek, upstream of the former Honeywell water intake location (0.6 mi [1 km] upstream of Airport Road). This designation indicates that, in addition to Class C uses, these waters are trout waters and that the dissolved oxygen (DO) specification for trout waters apply (6 NYCRR Part 895). Streams and small water bodies located in the course of a stream that have the classification or standard designation of C(T) or higher *(i.e.*, C[TS], B, or A) are collectively referred to as "protected streams," and are subject to the disturbance of protected streams provisions of the Protection of Waters regulations (6 NYCRR Part 608.2).

Flow rates in Ninemile Creek range from 50 cubic feet per second (cfs) to over 1,000 cfs, with an annual mean stream flow of 154 cfs for the years 1980 to 2000. Flow rates increase dramatically during storm events. The U.S. Geological Survey (USGS) gauges that collect daily flow data are located on Ninemile Creek upstream of the Site in the town of Camillus and within the Reach BC portion of the Site at Lakeland, approximately 2,500 ft (760 m) upstream of the mouth of the creek. Honeywell collects quarterly flow data from lower Geddes Brook.

Annual mean stream flow in Ninemile Creek dropped from 264 cfs in the 1970s to 154 cfs from 1980 to 2000. This drop in flow coincided with the diversion of former Honeywell discharges to other receiving waters, and then closure of their facilities. The total suspended solids (TSS) load has also decreased by approximately 30 percent since the closure of former Honeywell operations. These reductions in flow and sediment load have contributed to changes in the hydraulic regime and may have affected patterns of deposition and erosion.

The maximum areal extent of surface water at the Site was estimated in the FS by the use of the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Centers River Analysis System (HEC-RAS) flood model Version 3.1 and updated in the Supplemental FS report (see text box entitled "Flood Flow Model" on page 65).

The modeled floodplain extents for flood events of various sizes as well as the approximate extents of OU1 and OU2 are shown in Figure 3. The extent of the 50-year floodplain (*i.e.*, from a storm event which has a 2 percent chance of occurring in any given year), determined through the modeling effort, is comparable to the extent of the historical high water mark from 1972. As discussed in the RI report, the 1972 flood caused by Hurricane Agnes was the largest historically recorded flood event in central New York. The limits of that estimated flood event are generally well constrained by rapid changes in elevation of the land surrounding the stream (breaks in grade), which generally coincide with the limits of areas warranting remediation.

The floodplain portion of the Site contains state and federal wetlands. These wetlands, SYW-10 and SYW-18, are directly connected to the lower reaches of Geddes Brook and/or Ninemile Creek (see Figure 2) and are within the site limits. Wetland SYW-10, located along Ninemile Creek, is a 27.2-acre (11-hectare) Class I wetland [4]. This wetland is divided by I-690. On the lake side of I-690, the wetland is dominated by emergent vegetation and floodplain forest. This portion of the wetland is being investigated as part of the OU2 portion of the Geddes Brook/Ninemile Creek site. The wetland section on the western side of I-690 was historically a salt marsh; however, the saline inputs appear to be gone and the wetland is now dominated by typical emergent vegetation. Wetland SYW-18, located in the area around the confluence of Geddes Brook and Ninemile Creek, is a 27.2-acre (11-hectare) Class II wetland. The wetland is dominated by reeds, with a densely forested area in the upstream portion. This wetland encompasses a larger area than originally mapped, as discussed in Appendix E of the BERA. Delineation of these wetlands will be completed during remedial design.

SEDIMENT TRANSPORT AND CHARACTERISTICS

For this Proposed Plan, the stream channel is defined as those areas below the mean high-water level, while the floodplain is defined as those areas above the mean water level to the highest extent of flooding during the period of Honeywell operations, which is constrained by steep banks present along the Site (see discussion above in the “Site Description” section). Sediment transport is dependent on flow conditions, with the water velocities controlling the erosional or depositional character of Ninemile Creek and Geddes Brook. At low (base) flow with low water velocities, the suspended sediment load is limited to small, easily transported particles. At high (flood) flow with high water velocities, additional sediment from the stream bed can be resuspended and transported downstream. Inputs of sediment during high flow, however, come from erosion of the channel bank. When water flows over the stream banks and onto the floodplain, water velocities over the floodplain are slowed by the topography and by the vegetation. This results in depositional floodplain areas that accumulate sediment.

In natural systems, these types of erosion variations cause streams to curve or meander; the meanders are the bends in the river. Meanders are common features of rivers caused by the erosion and deposition of bank materials. The current in a river flows most quickly near the outer edge of a meander and most slowly near the inner edge. Since erosion increases as current speed increases, and deposition increases as current speed drops, rivers erode material on the outside

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[4] NYSDEC classifies and regulates wetlands in New York State pursuant to 6 NYCRR Parts 663 and 664. Four classes of wetlands have been established and are ranked according to their ability to perform wetland functions and provide wetland benefits. Class I wetlands provide the most critical functions and benefits, while Class IV wetlands provide fewer functions and benefits.

of meanders and deposit sediment on the inside. Typically, over time, the meanders gradually migrate downstream.

However, the lower reaches of Geddes Brook and Ninemile Creek have not been naturally meandering, as they have been artificially and permanently restricted to a large degree by large immobile constructed features. In Reach CD, Solvay Wastebeds 9 through 10 restrict any movement of the Ninemile Creek channel to the west, while the State Fair Landfill restricts most of the movement to the east. In Reach BC, Solvay Wastebeds 9 through 10 restrict any movement to the west for about the upper third of this reach. The rest of the stream banks are constrained by the major highways I-690 and State Route 695 (along with their entrance/exit ramps), and State Fair Boulevard. In Reach AB, I-690 restricts movement to the west for most of the reach, and Solvay Wastebeds 1 through 8 restrict movement to the east. There is some opportunity for the creek to meander near its mouth, although even in this section, it would be limited by the deeply entrenched channel and the heavily wooded bank on the west. Thus, for almost the entire length of the Site, there has been little possibility for the stream channel to change its course.

The most erosive section of Geddes Brook is in the region where the West Flume and the unnamed tributary enter the stream. This region is narrow and steep and consequently has high stream power. Deeper sediment in lower Geddes Brook reflects a more depositional environment. Ninemile Creek is primarily depositional, with the exception of the reach just below the point where Geddes Brook joins the creek. In this reach, Ninemile Creek has both erosional and depositional areas downstream of the Geddes Brook entry, as water flow moves from one bank to the other and around islands.

The current distribution of sediments in Ninemile Creek is the result of historical depositional and erosional patterns, historical anthropomorphic modifications to the stream, and the current depositional and erosional regime. Overall, the historical discharges by Honeywell have resulted in two effects:

- The large amounts of solids discharged into the streams, along with the potential for the dissolved solids to precipitate out, caused much more of lower Geddes Brook and lower Ninemile Creek to be depositional during Honeywell's operations than is currently the case.

- Deposition rates during Honeywell's operations were much greater than those currently experienced, as evidenced by the accumulation of several feet of Solvay waste. A prime example of this change between historical and current regimes is the section of Ninemile Creek immediately below the confluence with Geddes Brook (Reach CD), which is currently erosional even at low flow, yet in the past accumulated large deposits of calcite-contaminated material.

The re-routing of the streams produced different hydrologic conditions with respect to width, depth, and gradient. In addition, the alteration of the stream bed by various activities impacted the contaminant deposition patterns that would be typically seen in stream systems. Typically, the highest concentrations of a contaminant are seen in the sediments and floodplain near the source and then gradually decline farther from the source. At this site, the source of mercury contamination was determined to be the Honeywell LCP Bridge Street plant which started using mercury in 1953, discharging it through the West Flume into Geddes Brook. Downstream of the culverts in lower Geddes Brook, the highest mercury concentrations within the Geddes Brook/Ninemile Creek site are found in the Ninemile Creek Reach CD channel and floodplain south

of the large island. Although the majority of Ninemile Creek's flow was carried by the northern channel, this southern channel carried most of the water flowing from Geddes Brook, the source of mercury to the stream. However, the mercury concentrations in the stream channel of Geddes Brook, while elevated, are lower than in Ninemile Creek Reach CD and lower than in the Geddes Brook floodplain. This is likely because the lower Geddes Brook channel was dredged in, or just prior to, 1966 (four years before pollution controls were installed at Honeywell's LCP Bridge Street plant in 1970) and the spoils were placed in the floodplain (now seen as mounds along the channel).

The mercury levels in the Reach BC channel, while elevated, are lower than both Reach CD, as expected, and Reach AB, which being downstream of Reach BC would be expected to have lower concentrations. However, Reach BC of Ninemile Creek was relocated to the east in the late 1960s. The former channel was located approximately where the ramp for Route 695 is now. Therefore, both the channel and floodplain of Reach BC contain mercury concentrations somewhat lower than might be expected, although still elevated. In Reach AB, the mercury concentrations in the floodplain tend to be much higher than the concentrations in the channel. This is because much, although not all, of the contaminated sediments in the Reach AB channel were dredged in 1968 and the spoils placed in the nearby dredge spoils area site and/or along the channel bank. The contaminated floodplain of Reach AB still contains high concentrations of mercury, but the channel sediments in this reach are lower than in the floodplain. Thus, although the pattern of the mercury distribution is not typical, an understanding of the history of the Site ensures that the source of mercury contamination was properly identified and addressed in this and other remedial programs. Although these modifications to the streams impacted the historic distribution of mercury and other contaminants, levels remain throughout the Site that warrant remediation, as discussed later in this Proposed Plan, and remedial alternatives are based on the current distribution of mercury and other CPOIs.

Additional information on sediment transport and stream channel characteristics can be found in the RI report and in the "Site History" section of this Proposed Plan.

As discussed above, the Geddes Brook IRM calls for changing the deeply incised, channelized stream to a shallow, sinuous channel, which would run through a restored wetland, with the potential to meander through that wetland. As discussed later in this Proposed Plan, the alignment of Reach CD of Ninemile Creek would be altered while retaining connection to the floodplain and the wetland restored, while Reach BC would remain highly channelized.

SOIL CHARACTERISTICS

The soils of the Onondaga Lake watershed include soils formed during glacial times, and soils of more recent origin. Deposits of glacial origin, include till, outwash, alluvial, and glaciolacustrine sediments. The soils tend to be medium-textured, well drained, and high in lime.

The soils overlying bedrock and glacial material in the study area include alluvial deposits along Geddes Brook and Ninemile Creek, organic-rich sediments and peat deposited in post-glacial marshes and swamps, and lacustrine deposits in the Onondaga Lake basin. The lacustrine deposits are composed primarily of marl with varying amounts of silts and fine sand. Fill deposits composed of cinders, ash, and Solvay waste are located above the native soils in many upland areas near the Site.

Within the Ninemile Creek valley, large amounts of Solvay Process wastes were placed in Wastebeds 9 through 15, both north (Wastebeds 9 through 11) and south (Wastebeds 12 through 15) of Ninemile Creek. Wastebeds 9 through 15 occupy approximately 662 acres (268 hectares) and range in thickness from approximately 3 to 69 ft (1 to 21 m). As noted above, Ninemile Creek was historically diverted to accommodate accumulations of these wastes. Wastebeds 9 and 10 are separated from Wastebed 11 by a low interbed area that is the original ground surface prior to construction of the wastebeds. Remnants of the original Ninemile Creek channel are present within this interbed area.

BIOTA

Aquatic Species

The major aquatic communities sampled during the RI at the Site include benthic macroinvertebrates (the insects, worms, and other animals which inhabit the stream bottom) and fishes. Benthic macroinvertebrate communities were sampled in these water bodies by Honeywell at 24 stations in 1990 and at eight stations in 1998. More than 80 taxa (types of organisms) were identified in the samples. Soft-substrate macroinvertebrates included amphipods, chironomids, and non-tubificid and tubificid oligochaetes. Hard-substrate macroinvertebrates included amphipods, chironomids, caddisflies, mayflies, and non-tubificid oligochaetes. Nocturnally drifting invertebrates included amphipods, chironomids, caddisflies, mayflies, and non-tubificid oligochaetes.

The fish communities in Geddes Brook and Ninemile Creek were evaluated in 1973 by independent researchers, and in 1990 and 1998 by Honeywell. Over 25 fish species from 11 families were found during surveys at the Site in 1973, 1990, and 1998. The most numerous species included longnose dace (*Rhinichthys cataractae*), creek chub (*Semotilus aromaculatus*), alewife *(Alosa pseudoharengus*), tessellated darter (*Etheostoma olmstedi*), white sucker (*Catostomus commersoni*), pumpkinseed (*Lepomis gibbosus*), and bluegill (*Lepomis macrochirus*). In 2002, TAMS/Earth Tech (for NYSDEC) sampled young-of-year (YOY) fish at three stations in lower Ninemile Creek downstream of Geddes Brook. The following species were collected: bluegill, killifish (*Fundulus diaphanous*), largemouth bass (*Micropterus salmoides*), tessellated darter, blacknose dace (*Rhinichthys atratulus*), and white sucker.

Historic studies conducted during Honeywell's period of operation showed heavily impacted communities throughout the Site. As noted in a 1974 NYSDEC report (Cooper et al., 1974), based on a field study conducted in 1973, "the water [of Ninemile Creek] was turbid and light brown in color. The odor of chlorine was very noticeable. Only one specimen of a fly maggot (*Diptera*) was found in the Surber sample. No other organisms were found while making fairly intensive dip-net sampling. The stream bottom for all practical purposes was sterile. No fish life was observed and probably did not exist. Station 9 was grossly polluted by toxic wastes."

Terrestrial Species

Over 60 bird species have been observed near Onondaga Lake and the Geddes Brook/Ninemile Creek site, including double-crested cormorants (*Phalac rocorax*), herons (*e.g.*, great blue heron [*Ardea herodias*]), ducks (*e.g.*, mallard [*Anas platyrhynchos*]), swallows (*e.g.*, tree swallow [*Tachycineta bicolor*]), blue jays (*Cyanocitta crisata*), American crows (*Corvus brachyrhynchos*), American robins (*Turdus migratorius*), and sparrows (*e.g.*, song sparrow [*Melospiza melodia*]).

Vegetation along Ninemile Creek provide nesting areas and foraging habitat for waterfowl, ring-necked pheasants (*Phasianus colchicus*), owls (*e.g.*, barred owl [*Strix varia*]), and hawks (*e.g.*, red-tailed hawk [*Buteo jamaicensis*]).

Over 25 mammalian species have been observed near Onondaga Lake and the Geddes Brook/Ninemile Creek site, including opossums (*Didelphis virginiana*), Northern short-tailed shrews (*Blarina brevicauda*), Eastern cottontails (*Sylvilagus floridanus*), Eastern chipmunks (*Tamias striatus*), woodchucks (*Marmota monax*), squirrels (*e.g.*, gray squirrel [*Sciurus carolinensis*]), mice (*e.g.*, deer mouse [*Peromyscus maniculatus*]), meadow voles (*Microtus pennsylvanicus*), muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), moles (*e.g.*, starnosed mole [*Condviura cristata*]), foxes (*e.g.*, red fox [*Vulpes fulva*]), and white-tailed deer (*Odocoileus virginianus*). Periodic sightings of river otter (*Lutra canadensis*) have been made in the Ninemile Creek area.

Rare, Threatened, and Endangered Species

According to the databases maintained by the New York Natural Heritage Program (NYNHP) and the U.S. Fish and Wildlife Service (USFWS), and based also on field observations made during the RI field effort, 11 state-listed rare, threatened, or endangered species have been observed near Geddes Brook and Ninemile Creek, including three plant species, seven bird species, and one mammal. The plants include three species known only from historical records: Sartwell's sedge (*Carex sartewellii*), little-leaf tick-trefoil (*Desmodium ciliare*), and red pigweed (*Chenopodium rubrum*). Six state-listed bird species, including the common loon (*Gavia immer*), common nighthawk (*Chordeiles minor*), sharp-shinned hawk (*Accipiter striatus*), osprey (*Pandion haliaetus*), horned lark (*Eremophila alpestris*), and red-headed woodpecker (*Melanerpes erythrocephalus*) have been observed near Geddes Brook and Ninemile Creek. The mammal is the state-listed endangered Indiana bat (*Myotis sodalis*). The common tern (*Sterna hirundo*), a New York State-threatened species, has also been seen in the area. According to the USFWS, except for the occasional transient individual, no federally listed or proposed threatened or endangered flora or fauna are known to exist within the Site area.

RESULTS OF THE REMEDIAL INVESTIGATION

The Site was the subject of multiple investigations conducted by Honeywell from 1992 to 2002, with additional investigation of YOY fish by NYSDEC in 2002. The investigations conducted by Honeywell in 1992 and 1995 were part of the Onondaga Lake Bottom subsite's RI and focused on quantifying loads of contaminants (especially mercury) from the Geddes Brook/Ninemile Creek site to the lake. Site-specific RI field work was conducted by Honeywell in 1998 (Geddes Brook/Ninemile Creek RI/FS Phase 1 sampling), 2001 (Geddes Brook/Ninemile Creek supplemental RI/IRM sampling), and 2002 (Ninemile Creek supplemental RI floodplain sampling and Geddes Brook IRM pre-design sediment and floodplain soil sampling). Results of these three investigations were presented in the Geddes Brook/Ninemile Creek RI report (TAMS/Earth Tech, 2003c). Additional floodplain data were collected by Honeywell in 2007 and these data are presented in the Supplemental FS report (Parsons, 2008a).

The HHRA report (TAMS/Earth Tech, 2003a) and BERA report (TAMS/Earth Tech, 2003b) were completed by NYSDEC as part of the RI process. These risk assessments are discussed in the "Summary of Site Risks" section of this Proposed Plan. The RI, HHRA, and BERA were finalized by NYSDEC in July 2003.

As a result of the RI studies and risk assessments, numerous contaminants were identified as CPOIs (see Tables 1 and 2 and the text box entitled "What are Chemical Parameters of Interest?" [page 31]), including:

- Mercury and other metals.
- Volatile organic compounds (VOCs).
- Semivolatile organic compounds (SVOCs).
- Pesticides.
- PCBs.
- PCDD/PCDFs.
- Ionic waste constituents.

Both total mercury and methylmercury were analyzed during the RI. In this Proposed Plan, total mercury is generally referred to as "mercury." Total mercury encompasses all mercury species present in a sample, including inorganic species such as ionic mercury and organic species such as methylmercury. Methylmercury is the most toxic and most bioaccumulative form of mercury, with over 95 percent of total mercury in fish tissue present as methylmercury.

Data summaries for Geddes Brook and Ninemile Creek channel sediments, floodplain soils/sediments, surface water, and fish are presented in Tables 3 through 6 in this Proposed Plan. These tables present data from the RI, unless otherwise noted. Maps showing the extent of mercury contamination within the OU1 portion of the Site at depths up to 3 ft (90 cm) in channel sediments and floodplain soils/sediments are presented in this Proposed Plan as Figures 6a through 6c. These figures also show mercury floodplain data collected in 2007. Additional maps for mercury and other CPOIs can be found in Chapter 5 of the RI report (TAMS/Earth Tech, 2003c) and Chapter 2 and Appendix C of the FS report (Parsons, 2005). The data collected in 2007 are presented in Appendix B of the Supplemental FS report (Parsons, 2008a).

Channel Sediments

Mercury

Mercury concentrations in creek channel sediments based on data collected through 2002 generally reflected the input and transport of mercury from the West Flume to Geddes Brook and from Geddes Brook to Ninemile Creek. Sediment concentrations were also affected by the stream channel geomorphology and historical changes to the stream channel. Mercury concentrations were highest in Geddes Brook downstream of the West Flume, and in Ninemile Creek downstream of the Geddes Brook confluence. The ranges of total mercury concentrations in surface sediments (0 to 15 cm) in the upper and lower Ninemile Creek portions of the Site were 0.06 to 0.15 mg/kg[5] and 0.01 to 21.1 mg/kg, respectively. Within lower Ninemile Creek, the highest concentrations were found in Reach CD and near the mouth of the creek where it enters Onondaga Lake. In Geddes Brook, the ranges of total mercury concentrations in surface sediments in the upper and lower

[5] This range of concentrations in the upper Ninemile Creek portion of the Site from Amboy Dam to just upstream of Geddes Brook is based on two surface sediment samples collected in 1998 as part of the RI. An additional eight surface sediment samples were collected in 1998 and 2001 as part of the RI in Ninemile Creek upstream of Amboy Dam with mercury concentrations ranging from 0.08 to 1.4 mg/kg. In addition, four surface sediment samples were collected by NYSDEC in upper Ninemile Creek with mercury concentrations ranging from less than 0.05 to 0.18 mg/kg. The average mercury concentration of all 14 samples in upper Ninemile Creek, upstream of Reach CD, was 0.33 mg/kg (if the highest value is removed, this average would be 0.25 mg/kg).

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

What are Chemical Parameters of Interest?

The **chemical parameters of interest**, or **CPOIs**, for the Geddes Brook/Ninemile Creek RI/FS are defined as those elements or compounds that were selected as **contaminants of potential concern (COPCs)**, **chemicals of concern (COCs)**, or **stressors of concern (SOCs)**. The major classes of CPOIs at the Site include mercury and other metals, SVOCs (including PAHs, hexachlorobenzene, and phenol), PCBs, PCDD/PCDFs, and calcite.

COPCs: COPCs are used in human health risk assessments (HHRAs) to determine contaminants that may be harmful to humans. An HHRA for the Geddes Brook/Ninemile Creek site was performed as part of the RI. COPCs were developed using available contaminant concentration data for fish (fillets only; limited to species likely to be consumed by humans), channel sediments, floodplain soils/sediments, and surface water. A total of about 40 individual COPCs in one or more site media were identified in the HHRA that fall into the classes identified above plus other SVOCs and pesticides. (See attached Table 1 entitled "Contaminants of Potential Concern for the Geddes Brook/Ninemile Creek HHRA.")

COCs: COCs are used in baseline ecological risk assessments (BERAs) to determine chemicals that may be harmful to the environment. A BERA for the Geddes Brook/Ninemile Creek site was performed as part of the RI. COCs were developed using toxicity values to establish conservative thresholds for adverse effects to ecology (surface water, channel surface sediments, floodplain surface soils/sediments, plants, fish, and wildlife). As presented in the BERA, numerous toxic chemicals were detected at elevated concentrations in various site media. A total of 28 COCs in one or more site media were identified in the BERA that fall into the classes identified above plus select VOCs, other SVOCs, and pesticides. (See attached Table 2 entitled "Contaminants and Stressors of Concern Selected for Geddes Brook/Ninemile Creek Site Media in the BERA.")

SOCs: SOCs are used in BERAs to determine those chemical contaminants which may not be addressed as hazardous wastes or hazardous substances, but which may cause effects or conditions that are harmful to the environment. The SOCs identified in the BERA include calcite in channel sediments, and chloride, sodium, and total dissolved solids in surface water. (See attached Table 2 entitled "Contaminants and Stressors of Concern Selected for Geddes Brook/Ninemile Creek Site Media in the BERA.")

reaches were 0.06 to 0.36 mg/kg[6] and 0.41 to 15.7 mg/kg, respectively. In both lower Geddes Brook and lower Ninemile Creek, the highest concentrations of mercury were in the 1.5 to 2.5 ft (*i.e.*, 45 to 75 cm) depth interval with ranges of 0.74 to 79 mg/kg (mean of 16.7 mg/kg) and 0.01 to 118 mg/kg (mean of 5.3 mg/kg), respectively.

In Reach CD, the higher mercury concentrations showed a distinct distribution pattern and were located primarily on the right side of Ninemile Creek, facing downstream. The presence of islands in this reach impedes complete mixing of the suspended solids discharged from Geddes Brook into Ninemile Creek, thus leading to higher deposition and concentrations of mercury, as well as other CPOIs, in this area. In Reaches AB and BC (downstream of Reach CD), where islands are absent, mercury concentrations did not show the same pattern of mercury deposition apparent within Reach CD. Reach BC of Ninemile Creek had the lowest overall mercury concentrations in lower Ninemile Creek sediments. Mercury concentrations were generally highest in the 1- to 2-foot (30

[6] This range of concentrations in the upper Geddes Brook portion of the Site, from approximately 2,500 ft (760 m) upstream from its intersection with Gerelock Road to its intersection with the West Flume, is based on five surface sediment samples collected in 1998 and 2001 as part of the RI. An additional surface sediment sample was collected in 1998 as part of the RI in Geddes Brook upstream of the site limits with a mercury concentration of 0.08 mg/kg. In addition, seven surface sediment samples were collected by NYSDEC in upper Geddes Brook with mercury concentrations ranging from less than 0.06 to 0.1 mg/kg. The average mercury concentration of all 13 samples in upper Geddes Brook, upstream of the West Flume, was 0.12 mg/kg.

to 60 cm) interval within this reach (*i.e.*, over 6 mg/kg in the southern half of Reach BC in this depth interval). Sediments in Reach AB of Ninemile Creek were generally characterized by elevated surficial mercury concentrations that declined with depth. This could have been a result of the previous dredging of the channel. This reach is currently depositional and contains relatively deep sediments (*i.e.*, 5 to 10 ft [1.5 to 3 m]) based on available sediment probing results.

Patterns of methylmercury (a highly toxic and bioaccumulative form) were similar to those of mercury, with higher concentrations in the lower reaches of the streams than in the upper reaches. Surface sediment concentrations of methylmercury ranged from less than 0.1 to 6.3 micrograms per kilogram (µg/kg). From a sediment depth of 0.5 to 3 ft (*i.e.*, 15 to 90 cm), methylmercury concentrations greater than 3 µg/kg were observed primarily in lower Ninemile Creek. As with total mercury, the highest concentrations of methylmercury were generally observed in Reach CD. For Geddes Brook/Ninemile Creek site sediment locations and depths where both total mercury and methylmercury have been measured, concentrations of methylmercury are generally less than 1 percent of total mercury (average of about 0.3 percent).

Other CPOIs

Other CPOIs detected in creek sediments included metals other than mercury and organic compounds. Other inorganic CPOIs (*e.g.*, arsenic, lead, and sodium) were detected throughout Geddes Brook and Ninemile Creek sediments.

Patterns of contaminant distribution showed a significant increase in sodium from upper Ninemile Creek to lower Ninemile Creek. Higher concentrations of lead and arsenic (*i.e.*, greater than the NYSDEC severe effects levels [SELs] for arsenic [33 mg/kg] and lead [110 mg/kg]) were found only in lower Ninemile Creek and lower Geddes Brook, and not in the upper reaches of the streams. These higher concentrations of arsenic and lead were found in the same areas as elevated concentrations of mercury.

Organic CPOIs detected in sediments of lower Ninemile Creek and lower Geddes Brook which exceeded NYSDEC's sediment screening criteria included hexachlorobenzene, various individual PAHs, phenol, PCBs, and PCDD/PCDFs.

Hexachlorobenzene had a distribution pattern generally similar to that observed for mercury. The highest concentrations were found in lower Geddes Brook just below the West Flume confluence (140 and 108 mg/kg), and in Reach CD of Ninemile Creek (26 mg/kg). Hexachlorobenzene was also found in Reach BC just upstream of the highway overpasses.

The maximum concentration of total PAHs within the site limits was found at the Geddes Brook station just downstream of the confluence with the West Flume. The highest concentrations of PCDD/PCDFs were found in deeper sediments (co-located with mercury) in lower Geddes Brook, just below the confluence with the West Flume. The highest concentration of Aroclor 1254 (Aroclors were a commercial mixture of PCBs) was 2 mg/kg at one station in lower Ninemile Creek and at one station in lower Geddes Brook. The highest concentration of Aroclor 1268 was 2 mg/kg at one station in lower Ninemile Creek.

Calcite (*i.e.*, calcium carbonate) was identified as a stressor of concern (SOC) in the BERA. Calcium concentrations were higher in sediments in the lower reaches of Geddes Brook and Ninemile Creek than in the upper reaches. In Reach CD of Ninemile Creek, calcium concentrations (similar to mercury) were higher in sediments from the right side of the creek, facing downstream,

than in the left side sediments. These calcium concentrations were consistent with observations of calcite made in the boring logs in this area.

Floodplain Soils/Sediments

Mercury

The patterns of mercury concentrations in floodplain soils/sediments (including the islands and wetland portions of the floodplains) were similar to those found in channel sediments. In Geddes Brook floodplain areas, mercury was detected at concentrations up to 269 mg/kg during sampling conducted for the Geddes Brook IRM. The highest concentrations in Ninemile Creek floodplain areas were found downstream of the Geddes Brook confluence in Reach CD, with a maximum concentration of 58.7 mg/kg, and near the mouth of the creek in Reach AB, with a maximum concentration of 76.9 mg/kg. In Reach CD, elevated concentrations were detected on the right side of the creek, facing downstream. Reach BC had the lowest overall mercury concentrations in floodplain soils/sediments in lower Ninemile Creek. In Reach AB, the highest mercury concentrations were found near the mouth of Ninemile Creek and generally decrease with depth. However, there are several locations adjacent to the creek in this reach where mercury concentrations remain elevated at a depth of 3 ft (90 cm), which is the maximum depth of the RI floodplain data.

The discussions above are based on data collected from 1998 to 2002. Mercury concentrations from floodplain data collected by Honeywell in 2007 in support of the Supplemental FS are within the range of concentrations detected from 1998 through 2002. In addition, the 2007 floodplain data indicate that concentrations of mercury in the clay layer, where found below the floodplain soils, are generally below 0.15 mg/kg.

Methylmercury was only analyzed for a subset of the 1998 surface (0 to 15-cm-deep) soil/sediment samples. Higher concentrations were found along the lower reaches of the streams than in upper reaches. These patterns reflect the general pattern for total mercury concentrations in the floodplain. Methylmercury concentrations in the floodplain soils/sediments ranged from 0.11 to 27.5 µg/kg. For Geddes Brook/Ninemile Creek site floodplain locations and depths where both total mercury and methylmercury have been measured, concentrations of methylmercury are generally less than 1 percent of total mercury (average of about 0.6 percent).

Other CPOIs

Various metals (*e.g.*, arsenic and lead) were identified as CPOIs for floodplain and island soils and wetland sediments in the risk assessments. For these metal CPOIs, there was generally little difference in average concentrations between the upper and lower reaches of Geddes Brook and Ninemile Creek.

Organic CPOIs identified in the initial screening of the risk assessments based on exceedances of the screening criteria included hexachlorobenzene, PAHs, phenol, PCBs, and PCDD/PCDFs. Concentrations of hexachlorobenzene, total PAHs, PCB Aroclor 1254, PCB Aroclor 1268, and PCDD/PCDFs were generally higher in floodplain soils/sediments along Reach CD than in other reaches of Ninemile Creek, and were co-located with elevated mercury concentrations. Some PCDD/PCDFs were also found along Reach BC.

As with channel sediments, calcium concentrations in floodplain soils/sediments were higher in the lower reaches of Geddes Brook and Ninemile Creek than in the upper reaches.

Surface Water

Mercury

In the surface water, total mercury concentrations reflected the input of mercury from the West Flume to Geddes Brook and from Geddes Brook to Ninemile Creek. In 1998, the average detected unfiltered total mercury concentrations were 2.1 and 22.3 nanograms per liter (ng/L) in upper and lower Geddes Brook, respectively. In upper and lower Ninemile Creek, the average detected unfiltered total mercury concentrations were 1.8 and 9.2 ng/L, respectively, in 1998. Samples collected at the mouth of the West Flume had the highest concentrations of unfiltered total mercury (815 and 1,090 ng/L in July and September of 1998, respectively). Dissolved total mercury was detected only in the West Flume (56.8 ng/L in July and 41.4 ng/L in September) and Geddes Brook below the West Flume (1.33 ng/L and 1.41 ng/L in a duplicate sample in July). These concentrations of dissolved mercury exceeded the lowest New York State surface water standard for dissolved mercury (0.7 ng/L). See also discussion below under “PRG 4.”

The average detected dissolved methylmercury concentrations from July and September 1998 were 0.029 and 0.037 ng/L in upper and lower Geddes Brook, respectively, and 0.041 and 0.021 ng/L in upper and lower Ninemile Creek, respectively. Samples collected at the mouth of the West Flume had the highest concentrations of dissolved methylmercury (1.14 ng/L in July and 1.26 ng/L in September of 1998). There was little change in dissolved methylmercury concentrations along the length of Ninemile Creek.

The concentration of total mercury on suspended sediments (*i.e.*, total mercury concentration on particles carried in the water) was calculated from the 1998 data under base-flow (*i.e.*, low water) conditions. Suspended sediments from the West Flume had the highest concentrations of mercury (30 and 58 mg/kg in July and September), followed by lower Geddes Brook samples (6.8 and 2.7 mg/kg) and the September sample from the most downstream Ninemile Creek station (2.0 mg/kg). All other suspended sediment samples contained less than 1 mg/kg total mercury. Most of the mercury amounts (*i.e.*, 75 to 99 percent) in surface water samples were associated with particles.

Comparison of the 1998 RI data to previous investigations in 1990 and 1992 indicated that mercury concentrations in surface water from the West Flume, lower Geddes Brook, and lower Ninemile Creek, sampled at low flow, were between 77 and 90 percent lower in 1998 than in 1990 and 1992. The most recent high flow sampling conducted in 1995 found considerably higher mercury concentrations than at low flow, indicating that different sources and transport processes may be important during high flow. During high-flow events in 1995, total mercury concentrations were 1.34 to 11.1 ng/L in upper Ninemile Creek (just above the Geddes Brook confluence), 27.6 to 455 ng/L in lower Ninemile Creek (at State Fair Boulevard), and 169 to 615 ng/L in lower Geddes Brook.

Other CPOIs

Select metals other than mercury (*e.g.*, lead) and one group of organic compounds (PCDD/PCDFs) were retained in the HHRA as human health CPOIs in surface water. Select metals other than mercury (*e.g.*, barium, lead, and manganese) and one organic compound (chlorobenzene) were retained in the BERA as ecological CPOIs in surface water.

Organic CPOIs were only detected sporadically in the surface water of Geddes Brook and Ninemile Creek. PCDD/PCDFs and chlorobenzene were detected in the 1998 sampling.

Four conventional parameters (total chloride, calcium, sodium, and TDS) were identified as SOCs in the BERA. The highest concentrations of these parameters in Geddes Brook were found at stations located downstream of the unnamed tributary which carries drainage from Wastebeds 12 through 15. In Geddes Brook, concentrations of sodium were higher in surface water in lower reaches than in upper reaches by approximately 1.3 to 4.2 times. Concentrations of these parameters in Ninemile Creek roughly doubled as the creek flowed past Wastebeds 9 through 11. In Ninemile Creek, concentrations of sodium were higher in lower reaches than in upper reaches by approximately 1.2 to 3 times. See the "Site Geology/Hydrogeology" section of this Propose Plan for discussion of chloride, calcium, and TDS results.

Fish

Adult fish were collected for chemical analysis in Ninemile Creek in 1990, 1998, and 2000, and YOY fish were collected in 1990, 1998, 2000, and 2002. Because adult fish move between the streams and lake, the source of mercury in these fish (*i.e.*, stream, lake, or both) is unclear. For these reasons, YOY fish were also collected since they tend to reside within a small area, and provide a clearer understanding of where these fish acquire mercury in their tissue.

Fish sampled in 1990 had mercury concentrations ranging from 0.13 to 2.5 mg/kg wet weight (ww) in fillets collected from the Site, which exceeded EPA's methylmercury in fish criterion of 0.3 mg/kg for protection of human health. See also discussion below under "PRG 3."

Mercury concentrations in adult fish collected in 1998 ranged from 0.07 to 1.5 mg/kg ww in fillets and from 0.01 to 1.0 mg/kg ww in remainder tissues (the rest of the fish after the fillets are removed). The lowest concentrations were found in samples from the most upstream (above Amboy Dam) locations in Ninemile Creek. The highest concentrations were found in Ninemile Creek just downstream of the Geddes Brook confluence (Reach CD). In 2000, fish were only collected at the mouth of Ninemile Creek, and mercury in those adult fish ranged from 0.5 to 0.9 mg/kg ww in fillets and 0.4 to 0.7 mg/kg ww in remainder tissue.

In YOY fish, mercury concentrations were higher in samples collected below the Geddes Brook confluence (Reach CD) and at the mouth of Ninemile Creek than in samples collected in upper Ninemile Creek. Mercury was detected in YOY fish at concentrations ranging from 0.02 to 0.05 mg/kg ww in 1998 in upper Ninemile Creek (Honeywell was unable to collect YOY fish samples in lower Ninemile Creek in 1998) and 0.14 to 0.22 mg/kg ww in 2000 at the mouth of Ninemile Creek. In 2002, mercury was detected in YOY fish at concentrations ranging from 0.18 to 0.85 mg/kg ww at Ninemile Creek stations downstream of Geddes Brook.

In addition to mercury, other CPOIs were detected in both adult and YOY fish. The BERA retained arsenic, selenium, zinc, DDT and metabolites, total PCBs, and PCDD/PCDFs as chemicals of concern for fish. Hexachlorobenzene, dieldrin, DDT and metabolites, heptachlor epoxide, PCBs, and PCDD/PCDFs exceeded human health screening criteria for fish consumption in the HHRA.

Impacts to Fish and Wildlife Resources

The contamination in the media described above has contributed to negative effects on the fish and wildlife resources at the Site in a number of ways, including:

- Chloride loadings to Geddes Brook and Ninemile Creek from Solvay waste.

- Decreased value of habitat due to calcite crust formation and excessive turbidity.
- Expected acute and chronic toxic impacts to biota within the streams, wetlands, and floodplains.
- Increased dominance of benthic macroinvertebrate communities by pollution-tolerant taxa.
- Impoverished fish communities in Ninemile Creek.
- Bioaccumulation of mercury and other contaminants in fish and likely bioaccumulation in other biota.

Historical studies documented that waste discharges into Ninemile Creek during plant operations adversely affected the fish community to the extent that Ninemile Creek was considered unsuitable to support fish (New York State Conservation Department, 1946, 1947). A study conducted by CDR in 1990 for Honeywell found the fish fauna in the slow, deep canals of Ninemile Creek, which constitute about 70 percent of the creek length, were generally impoverished in comparison to fish fauna at other habitats in the study area (CDR, 1991).

Additional information on impacts to fish and wildlife resources can be found in the BERA report and in the "Summary of Site Risks" section of this Proposed Plan.

A detailed evaluation of the nature and extent of contamination, including contaminant distribution maps, can be found in Chapter 5 of the RI report.

Groundwater

Groundwater at the Site is not considered to be a medium requiring remediation, since both Geddes Brook and Ninemile Creek below Amboy Dam are gaining streams (*i.e.*, groundwater flows upward, discharging into these water bodies). Any groundwater contamination beneath or near the Site would be from upland sites, which are and/or will be investigated separately, as appropriate.

Transport and Fate of Contaminants

Transport and fate refers to the movement of CPOIs in the environment, their transformation, and their ultimate destination. The movement is largely a function of deposition, suspension, and redeposition of CPOIs that are bound to the sediments. These processes are critical to understanding the relative importance of contaminant sources and the outcome of proposed remedial actions. Transport and fate processes, therefore, need to be characterized at a level sufficient to support evaluation of remedial alternatives.

The analysis of transport and fate of CPOIs in the Site is complicated by two factors. First, flow conditions and discharges to the Site have changed significantly over time. Flows in Ninemile Creek dropped significantly from the 1970s to the 1980s as former Honeywell discharges were diverted from the West Flume and the wastebeds. Similarly, concentrations of TSS, TDS, and mercury in Ninemile Creek have been declining over the years since former Honeywell operations and active discharges ceased. Second, high flow events are expected to play a dominant role in mobilizing CPOIs from sediments and floodplain soils, yet data collection during such events has been limited. The peak flow rates were generally recorded during the snowmelt or spring runoff period; however, no chemical concentration data were available from this period. The load analysis presented in the RI report for conditions during high flow is based on samples taken during one high-flow event in October 1995.

Mercury

The transport and fate of mercury are strongly influenced by the tendency of mercury to associate with sediment/soil particles and, therefore, the tendency of particles to be resuspended or eroded and transported during high flow events. During base flow when transport of particles is low, the primary source of mercury to the Site has been the LCP Bridge Street subsite, which contributed mercury to the Site via the West Flume. Total unfiltered mercury concentrations in surface water increased in Geddes Brook downstream of the West Flume and in Ninemile Creek downstream of Geddes Brook. Methylmercury concentrations increased in Geddes Brook downstream of the West Flume but did not increase in Ninemile Creek downstream of Geddes Brook (possibly because methylmercury is rapidly oxidized in surface water).

Analysis of the mercury load carried in the Ninemile Creek water column during base flow (based on four sampling events in 1990 and 1998) suggests that Geddes Brook supplied 15 to 43 percent (mean of 33 percent) and upper Ninemile Creek supplied approximately 20 percent of the mercury load carried in lower Ninemile Creek (Figures 7 and 8). The remainder of the mercury load (mean of 47 percent of total load) carried in lower Ninemile Creek is presumed to come from internal sources (*e.g.*, from the sediments in the creek) within lower Ninemile Creek.

For Geddes Brook, load analysis at base flow (based on four sampling events in 1990 and 1998) suggested that the West Flume supplied 50 to 70 percent of the total mercury load in lower Geddes Brook. The remainder of the mercury load in lower Geddes Brook is presumed to come from internal sources (*e.g.*, sediment) within lower Geddes Brook. However, on at least one occasion, lower Geddes Brook appeared to have been a sink for mercury (*i.e.*, more mercury entered the brook from the West Flume than was carried in the lower reaches).

Estimation of loads during high flow was based on a single event with a flow of 500 cfs, during which the load of mercury increased by a factor of ten over the load at base flow. As discussed in the RI report, during the one high-flow event for which data are available (October 21 and 22, 1995), Geddes Brook contributed 14 percent of the total mercury load carried in lower Ninemile Creek (compared to 33 percent at base flow). The majority of the total mercury load in lower Ninemile Creek (82 percent) during this high-flow event was, therefore, attributed to erosion and transport of streambed sediments and bank sediment/floodplain soils within lower Ninemile Creek. There was considerable uncertainty associated with the load estimates for this event and with the implication of these estimates on annual loads to the lake. Nevertheless, the analysis strongly suggested that internal sources within lower Ninemile Creek likely contribute to the mercury load carried to Onondaga Lake.

The main source of internal loads in lower Ninemile Creek is likely streambed sediments and stream bank sediments/floodplain soils in Reach CD. Reach CD contains the highest concentrations of mercury and other CPOIs in Ninemile Creek. The high concentrations of mercury in this reach reflects historical patterns of transport and deposition and the fact that this reach has remained unaltered since the 1930s, while other reaches have been re-routed and/or dredged.

Sediments can be resuspended and transported downstream. Based on general hydrologic principals and quantitative modeling, the largest inputs of sediment during high flow, however, come from erosion of the channel bank. During even higher flows, when water flows over the channel banks and onto the floodplain, bank erosion is still the major source of particles. (See further discussion below under “PRG 1.”)

In addition to the transport and fate of mercury on particles from the Geddes Brook/Ninemile Creek channel and floodplain, the production of methylmercury (*i.e.*, methylation of inorganic mercury) is an important process because of methylmercury's potential toxicity and tendency to bioaccumulate. Methylmercury is formed naturally by bacteria in the environment in the absence of oxygen, such as in anoxic sediment. In aquatic environments, methylmercury formed in sediment enters the food web through both benthic (*i.e.*, sediment-associated) and water column-associated pathways. Organisms at the top of the food chain (*e.g.*, wildlife that consume fish) receive the highest methylmercury exposure.

In terrestrial environments, anoxic conditions are more limited and methylmercury production is therefore limited. Methylmercury in terrestrial environments is potentially available to receptors such as the shrew that consume terrestrial invertebrates (*e.g.*, earthworms [*Lubricus terrestris*]) that are exposed to methylmercury in soil.

Other Metal CPOIs

Filtered and unfiltered surface water sampling results indicated that the concentration of metals (other than mercury) associated with particles did not vary significantly within the Site. Sediment sampling results were similar. Metals were generally found at higher concentrations in floodplain soils/sediments than in channel sediments, suggesting preferential settling of fine-grained material in floodplain soils/sediments or dilution in the streambed.

The ultimate fate of soluble and sediment-associated metal CPOIs is eventual transport to Onondaga Lake.

Organic CPOIs

Most of the organic CPOIs are highly persistent and remain associated with sediments. Like mercury, the organic CPOIs (*e.g.*, hexachlorobenzene, PCBs, PAHs, and PCDD/PCDFs) appear to be primarily associated with depositional zones downstream of the LCP Bridge Street subsite and the West Flume. As such, the organic CPOIs tend to be co-located with elevated mercury concentrations in Reach CD of Ninemile Creek, where the creek has remained unaltered since at least the 1930s. As with mercury and other metals, sediments containing organic CPOIs can be transported downstream if resuspended. Based on data from Onondaga Lake sediments near the mouth of Ninemile Creek, the Site is a possible source of some organic CPOIs to the lake. These organic CPOIs include hexachlorobenzene, PCBs, PAHs, and PCDD/PCDFs.

Ionic Waste Constituents

Ionic waste constituents, including calcium, sodium, chloride, and carbonates, can enter into and impact the streams in either dissolved or solid forms.

With regard to dissolved ionic waste constituents, the concentration of TDS, which includes ionic waste constituents, exceeds the New York State surface water quality standard (500 mg/L) under base-flow conditions (*i.e.*, when groundwater contributions to the system are most obvious) in Ninemile Creek above the wastebeds (four samples at two locations in the 1998 sampling range from 720 to 809 mg/L), and further increases as the creek flows past Wastebeds 9 through 15 (concentration ranges from 1,430 to 2,810 mg/L). The ionic waste constituents in this segment enter the creek from groundwater and surface runoff associated with Wastebeds 9 through 15 and are predominantly in the form of dissolved calcium chloride and sodium chloride.

In regards to solid ionic waste constituents, calcite deposits (*i.e.*, solid calcium carbonate) are found adjacent to the wastebeds in upper Ninemile Creek and in various locations in lower Ninemile Creek (particularly in Reach CD). Under high-flow conditions, erosion of the calcite deposits results in transport of particulate calcite downstream, eventually to Onondaga Lake. TSS loads, which are assumed to be approximately 50 percent calcite based on sediment analysis in Onondaga Lake, increase significantly during storm-related high-flow events, due primarily to creek bank erosion. Analysis of TSS loads during the one high-flow event for which data are available shows that lower Ninemile Creek is a major source of TSS to the load carried by the creek. The New York State standard for TSS, which is "none from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages," would be considered exceeded during high-flow conditions.

Principal Threat Waste

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

No principal threat wastes have been identified at the Site.

SCOPE AND ROLE OF RESPONSE ACTION

The primary objective of this response action and the Geddes Brook IRM is to address the risks to human health and the environment due to mercury and other CPOIs in the contaminated lower Geddes Brook and lower Ninemile Creek channel sediments, surface water, and floodplain soils/sediments.

The NCP defines an operable unit as a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phase of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.

NYSDEC and EPA have to date identified eight subsites, as shown in Figure 9, which comprise the Onondaga Lake NPL site. These subsites are also considered to be operable units of the NPL site by EPA and actions at these subsites have and will need to meet all CERCLA requirements. The Geddes Brook/Ninemile Creek site is an operable unit of the Onondaga Lake Bottom subsite. The status of the subsites is discussed below.

Onondaga Lake Bottom Subsite

In July 2005, NYSDEC and EPA issued a ROD for this subsite of the Onondaga Lake NPL site. The selected remedy includes dredging an estimated 2.65 million cubic yards (2 million cubic meters) of contaminated sediments and isolation capping of an estimated 425 acres (172 hectares) in the littoral zone (water depths ranging from 0 to 30 ft [0 to 9 m]), thin-layer capping of an estimated 154 acres (62 hectares) in the profundal zone (water depths exceeding 30 ft [9 m]), an oxygenation pilot study (of the water near the lake bottom) which will be followed by full-scale oxygenation if supported by the pilot study, and monitored natural recovery (MNR) in the profundal zone. It is anticipated that the most highly contaminated materials would be treated and/or disposed of off-site. The balance of the dredged sediment would be placed in a sediment consolidation area (SCA) at Wastebed 13. Wastewater generated by the dredging/sediment handling processes as a result of dewatering of the sediments at the SCA would be treated prior to being discharged back to the lake. An Explanation of Significant Differences which describes a change to a portion of the remedy required by the ROD in the southwest portion of the lake was issued by NYSDEC and EPA in December 2006. The change was necessary to ensure the stability of the adjacent causeway and the adjacent area which includes a portion of I-690, and was supported by recent, more extensive sampling of the area which indicates that the pure chemical contamination is significantly less extensive in this area than estimated in the ROD. In January 2007, Honeywell entered into a consent decree with the State of New York whereby Honeywell committed to implement the remedy at the site. Extensive pre-design investigations (PDI) commenced in September 2005 and are ongoing, along with remedial design activities (Parsons, 2008c). Dredging in the lake is scheduled to begin in May 2012.

LCP Bridge Street Subsite

In September 2000, NYSDEC issued a ROD for this subsite of the Onondaga Lake NPL site. In March 2002, Honeywell entered into an administrative consent order with NYSDEC whereby Honeywell committed to implement the remedy at the site. The remediation of the LCP Bridge Street subsite was substantially completed in 2007. Remedial construction included removal of contaminated sediments from the West Flume, on-site ditches, and wetlands; restoration of wetlands; installation of a low-permeability cutoff wall around the site; installation of a low-permeability cap; and capture of contaminated groundwater inside the cutoff wall. Remediation of the LCP Bridge Street subsite has controlled discharges of mercury and other CPOIs to the West Flume, some of which ultimately migrated to Onondaga Lake through Geddes Brook and Ninemile Creek. Maintenance and monitoring activities are ongoing.

Other Subsites

The Ley Creek PCB Dredgings Subsite ROD was issued in 1997 and remedial construction activities were completed in 2001.

The Semet Residue Ponds Subsite ROD was issued in 2002. Construction activities associated with a portion (lakeshore barrier wall/collection system for the shallow and intermediate zones) of the groundwater remedy component were completed in 2007. Design of the remaining portion (groundwater collection system adjacent to Tributary 5A) is underway. NYSDEC and EPA are evaluating a potential modification to the portion of the remedy that addresses the pond residues.

The Town of Salina Landfill Subsite ROD was issued in 2007 and design is underway.

RI/FSs are underway for the Willis Avenue, Wastebed B/Harbor Brook, and General Motors (GM) Former Inland Fisher Guide (IFG) subsites. Construction activities associated with the Willis Avenue lakeshore barrier wall/collection system are underway.

SUMMARY OF SITE RISKS

As part of the RI process, baseline risk assessments were conducted for the Site to estimate the risks to human health and the environment (see text box entitled "What Is Risk and How Is it Calculated?" [page 42]). The baseline risk assessments, consisting of an HHRA, which evaluated risks to people, and a BERA, which evaluated risks to the environment, analyzed the potential for adverse effects both under current conditions and if no actions are taken to control or reduce exposure to hazardous substances at the Site. As indicated below, based upon the results of the RI and the risk assessments, NYSDEC and EPA have determined that active remediation is necessary to protect public health or welfare and the environment from actual and threatened releases of hazardous substances into the environment. In addition, the control of contamination migrating from Geddes Brook and Ninemile Creek into Onondaga Lake is an integral part of the overall remediation of Onondaga Lake.

Human Health Risk Assessment

A site-specific HHRA was performed to quantitatively evaluate both cancer risks and non-cancer health hazards associated with potential current and/or future exposures to chemicals present in Geddes Brook and Ninemile Creek surface water, floodplain soils/sediments, channel sediments, and fish in the absence of any action to control or mitigate those chemicals. The HHRA is used to determine whether the risks associated with the site justify remedial action; however, the HHRA does not identify specific remedial goals. The HHRA was prepared to evaluate potential risks associated with exposure to elevated concentrations of mercury, lead, PCDD/PCDFs, and other COPCs in surface water; mercury, lead, arsenic, hexachlorobenzene, PAHs, PCBs, PCDD/PCDFs, and other COPCs in channel sediments; mercury, lead, arsenic, hexachlorobenzene, PAHs, PCBs, PCDD/PCDFs, and other COPCs in floodplain soils/sediments; and mercury, arsenic, hexachlorobenzene, PCBs, PCDD/PCDFs, and other COPCs in fish.

Hazard Identification

In addition to mercury (including methylmercury), approximately 40 other chemicals were identified as COPCs in one or more site media using a screening process that compared measured concentrations to risk-based target concentrations. Risks were calculated for these COPCs in the HHRA.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

What Is Risk and How Is it Calculated?

A Superfund baseline risk assessment is an analysis of the potential adverse effects caused by hazardous substances at a site in the absence of any actions to control or mitigate these effects under current and future conditions. Both human health risk assessments (HHRAs) and baseline ecological risk assessments (BERAs) have four main components used for assessing site-related human health or environmental risks:

Hazard Identification (used in an HHRA) or Problem Formulation (used in a BERA): In the *Hazard Identification* step of the HHRA, the COPCs in various media (*i.e.*, channel sediments, floodplain soils/sediments, surface water, and fish) are identified based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation. In the *Problem Formulation* component of the BERA, COCs are identified, ecological effects and exposure pathways are reviewed, assessment endpoints are selected, and a conceptual model is developed.

Exposure Assessment: In this component, the different exposure pathways through which receptors (people and animals) might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated sediment. Factors relating to the exposure assessment include, but are not limited to, the concentrations that people or wildlife might be exposed to and the potential frequency and duration of exposure.

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

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. In an HHRA, exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk," or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current federal Superfund guidelines for acceptable exposures are "generally concentration levels that represent an excess upper bound cancer to an individual of between 10^{-4} to 10^{-6}" (40 Code of Federal Regulations [CFR] § 300.430[e][2][A][2]) (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk). The 10^{-6} risk is used as the point of departure for determining remediation goals. For non-cancer health effects, a "hazard quotient" (HQ) is calculated for each contaminant. An HQ represents the ratio of the estimated exposure to the corresponding reference doses (RfDs). The sum of the HQs is termed the "hazard index" (HI). The key concept for a non-cancer HI is that a "threshold level" (measured as an HQ or HI of 1) exists, below which non-cancer health effects are not expected to occur. In a BERA, risks to the environment are evaluated using individual contaminant HIs calculated for representative species.

Exposure Assessment

Geddes Brook and Ninemile Creek are surrounded by lands used for industrial, commercial, and recreational purposes. No residential property directly abuts the Site. People who consume fish from Geddes Brook and Ninemile Creek and recreational visitors exposed to Geddes Brook and Ninemile Creek sediments, surface water, and floodplain and wetland soils/sediments are the receptors or individuals with the greatest potential for exposure to COPCs. Cancer risks and non-cancer health hazards were evaluated for young children (less than 6 years old), older children (6 to less than 18 years old), and adults (18 and over) who consume fish from Geddes Brook and Ninemile Creek. Cancer risks and non-cancer health hazards were also evaluated for older children and adults who are exposed to sediments, surface water, and floodplain and wetland

soils/sediments within the Site during recreational activities. Under current conditions, potential exposures for recreational visitors to the Site are limited by the lack of public swimming areas.

The NYSDOH has also issued specific, restrictive fish consumption advisories for Onondaga Lake and its tributaries, including Geddes Brook and Ninemile Creek, which currently advises that women of childbearing age, infants, and children under the age of 15 should not eat any fish from Onondaga Lake and its tributaries and all others should eat no more than one meal per month of any species, with no walleye and bass larger than 15 inches to be eaten at all. However, because the HHRA addresses future conditions, it was assumed that the public would consume fish caught in Geddes Brook and Ninemile Creek, and that recreational visitors would be exposed to sediments, surface water, and floodplain and wetland soils/sediments of the Site.

The HHRA assesses risk under both current and future use scenarios. Potential future uses are evaluated under the assumption that there are no restrictions, advisories, or limitations in place, although it was assumed that there would continue to be no residential exposure to sediments and soils since the Site consists of open channel and floodplain/wetland areas that are unlikely to be developed in the future. Thus, since no occupied structures currently exist on-site and none are likely to built on-site in the future, a residential scenario was not evaluated in the HHRA. Exposure pathways evaluated quantitatively include consumption of fish from Geddes Brook and Ninemile Creek, incidental ingestion of and dermal contact with surface and subsurface channel sediments, incidental ingestion of and dermal contact with surface and subsurface floodplain soils/sediments, and incidental ingestion of and dermal contact with surface water.

In addition to exposures attributable to fish consumption and direct exposures to contaminated media by recreational visitors, the HHRA also evaluated potential exposures to construction workers who may contact contaminated media (*i.e.*, channel sediments, floodplain soils/sediments, and surface water) during work on the Site.

Because risk assessments are designed to be conservative so that risk management strategies can be protective of human health, as well as consistent with EPA requirements, two types of exposure scenarios were analyzed in the HHRA to assess a range of potential risk: the reasonable maximum exposure (RME), which portrays the highest level of human exposure that could reasonably be expected to occur, and the central tendency (CT, or “typical”) scenarios. Cancer risks and non-cancer health hazards were assessed for exposures attributable to fish consumption and direct exposures to contaminated media by recreational visitors and construction workers at the Site under both these scenarios.

Toxicity Assessment

Risk estimates for all COPCs were based on use of toxicity values, using carcinogenic slope factors (CSFs) to assess potential carcinogenic effects and reference doses (RfDs) to assess potential non-cancer effects. These measures were primarily derived and published by EPA. The three COPCs (or COPC groups) responsible for a majority of estimated site risks are methylmercury, PCBs, and PCDD/PCDFs, as described below.

- Methylmercury is a toxic chemical with which a number of adverse health effects have been associated in both human and animal studies (see the text box entitled “What is Mercury?” [page 18]). With respect to the adverse effects of methylmercury, the largest amount of data exists on neurotoxicity, particularly in developing organisms.

- PCBs cause cancer in animals and probably cause cancer in humans, based on evidence in laboratory animals (see the text box entitled "What are Organic Contaminants in the Geddes Brook/Ninemile Creek Site?" [page 19]). In addition, serious non-cancer health effects have been observed in animals exposed to PCBs. Studies of Rhesus monkeys exposed to PCBs indicate a reduced ability to fight infection and reduced birth weight in offspring exposed in utero.

- PCDD/PCDFs probably cause cancer in humans, based on evidence in laboratory animals (see the text box entitled "What are Organic Contaminants in the Geddes Brook/Ninemile Creek Site?" [page 19]). They have also been associated with a wide variety of toxic effects in animals, including acute toxicity, enzyme activation, tissue damage, and developmental abnormalities.

Risk Characterization

Contamination at the Site presents risks to human health that are above applicable EPA guidelines, particularly as a result of fish consumption. The primary sources of cancer risks and non-cancer health hazards are mercury, PCBs, and PCDD/PCDFs.

- **Cancer risks (fish consumption and recreational scenarios):** The calculated RME cancer risks (ranging from 2.9×10^{-5} for young children to 9.3×10^{-5} for adults) associated with fish consumption exceeded the low end of the target cancer risk range (1×10^{-6}) by more than an order of magnitude, but were less than the high end of the target risk range (1×10^{-4}). The calculated CT cancer risks for fish consumption were slightly greater than 1×10^{-6}, ranging from 1.2×10^{-6} to 1.3×10^{-6}. PCBs and PCDD/PCDFs contributed the bulk of the cancer risk associated with fish consumption.

  RME cancer risk estimates associated with several other exposure pathways related to channel sediments, floodplain soils/sediments, and surface water in recreational scenarios were greater than 1×10^{-6} but lower than 1×10^{-4}. CT risk estimates for only two of these pathways (exposure to surface sediments and surface water in upper Geddes Brook) slightly exceeded the low end of the target risk range (1×10^{-6}). However, for these routes of exposure there was no increase in calculated risks from the upper to the lower reaches, and the chemicals presenting the highest risks are typical of urban runoff.

- **Non-cancer health hazards (fish consumption and recreational scenarios):** The RME non-cancer hazard indices (HIs) for the recreational angler fish consumption pathway (ranging from 4.1 to 6.4) exceeded the target hazard index of 1.0. The CT HIs (ranging from about 0.3 to 0.5) were below 1.0. The elevated HIs for the fish consumption pathways were primarily related to PCBs (highly chlorinated Aroclors, assessed as Aroclor 1254), methylmercury, and, to a lesser extent, dieldrin. RME and CT HIs for all pathways other than fish ingestion were less than 1.0.

- **Cancer risks (construction worker scenario):** RME cancer risks (1.2×10^{-6}) for exposure to upper Geddes Brook sediments for future construction workers slightly exceeded the low end of the target risk range of 1×10^{-6}. All other RME and CT risks for future construction workers were less than the target range.

- **Non-cancer health hazards (construction worker scenario):** None of the calculated non-cancer hazards (for both RME and CT scenarios) for future construction workers and recreational visitors associated with pathways other than fish consumption exceeded the target threshold of 1.0, indicating that exposure to COPCs from all pathways except fish consumption are not predicted to result in adverse non-cancer effects.

In addition, the potential risks and hazards to subsistence fishers were evaluated in the uncertainty section of the HHRA. Although the RME and CT exposures were used to quantify risks and hazards from the Site, the uncertainty section examines additional factors which could influence risk characterization, such as the higher consumption rates from a subsistence life style. As discussed in the Geddes Brook/Ninemile Creek HHRA report (Section 7.3.3), the potential risks and hazards to a subsistence fisherman, which would be greater than the risks and hazards calculated for the adult recreational angler by a factor of seven for the RME and nine for CT scenarios, are also above applicable EPA guidelines.

Baseline Ecological Risk Assessment

The BERA evaluated the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more chemicals or stressors. The BERA was prepared to evaluate potential risks associated with exposure to elevated concentrations of mercury, lead, and other contaminants of concern (COCs) and stressors in surface water; mercury, arsenic, lead, hexachlorobenzene, phenol, PAHs, PCBs, and other COCs and stressors in channel sediments; mercury, arsenic, lead, hexachlorobenzene, phenol, PAHs, PCBs, PCDD/PCDFs, and other COCs and stressors in floodplain soils/sediments; and mercury, arsenic, PCBs, PCDD/PCDFs, and other COCs in fish. The framework used for assessing site-related ecological risks is similar to that used for HHRAs and consists of problem formulation, ecological exposure assessment, ecological effects assessment, and risk characterization.

Problem Formulation

Problem formulation identifies the major factors to be considered in a BERA, including COC and SOC (*e.g.*, ionic waste) characteristics, ecosystems and/or species potentially at risk, and ecological effects to be evaluated. It establishes the goals, breadth, and focus of the assessment, develops a conceptual model, and selects assessment endpoints, which are explicit expressions of the environmental value that is to be protected. In an HHRA, only one species (humans) is evaluated and the cancer and non-cancer effects are typically the assessment endpoints. In contrast, a BERA involves multiple species that are likely to be exposed to differing degrees and respond differently to the same contaminant. Assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site.

Assessment endpoints selected for the Geddes Brook/Ninemile Creek BERA are based on the sustainability of plant and animal communities and populations. “Sustainability” relates to survival, growth, and reproduction. The assessment endpoints include:

- Sustainability of a terrestrial plant community that can serve as a shelter and food source for local invertebrates and wildlife.
- Sustainability of a benthic invertebrate community that can serve as a food source for local fish and wildlife.
- Sustainability of local fish populations.
- Sustainability of local amphibian and reptile populations.
- Sustainability of local insectivorous, piscivorous (fish-eating), and carnivorous bird populations.
- Sustainability of local insectivorous and piscivorous mammal populations.

Detailed quantitative assessments of the sustainability of selected fish and wildlife populations were conducted by selecting individual species representative of various feeding preferences, predatory levels, and habitats. Receptors selected to represent the Geddes Brook/Ninemile Creek ecological community for the BERA included benthic macroinvertebrates, four species of fish (bluegill, brook trout [*Salvelinus fontinalis*], smallmouth bass [*Micropterus dolomieu*], and white sucker), four species of birds (tree swallow, belted kingfisher [*Ceryle alcyon*], great blue heron, and red-tailed hawk), and four species of mammals (little brown bat [*Myotis lucifigus*], short-tailed shrew, mink, and river otter). The remaining receptors (*i.e.*, terrestrial plants, amphibians, reptiles) were evaluated qualitatively.

Ecological Exposure Assessment

The assumptions and models used to predict the potential exposure of plants and animals to COCs associated with the Site are addressed in this component. Exposure parameters (*e.g.*, body weight, prey ingestion rate, home range) of wildlife species selected as representative receptors and site-specific fish, channel sediments, floodplain soils/sediments, and water COC concentrations, were used to calculate the exposure concentrations or dietary doses using food-web models.

Ecological Effects Assessment

Mercury and numerous other potentially toxic chemicals, including metals, PCBs, PAHs, hexachlorobenzene, and PCDD/PCDFs, were detected at concentrations above ecological screening levels in various site media.

Measures of toxicological effects were selected based on lowest-observed-adverse-effect levels (LOAELs) and no-observed-adverse-effect levels (NOAELs) from studies reported in the scientific literature. Reproductive effects (*e.g.*, egg maturation, egg hatchability, and survival of juveniles) were generally the most sensitive endpoints.

Risk Characterization

Multiple lines of evidence, based on various measurement endpoints (measures of effect), were used to evaluate major components of the Geddes Brook/Ninemile Creek ecosystem to determine if contamination has adversely affected plants and animals at the Site. Almost all lines of evidence indicate that inputs of chemicals to Geddes Brook and Ninemile Creek and their associated floodplains/wetlands in the lower reaches have produced adverse ecological effects at all trophic levels (levels of the food chain) examined. Ionic wastes have also impacted the Site, reducing habitat value for aquatic macrophytes, benthic invertebrates, and fish that use the stream for feeding or spawning.

As discussed in the BERA, mercury and possibly other chemicals have bioaccumulated in most organisms serving as a food source for biota in the Site, resulting in risks to fish and wildlife above acceptable levels. Comparisons of measured tissue concentrations and modeled doses of chemicals to measures of toxicological effects show exceedances of hazard quotients for chemicals at the Site. Many of the chemicals at the Site are persistent (*i.e.*, they remain in the same chemical state without breaking down); therefore, the risks associated with these chemicals are unlikely to decrease significantly unless remediation is performed.

Exceedances of toxicity-based sediment effects concentrations from the literature suggest that adverse effects to invertebrates due to contact with surface channel sediments and floodplain soils/sediments will frequently occur in lower Geddes Brook and lower Ninemile Creek. This is confirmed by sediment toxicity testing that was conducted in Geddes Brook and Ninemile Creek. These tests indicate that sediment toxicity appears to occur in both streams in those areas downstream of and directly influenced by the discharges of the West Flume from the LCP Bridge Street subsite.

Summary of Human Health and Ecological Risks

Key results of the HHRA include the finding that contamination at the Site presents risks to human health that are above EPA guidelines, particularly as a result of fish consumption. The primary sources of these cancer risks and non-cancer health hazards are methylmercury, PCBs, and PCDD/PCDFs.

Key results of the BERA indicate that comparisons of measured tissue concentrations and modeled doses of chemicals to toxicity reference values show exceedances of hazard quotients for site-related chemicals. Many of the contaminants at the Site are persistent and, therefore, the risks associated with these contaminants are unlikely to decrease significantly in the absence of remediation. On the basis of these comparisons, it has been determined through the BERA that all receptors of concern are at risk. Contaminants and stressors at the Site have either impacted or potentially impacted every trophic level examined in the BERA.

Based upon the results of the RI and the risk assessments, NYSDEC and EPA have determined that active remediation is necessary to protect public health or welfare and the environment from actual and threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES AND PRELIMINARY REMEDIATION GOALS

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance (TBCs), and risk-based levels. There are no federal or New York State sediment cleanup standards for mercury or the other CPOIs found in Geddes Brook and Ninemile Creek channel and wetland sediments. However, as discussed below, NYSDEC's (1999) sediment screening criteria have been used as TBC criteria to develop remedial alternatives for the channel and floodplain.

Since completion of the FS report (Parsons, 2005) in May 2005, NYSDEC issued soil cleanup objectives (SCOs) for inactive hazardous waste sites (6 NYCRR Part 375.6). Since the majority of the floodplain portion of the Site is a regulated wetland with soils more characteristic of sediments than upland soils, the Part 375 SCOs have not been used in this Proposed Plan to determine areas warranting remediation. However, as discussed below in the "Description of Alternatives" section, the unrestricted use SCOs (6 NYCRR 375-6.8[a]) are goals that will be used to determine clean soil acceptable for use as suitable habitat layer material.

Although the channel sediments and floodplain soils/sediments are the primary focus of the remediation, the degrees of attainment of New York State's surface water standards and guidance values and site-specific fish target concentrations were also evaluated in the Supplemental FS report and this Proposed Plan.

The RAOs for OU1 are based on site-specific information including the nature and extent of CPOIs, the transport and fate of mercury and other CPOIs, and the baseline human health and ecological risk assessments. The RAOs were developed as goals for controlling CPOIs within the Site and protecting human health and the environment. The RAOs for OU1 are:

- RAO 1: To eliminate or reduce, to the extent practicable, further transport of sediments and soils, containing mercury and other CPOIs, from the channel and floodplain of lower Geddes Brook and lower Ninemile Creek to Geddes Brook, Ninemile Creek, and, ultimately, Onondaga Lake.

- RAO 2: To eliminate or reduce, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources, as well as 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.

In order to achieve these RAOs, preliminary remediation goals (PRGs) were established to provide additional information with which remedial alternatives can be developed and selected. The Site contains four primary media that have been impacted by CPOIs: channel sediments, floodplain soils/sediments, biological tissue, and surface water. The following four PRGs have been developed to address each of the affected media:

- PRG 1: Reduce, contain, or control, to the extent practicable, mercury and other CPOI concentrations in erodible channel sediments and in erodible floodplain soils/sediments within the Site.

- PRG 2: Achieve CPOI concentrations, to the extent practicable, in channel sediments and floodplain soils/sediments that are protective of human health and fish and wildlife resources. This PRG covers a range of risk levels for mercury and other CPOIs.

- PRG 3: Achieve CPOI concentrations, to the extent practicable, in fish tissue that are protective of humans and wildlife that consume fish.

- PRG 4: Achieve, to the extent practicable, aqueous CPOI concentrations to meet surface water quality standards.

PRG 1 – Erodible Channel Sediments and Erodible Floodplain Soils/Sediments

PRG 1: Reduce, contain, or control, to the extent practicable, mercury and other CPOI concentrations in erodible channel sediments and in erodible floodplain soils/sediments within the Site.

Since the spread of mercury and most other key CPOIs (arsenic, lead, hexachlorobenzene, PCBs, PCDD/PCDFs, and PAHs) is primarily associated with the transport of soils and sediment particles, minimization of transport of sediments and soils from the streambed and floodplains of lower Geddes Brook and lower Ninemile Creek also would minimize the transport of these contaminants. This can be best addressed by targeting those CPOI-containing sediments and floodplain soils/sediments that are prone to erosion, resuspension, and transport through surface water. Therefore, PRG 1 focuses on the erodible sediments and floodplain soils/sediments along lower Geddes Brook and lower Ninemile Creek to achieve reduction of transport of streambed sediments and floodplain soils/sediments.

As part of the RI report (see Appendix H), a qualitative and quantitative assessment was conducted to determine which sections of the Geddes Brook and Ninemile Creek stream channels are erosional or depositional at low flows. This issue was further investigated in the FS report (see FS Figures 1-17 to 1-24, and Appendix A) and in the Supplemental FS report (see Appendix D). Using a quantitative model (*i.e.*, USACE's HEC-RAS model), the erosion potential of the lower Geddes Brook and lower Ninemile Creek channels and floodplains was determined for a range of flows, up to and including the 500-year flood event. Results from these evaluations indicate that the streams and the banks within the floodplain are erosive at almost all locations during major storm events, while the floodplain overbank areas are depositional under all storm conditions. Thus, to address this PRG, those areas subject to stream erosion (*i.e.*, all channel deposits and stream banks) are included in the remedial alternatives.

Applicability to RAOs

PRG 1 addresses RAOs 1 through 3 to varying degrees, as follows:

- RAO 1: The reduction, containment, or control of mercury and other CPOI concentrations in erodible channel sediments and in erodible floodplain soils/sediments would directly address further transport of mercury and other CPOIs from channel sediments and from floodplain soils/sediments.

- RAO 2: Reducing the concentrations of mercury and other CPOIs on erodible channel sediments and floodplain soils/sediments would reduce the further transport of contaminants from the streambeds and floodplains, thus reducing adverse ecological effects to the benthic and terrestrial community. In addition, reductions of CPOI concentrations would reduce adverse effects associated with direct exposure of humans, fish, and wildlife to sediments and soils, as well as adverse effects associated with bioaccumulation of CPOIs.

- RAO 3: Reducing the transport of CPOIs from erosion of the streambeds and floodplains into the water column would help to address RAO 3 by reducing the levels of mercury and other CPOIs in surface water in order to meet surface water quality standards.

PRG 2 – CHANNEL SEDIMENTS AND FLOODPLAIN SOILS/SEDIMENTS

PRG 2: Achieve CPOI concentrations, to the extent practicable, in channel sediments and floodplain soils/sediments that are protective of human health and fish and wildlife resources. This PRG covers a range of risk levels for mercury and other CPOIs.

Toxicity

Target sediment concentrations that address direct contact toxicity to benthic organisms are considered "not-to-exceed" levels at individual locations. As directed by the NYSDEC (1999) Technical Guidance for Screening Contaminated Sediments, site-specific sediment toxicity testing was conducted which confirmed sediment toxicity at the Site. However, this work did not produce sufficient data for the derivation of site-specific toxicity-based sediment effect concentrations (SECs). Therefore, literature-based values were used in the BERA and in development of remedial alternatives which is common practice. The target concentrations considered for this site include criteria/guidelines for sediment toxicity to benthic macroinvertebrates from New York State, as well as the Province of Ontario and Washington State. These literature values are based on studies of a wide variety of freshwater and marine aquatic systems. Each literature-based value is defined with a differing level of expected effects at each concentration. (See text boxes called "Toxicity-Based Sediment Effect Concentrations [SECs] Selected as PRGs for Mercury and Other Inorganics" [page 51] and "Toxicity-Based Sediment Effect Concentrations [SECs] Selected as PRGs for Organic Contaminants" [page 52].)

In addition to channel sediments, the toxicity PRGs are also considered to be relevant for floodplain sediments since a majority of the floodplain consists of sediments associated with delineated federal and state wetlands. The physical and chemical characteristics of the channel sediments and the wetland sediments that predominantly comprise the floodplain are very similar. Thus, the same set of toxicity PRGs are used for both floodplain sediments and channel sediments.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Toxicity-Based Sediment Effect Concentrations (SECs) Selected as PRGs for Mercury and Other Inorganics

To evaluate sediment quality at the Geddes Brook/Ninemile Creek site, channel sediment and floodplain sediment/soil concentrations were compared to statewide criteria for sediment toxicity to benthic macroinvertebrates. These criteria are literature values that are based on studies of a wide variety of aquatic systems. The literature values used in developing the Proposed Plan were based on the following methods.

Effects Range-Low (ER-L) – The concentration that represents the lowest 10th percentile of the concentrations at which toxic effects were observed. At concentrations below the ER-L, toxic effects are rarely expected (Long and Morgan, 1990).

Effects Range-Median (ER-M) – The concentration that represents the 50th percentile (median) at which toxic effects were observed. At concentrations above the ER-M, toxic effects are likely to occur (Long and Morgan, 1990).

Lowest Effect Level (LEL) – The level of sediment contamination that can be tolerated by the majority (95 percent) of benthic organisms but still causes toxicity to a few (5 percent) species. It is derived in a two-step process in which the 90th percentile of the concentrations tolerated by a single species is determined (species screening level or SSLC). The 5th percentile concentration of the SSLCs considered represents the LEL (Persaud et al., 1993).

Severe Effect Level (SEL) – The level of sediment contamination that can causes toxicity to the majority (95 percent) of benthic organisms. It is derived in a two-step process in which the 90th percentile of the concentrations tolerated by a single species is determined (species screening level or SSLC). The 95th percentile concentration of the SSLCs considered represents the SEL (Persaud et al., 1993).

Sediment Quality Standard (SQS) – This concentration was derived for the Washington State Department of Ecology (Avocet and SAIC, 2002 and Avocet, 2003) by first assessing the strength of the relationship between individual contaminants and toxicity. For those contaminants which have a relationship with toxicity, an iterative statistical process is employed which provides the concentrations which are the most reliable predictors of toxic effects. The SQS for mercury cited in this Proposed Plan represents a concentration that is discernable from control samples with a change in mortality of 10 percent from the controls. Above this concentration, minor adverse effects may occur.

NYSDEC developed two levels of risk for metals contamination in sediment (NYSDEC, 1999). These are:

NYSDEC LEL – NYSDEC defines the LEL as the lowest of either the Persaud et al. (1993) LEL or the Long and Morgan (1990) ER-L.

NYSDEC SEL – NYSDEC defines the SEL as the lowest of either the Persaud et al. (1993) SEL or the Long and Morgan (1990) ER-M.

For **mercury**, which is the primary contaminant of concern at this site, the following sediment PRGs were used to develop and/or evaluate remedial alternatives: 0.15 mg/kg, which is the NYSDEC (1999) LEL; 0.5 mg/kg, which is the SQS from Washington State (Avocet, 2003); 1.3 mg/kg, which is the NYSDEC (1999) SEL; and 2.0 mg/kg, which is the Persaud et al. (1993) SEL.

Lead and arsenic are the other two inorganics that were determined to be potential risk drivers. For **lead**, the NYSDEC (1999) SEL of 110 mg/kg was used in developing the remedial alternatives while the LEL of 31 mg/kg was used for the comparative analysis. For **arsenic**, the NYSDEC (1999) SEL of 33 mg/kg was used in developing the remedial alternatives while the LEL of 6 mg/kg was used for the comparative analysis.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Toxicity-Based Sediment Effect Concentrations (SECs) Selected as PRGs for Organic Contaminants

For the organic contaminants that presented a potential impact to benthic toxicity, including hexachlorobenzene, PCBs, and phenol, NYSDEC's **Benthic Aquatic Life Chronic Toxicity (BALCT)** criteria, which are on an organic-carbon-normalized basis, were used to develop and/or evaluate each remedial alternative (NYSDEC, 1999). For purposes of the FS and this Proposed Plan, the site-wide average for total organic carbon (TOC) in sediment of 2.1 percent was used to convert the BALCT criteria to a dry-weight basis for determining exceedances of the PRGs. During the remedial design, additional TOC data would be obtained along with the chemical data for determining final areas of remediation.

For PCBs, the NYSDEC BALCT criterion of 19.3 µg/g organic carbon was used (19.3 µg/g organic carbon x 2.1% / 100) to derive a sediment PRG of 0.405 mg/kg.

For hexachlorobenzene, the NYSDEC BALCT criterion of 5,570 µg/g organic carbon was used (5,570 µg/g organic carbon x 2.1% / 100) to derive a sediment PRG of 117 mg/kg.

For phenol, 50 times the NYSDEC BALCT criterion of 0.5 µg/g organic carbon was used (50 x 0.5 µg/g organic carbon x 2.1% / 100) to derive a sediment PRG of 0.53 mg/kg. The factor of 50 was applied to phenol because, as stated in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) "for non-polar organic contaminants, exceedance of sediment criteria based on aquatic life chronic toxicity by a factor of 50 in a significantly large area indicates that biota are probably impaired and to achieve restoration of the ecosystem will require remediation of organic contaminants present."

For total PAHs, the ER-M of 35 mg/kg was used in the development of each remedial alternative while the ER-L of 4 mg/kg was used for the comparative analysis.

Bioaccumulation

Target sediment and soil concentrations that address bioaccumulation are designed to protect humans, fish, and wildlife resources from bioaccumulation and are derived from the human health and ecological risk assessments for the Site. Site-specific target fish tissue concentrations to protect human health and wildlife (*e.g.*, river otter, mink) against bioaccumulation were back-calculated from the HHRA risk models and BERA food web models. (See the text boxes on PRGs in fish tissue to protect human health and ecological receptors [pages 54 and 55].) Then, target sediment concentrations for bioaccumulation of CPOIs from sediments to fish tissue were developed through the application of a biota-sediment accumulation factor (BSAF). Also, a target soil concentration was calculated for the protection of wildlife (*e.g.*, short-tailed shrew) that consume terrestrial invertebrates. (See the text boxes on sediment quality values for channel sediments and floodplain soils/sediments to protect against bioaccumulation and direct contact [pages 56 and 57].) The site-specific bioaccumulation-based sediment/soil quality values (BSQVs) calculated for mercury are 0.8 mg/kg for channel sediments and 0.6 mg/kg for soils.

Concentrations of PCBs and PCDD/PCDFs in fish tissue and hexachlorobenzene in invertebrates (modeled) were also determined to be risk drivers for human health and wildlife. PCBs, hexachlorobenzene, and PCDD/PCDFs are not widespread in Geddes Brook and Ninemile Creek and are found primarily in a few specific areas of the streams. The NYSDEC sediment screening criteria for protection of wildlife and humans from bioaccumulation were used as the comparison values for these three CPOIs. Therefore, site-specific BSQVs were not developed for these CPOIs. The areas where these CPOIs are elevated are generally co-located with areas that would be addressed under the remedial alternatives evaluated in this Proposed Plan.

Target sediment and soil concentrations that address bioaccumulation are considered on a surface area-weighted average basis, since fish and wildlife integrate soils/sediments exposure over a larger area than benthic invertebrates. Therefore, residual (*i.e.*, post remediation) CPOI concentrations in channel sediments and floodplain soils/sediments on a surface area-weighted average basis reflect the concentrations at which bioaccumulating receptors are exposed. Additional information on how the remedial alternatives address these CPOIs can be found in the Supplemental FS report (*e.g.*, Tables 3-3 and 3-4; Parsons, 2008a).

Applicability to RAOs

- RAO 1: Reducing the concentration of CPOIs in the channel sediments and floodplain soils/sediments would limit the amount of contaminants available for further transport.

- RAO 2: Reducing channel sediment and floodplain soil/sediment concentrations would directly reduce adverse ecological effects to the benthic community. In addition, reductions of CPOI concentrations would reduce adverse effects associated with direct exposure of humans, fish, and wildlife to sediments and soils, as well as adverse effects associated with bioaccumulation of CPOIs.

PRG 3 – FISH TISSUE

PRG 3: Achieve CPOI concentrations, to the extent practicable, in fish tissue that are protective of humans and wildlife that consume fish.

PRG 3 directly addresses RAO 2 by eliminating or reducing existing and potential future adverse ecological effects on fish and wildlife resources, as well as potential risks to humans. Quantitative fish tissue target concentrations were developed to protect wildlife and human health. (See text boxes on PRGs in fish tissue to protect human health and ecological receptors [pages 54 and 55].) Site-specific BSQVs or NYSDEC sediment screening criteria to protect wildlife and humans from bioaccumulation were used as estimates of the concentrations in surface sediments and floodplain soils/sediments needed to reach acceptable target concentrations in fish tissue. (See text boxes on sediment quality values for channel sediments and floodplain soils/sediments to protect against bioaccumulation and direct contact [pages 56 and 57].)

It should be noted that EPA's National Recommended Water Quality Criterion for methylmercury, as measured in fish tissue, is 0.3 mg/kg. When both wildlife and human health fish tissue PRGs for Geddes Brook/Ninemile Creek are considered, the overall range of site-specific fish tissue PRGs for mercury (*i.e.*, about 0.1 to 0.6 mg/kg using the LOAEL for wildlife and the RME for human

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Preliminary Remediation Goals in Fish Tissue to Protect Human Health

Methylmercury and PCBs are bioaccumulative contaminants calculated to pose potential risks (*i.e.*, hazard quotients above 1) to humans consuming fish from Geddes Brook and Ninemile Creek. PRGs for mercury (as methylmercury) and PCBs in fish tissue were developed for Geddes Brook and Ninemile Creek using risk-based methods. There are no federal or New York State human health cleanup standards for mercury or PCBs in fish.

The concentrations of methylmercury for the human health PRGs for fish were calculated based on a hazard quotient of 1 for non-cancer risk for humans (see the "Summary of Site Risks" section of this Proposed Plan). The human health hazard quotient of 1 for individual CPOIs indicates the "threshold level" below which non-cancer effects are not expected to occur. The PRGs were calculated using the same exposure assumptions and toxicity values as the HHRA.

Human health mercury target fish tissue concentrations range from 0.6 to 0.9 mg/kg wet weight (ww) for the reasonable maximum exposure (RME) scenario with the lower end of the range based on young children and the upper end of the range based on adults.

PCB target fish tissue concentrations based on cancer risk targets of 1×10^{-5} and 1×10^{-4} range from 0.11 to 1.1 mg/kg ww, respectively, for the RME scenario for adults. The target range for children (0.35 to 3.5 mg/kg ww) is slightly higher. The fish tissue target concentrations corresponding to a risk of 1×10^{-6} (0.011 mg/kg ww for adults to 0.035 mg/kg ww for children) may not be achievable since they are much lower than the mean background fish concentration (0.04 mg/kg) in U.S. waters. The target tissue concentrations for the RME scenario based on non-cancer effects of PCBs (0.12 mg/kg ww for children to 0.19 mg/kg ww for adults) are within the range based on a cancer risk target of 1×10^{-5} (0.11 to 0.35 mg/kg ww).

Concentrations of PCDD/PCDFs for human health PRGs for fish were also calculated based on cancer risks. PRGs for non-cancer effects could not be developed (see HHRA). PCDD/PCDF target fish tissue concentrations based on cancer risk targets of 1×10^{-5} and 1×10^{-4} range from 1×10^{-6} to 1×10^{-5} mg/kg ww, respectively, for the RME scenario for adults. The target range for children (5×10^{-6} to 5×10^{-5} mg/kg ww) is slightly higher. The fish tissue target concentrations corresponding to a risk of 1×10^{-6} (1×10^{-7} mg/kg ww for adults to 5×10^{-7} mg/kg ww for children) may not be achievable since they are much lower than the mean background fish concentration (8×10^{-7} mg/kg) in U.S. waters.

These concentrations assume that only a fraction of the fish consumed by an individual comes from Geddes Brook or Ninemile Creek due to the limited carrying capacity of these water bodies. The calculations for these values are presented in Section I.3 of Appendix I of the FS report (Parsons, 2005) and in Attachment A-2 of Appendix A of the Supplemental FS report (Parsons, 2008a).

health) encompasses the EPA criterion[7]. Fish tissue target concentrations for PCBs and PCDD/PCDFs are presented in the PRGs in fish tissue to protect human health text box.

[7] The target fish tissue concentrations for mercury (0.1 and 0.3 mg/kg) are similar to the mean background concentration of mercury in fish of U.S. lakes and reservoirs (approximately 0.2 mg/kg; see Appendix G, page G-6 and Table G.1 of the Onondaga Lake FS [Parsons, 2004] and supplemental data through 2003 [USEPA, 2005]). Target fish tissue concentrations based on the subsistence fisher consumption rate evaluated in the uncertainty section of the HHRA are not included since these concentrations would not likely be achievable without a reduction in background sources of mercury and would not be a representative measure of the effectiveness of site remedial actions.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Preliminary Remediation Goals in Fish Tissue to Protect Ecological Receptors

Methylmercury was calculated to pose potential risks (*i.e.*, hazard quotients above 1) to piscivorous birds and mammals consuming fish from Geddes Brook and Ninemile Creek. PRGs for mercury (as methylmercury) in fish tissue were developed for Geddes Brook and Ninemile Creek using risk-based methods, as there are no federal or New York State cleanup standards for mercury in fish to protect fish or wildlife.

The concentrations of methylmercury for the PRGs for fish were calculated based on a hazard quotient of 1 for ecological receptors. The hazard quotients for ecological receptors were based on both the no-observed-adverse-effect level (NOAEL), representing the highest CPOI concentration at which no adverse effects are seen, and the lowest-observed-adverse-effect level (LOAEL), representing the lowest CPOI concentration shown to produce adverse effects. The PRGs were calculated using the same exposure assumptions and toxicity values as the BERA.

Mercury fish tissue PRGs range from 0.009 to 0.35 mg/kg ww, depending on the receptor species and whether the NOAEL or LOAEL is used to set the target hazard quotient. If only the LOAELs are used, the fish tissue PRGs range from approximately 0.1 to 0.3 mg/kg.

The calculations for these values are presented in Section I.2 of Appendix I of the FS report.

PRG 4 – SURFACE WATER

PRG 4: Achieve, to the extent practicable, aqueous CPOI concentrations to meet surface water quality standards.

PRG 4 directly addresses RAO 3 by eliminating or reducing levels of mercury and other CPOIs in surface water to meet surface water quality standards. Geddes Brook and Ninemile Creek currently meet most New York State surface water quality standards and guidelines (6 NYCRR Part 703). Numeric state surface water quality standards that are consistently not met in Geddes Brook and/or Ninemile Creek are those for aluminum, iron, mercury, and dissolved solids. The two lowest numeric state water quality standards for mercury are also periodically exceeded. The lowest standard, 0.7 ng/L as dissolved mercury for protection of human health via fish consumption, was exceeded in four of 29 surface water samples collected for the RI in 1998. These exceedances occurred in samples from two locations, one in lower Geddes Brook and one in the West Flume near the confluence with Geddes Brook. The samples collected from lower Geddes Brook (a sample and a field duplicate) had dissolved mercury concentrations of 1.3 and 1.4 ng/L. The two samples collected from the mouth of the West Flume had concentrations of 41.4 and 56.8 ng/L. The water quality standard to protect wildlife from exposure to mercury, 2.6 ng/L as dissolved mercury, was exceeded in only the two samples collected from the West Flume. It should be noted that the West Flume, which was sampled during the Geddes Brook/Ninemile Creek RI, has been remediated by Honeywell as part of the cleanup of the LCP Bridge Street subsite.

Narrative water quality standards for turbidity and suspended solids are periodically exceeded in both streams, and sporadic exceedances have been observed for several other CPOIs including thallium and chlorobenzene. For these constituents and other CPOIs, the reduction of CPOIs in site-related contributions from contaminated sediments and soils is expected to result in the achievement of the New York State water quality standards. In addition, closure of the wastebeds would help to achieve narrative water quality standards, including the prohibitions for turbidity and for suspended, colloidal, or settleable solids.

Sediment Quality Values for Channel Sediments to Protect from Bioaccumulation and Direct Contact

Since a variety of dynamic factors affect contaminant levels in fish, bioaccumulation-based sediment quality values (BSQVs) were developed for Geddes Brook and Ninemile Creek to estimate the mercury concentrations in sediments associated with the fish tissue PRGs. These BSQVs were derived to be protective of human health and the environment by reducing the potential for bioaccumulation from the sediments into fish. The first step entailed calculating site-specific biota-sediment accumulation factors (BSAFs) for fish fillets consumed by people and for whole fish consumed by wildlife using Geddes Brook and Ninemile Creek fish and surface sediment data. BSAFs for mercury were calculated by dividing the average contaminant concentration in fish tissue by the average contaminant concentration in sediments of lower Ninemile Creek.

The mercury PRGs for fish based on human and wildlife fish consumption were divided by the BSAF to calculate the target concentration of mercury in sediments. The human health sediment target concentrations of mercury were calculated to be between 2.1 and 3.2 mg/kg for the RME scenario, depending on the receptor used (*i.e*., adult, older child, young child).

Mercury wildlife sediment PRGs range from 0.08 to 2.0 mg/kg, depending on the receptor species and whether the NOAEL or LOAEL is used. Avian mercury target levels range from 0.1 to 2.0 mg/kg and mammalian target levels range from 0.08 to 0.8 mg/kg. The most sensitive ecological receptors, the mink and river otter, were used to calculate a LOAEL-based sediment target of 0.8 mg/kg. As this ecological-based target level was less than the low end of the human health target concentration range of 2.1 to 3.2 mg/kg (*i.e.*, also protective of human health), 0.8 mg/kg was selected as the target BSQV for mercury to compare to post-remediation surface-weighted average sediment concentrations (SWACs). The bioaccumulation-based targets are applied on an area-weighted basis (*i.e.*, by reach rather than point-to-point) since animals, such as fish, that bioaccumulate mercury and other bioaccumulative contaminants are not limited to a specific location of the Site.

A site-specific BSQV was not calculated for PCBs, as discussed in Appendix A of the Supplemental FS (Parsons, 2008a). As discussed in the text of the Proposed Plan, NYSDEC's bioaccumulation-based sediment screening criteria (NYSDEC, 1999) were used for evaluation purposes. The NYSDEC wildlife bioaccumulation screening value for PCBs is 0.03 mg/kg based on 2.1% total organic carbon (TOC). The NYSDEC screening value for human health bioaccumulation for PCBs is below the detection limit at the Geddes Brook/Ninemile Creek site and was therefore not used for evaluation purposes.

A site-specific BSQV was also not developed for hexachlorobenzene since the NYSDEC sediment screening criterion (NYSDEC, 1999) to protect wildlife from bioaccumulation was used as the comparison value for hexachlorobenzene. This value is 0.25 mg/kg based on 2.1% TOC. PCDD/PCDFs exceeded NYSDEC bioaccumulation screening criteria at only three of the 194 locations sampled. These locations would be remediated based on concentrations of other contaminants (*e.g.*, mercury) detected. Therefore, PRGs for PCDD/PCDFs in sediments were not developed.

Target concentrations for dermal exposure pathways were derived by adjusting concentrations of the CPOIs identified to result in a cumulative risk estimate of 1×10^{-5} (specifically, 1.49×10^{-5}) for all CPOIs. In these calculations for human health-based sediment concentrations for direct contact, a cumulative risk target of 1×10^{-5} (which is the midpoint of the risk range considered in CERCLA HHRAs) was applied. The remaining CPOIs were conservatively assumed to remain unchanged, although remedial methods to address any given CPOI would likely reduce concentrations of all chemicals present. Within the project area, benzo(a)pyrene had the largest contribution to the risk estimates. Remedial methods that address benzo(a)pyrene would also be expected to be effective with additional co-located PAHs. The PRG to protect from direct exposure to sediments/soils is 1.3 mg/kg of benzo(a)pyrene.

The calculations for these values are presented in Sections I.4 and I.5 of Appendix I of the FS report and in Attachment A-2 of Appendix A of the Supplemental FS report (Parsons, 2008a).

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Sediment Quality Values for Floodplain Soils/Sediments to Protect from Bioaccumulation and Direct Contact

BSQVs that are protective of human health and the environment were also developed for mercury, benzo(a)pyrene (representing PAHs), and hexachlorobenzene in Geddes Brook/Ninemile Creek floodplain soils/sediments.

To protect wildlife that consume terrestrial invertebrates, the first step of BSQV development entailed modeling rates of mercury accumulation in terrestrial invertebrates based on a transfer factor derived from the literature. The target concentration was then calculated using receptor-specific data and toxicity values. The LOAEL-based mercury PRG to protect the most sensitive ecological receptor, the short-tailed shrew, was calculated to be 0.6 mg/kg.

A target concentration of 0.25 mg/kg was established for hexachlorobenzene to be protective of wildlife based on NYSDEC's bioaccumulation-based sediment screening criterion. See text box above entitled "Sediment Quality Values for Channel Sediments to Protect from Bioaccumulation and Direct Contact."

To protect recreational visitors that may contact sediments, the benzo(a)pyrene direct contact-based value of 1.3 mg/kg calculated for channel sediments was also selected for floodplain soils/sediments, as the exposure assumptions were the same for both media.

The calculations for these values are presented in Sections I.4 and I.5 of Appendix I of the FS report and in Attachment A-2 of Appendix A of the Supplemental FS report (Parsons, 2008a).

Summary

The goals of the remedy that is ultimately selected are to achieve the RAOs and PRGs as defined in this Proposed Plan. Per the NCP, the success or failure of the Geddes Brook/Ninemile Creek remedial program, as assessed every five years, will be based on the attainment of all PRGs.

Because of the importance of the Geddes Brook/Ninemile Creek ecosystem as a natural resource, the protection of habitat through remediation and corresponding restoration has been an important consideration in the development of the various dredging/excavation and capping alternatives. The goal of restoring productive aquatic and terrestrial (wetland) habitats in the Site has been considered throughout the analysis of the various alternatives, along with the need to provide an effective remedy. A site-wide habitat restoration plan would be required as part of the remedial design under any selected remedy other than no action.

DESCRIPTION OF ALTERNATIVES

GENERAL

CERCLA §121(b)(1), 42 U.S.C. §9621(b)(1), mandates that remedial actions must be protective of human health and the environment, comply with ARARs, be cost-effective, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. CERCLA §121(d), 42 U.S.C. §9621(d), further specifies that a remedial action must attain a level or standard

of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4), 42 U.S.C. §9621(d)(4) (see the nine evaluation criteria listed below in the "Comparative Analysis of Disposal Options and Remedial Alternatives" section of this Proposed Plan). The various elements of the alternatives (including the preferred remedy) presented below do not represent an offer of settlement by the State of its pending litigation claims concerning the Site and the Onondaga Lake system.

The media of concern for remediation at the Site are channel sediments and floodplain soils/sediments. Alternatives that specifically address these media were developed by Honeywell in the FS report (Parsons, 2005) and Supplemental FS report (Parsons, 2008a).

The FS report evaluated a variety of remedial alternatives for both channel sediments and floodplain soils/sediments, using combinations of removal to various depths, isolation capping, backfilling, and habitat layer placement, 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 the Supplemental FS report, a number of site investigations and assessments have been conducted since the submittal of the FS report, 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, the Supplemental FS report and this Proposed Plan evaluate four alternatives: three representative alternatives from the FS report (updated to reflect the recent site information) and a new alternative (based on the recent site information). Also, while the FS report presented and evaluated alternatives separately for channel and floodplain areas, the alternatives in the Supplemental FS report and this Proposed Plan reflect coordinated activities for channel and floodplain areas to facilitate a focused evaluation.

With the exception of the "no action" alternative, all of the alternatives included in this Proposed Plan involve some combination of the following remedial technologies, which are described on the following pages:

- Dredging/excavation to remove contaminated channel sediments.
- Excavation to remove contaminated floodplain soils/sediments.
- Consolidation and disposal in the containment area at Honeywell's LCP Bridge Street subsite. The FS report and Supplemental FS report also evaluated disposal to a New York State commercial landfill off-site (see discussion below).
- Water treatment.
- Isolation capping of channel sediments.
- Backfilling.
- Installation of habitat layer.

Each of the action alternatives also includes wetland and stream restoration. Any wetland habitat that was damaged or removed as a result of remedial action would be restored. In instances where restoration is not feasible, actions such as wetland mitigation would be required. The design and construction of restoration elements must be consistent with the substantive requirements for permits associated with disturbance to state- and federal-regulated wetlands (*e.g.*, 6 NYCRR Part 663, Freshwater Wetlands Permit Requirements) and navigable waters (*e.g.*, 6 NYCRR Part 608, Use and Protection of Waters). The details would be developed during the remedial design, as part of a habitat restoration plan for the Geddes Brook/Ninemile Creek site.

The alternatives proposed for the OU1 portion of the Site are based on a variety of and, in some cases, a combination of technologies. Therefore, the section on technologies (below) is presented before the "Description of Geddes Brook/Ninemile Creek Operable Unit 1 Alternatives" section so that the alternatives may be clearly understood.

TECHNOLOGIES

Removal of Contaminated Channel Sediments (Dredging/Excavation) and Floodplain Soils/Sediments (Excavation)

Channel Sediments (Dredging/Excavation)

Removal of channel sediments can be accomplished in a submerged aqueous environment using hydraulic and/or mechanical dredging equipment or in a "dry" environment using more conventional upland construction equipment to excavate sediments after water has been drained and diverted.

Dredging and/or excavation at the Site would involve removal of contaminated channel sediments from lower Ninemile Creek to a depth that achieves a specified residual contaminant concentration (less than PRGs) or enables installation of a cap and habitat layer. It should be noted that lower Geddes Brook sediments will be excavated down to the underlying clay layer as part of the planned Geddes Brook IRM (for a detailed discussion of the Geddes Brook IRM, see the "Honeywell Facilities and Disposal Areas near Geddes Brook/Ninemile Creek" section of this Proposed Plan).

Sediments can be dredged hydraulically, mechanically, or by a combination of the two. Mechanical dredging was selected as the representative process for detailed evaluation in the FS report for estimating costs; however, the actual dredging and excavation methods would be determined during design. The type of dredging/excavation to be performed would likely depend on the site-specific area and stream reach conditions. Any requisite stream bank removal (for cap construction or contaminant excavation) would be performed using on-shore mechanical excavation.

The remedial design will need to evaluate appropriate roadway, bridge, and rail structural stability and safety-related considerations, especially in Reach BC. These considerations may impose limitations on the depths and footprints of removals in the vicinity of transportation structures.

Floodplain Soils/Sediments (Excavation)

Excavation at the Site would involve removal of floodplain soils/sediments from along lower Ninemile Creek to various depths. It should be noted that the floodplain soils/sediments along lower Geddes Brook will be removed to the clay layer as part of the planned Geddes Brook IRM. As discussed below, after removal, backfilling and placement of a habitat layer would occur to appropriate ground elevations to provide terrestrial or wetland habitat, as part of a habitat restoration plan for the Geddes Brook/Ninemile Creek site. It was assumed for the FS report and this Proposed Plan that floodplain soils/sediments would be removed using standard construction techniques such as backhoes and excavators.

Disposal

Sediment dredging and soil excavation projects require land areas for operations support and materials management (which includes dewatering, water treatment, solids staging and loading, and final disposal) of the dredged/excavated sediment and soil. Typically, the dredged/excavated

material from a remediation project is either consolidated in an on-site disposal location (with treatment, if required) if sufficient land area is available or is transported off-site for treatment or disposal.

The assessment of various land disposal options included consolidating excavated materials within the containment system at Honeywell's nearby LCP Bridge Street subsite and disposing of excavated materials at an existing off-site permitted landfill in the Rochester, New York, area. The estimated costs for these disposal options for the alternatives are included in the descriptions of alternatives below.

Water Treatment

Dredging/excavating, dewatering, and sediments handling can generate significant volumes of water. Transport and off-site treatment of this water was evaluated for each of the remedial alternatives in the FS report. However, the Supplemental FS report demonstrated that on-site treatment, at a location in the vicinity of the Site, and discharge of water would be more cost-effective and efficient. The actual location of treatment would be determined as part of the remedial design. On-site treatment and discharge of waters generated by the excavation of contaminated sediments and soils is assumed, for the purpose of the Supplemental FS report, to be similar to the temporary treatment system used at the LCP Bridge Street subsite, which consisted of pH adjustment equipment, a clarifier tank, bag filters, sand filters, and a granular activated carbon (GAC) and/or sulfur-impregnated GAC filtration system. Estimated equipment and operating costs for the temporary system are based on the system used at LCP. The treated water may be released back to the Geddes Brook/Ninemile Creek watershed in accordance with discharge requirements to be determined by NYSDEC, or managed in another way determined to be acceptable to NYSDEC.

Placement of Clean Materials (Channel and Floodplain)

The placement of clean material is included in all of the action alternatives developed for the Site. There are several purposes for placing clean materials over the Site, including to restore the natural elevations in the floodplain, to prevent potential adverse exposure to residual contaminated channel sediments and floodplain soils/sediments by human and ecological receptors, to provide habitat for wetland and upland species (*e.g.*, through vegetative cover), and to provide stable slopes and stream banks.

Depending on location, as described further in this Proposed Plan, these clean materials would consist of one or more of the following layers, from the surface down:

- Habitat Layer: Clean material designed to provide the proper conditions for animal and plant communities to grow. This layer is assumed in this Proposed Plan to be a minimum of 2-ft (60-cm) thick, unless otherwise noted. The type of substrate would be determined during design and could include a variety of materials in the stream and floodplain.

- Backfill: Soils used to bring the sediment or ground surface to an appropriate elevation below the habitat layer but not necessarily proper material for habitat (*e.g.*, inappropriate grain size, or organic content).

- Isolation Cap: Clean sand or other suitable clean material designed to isolate the habitat layer from underlying residual contamination in areas where contaminant transport via sediment porewater is a concern (*i.e.*, the stream channel or wetlands).

Where dredging/excavating results in removal of all significant contamination in the stream or floodplain, the area would be backfilled to bring the sediment or ground surface up to the designed elevation, if needed, and a habitat layer placed.

In floodplain areas, if residual contamination remains below the depth of removal, the area would be backfilled to bring the ground surface up to the designed elevation, if needed, and a habitat layer placed on top of the backfill. Unlike the channel areas where residual contamination could migrate upward due to diffusion and advection of porewater, a separate isolation cap may not be needed within the floodplain to isolate residual contamination at depth.

In the development of the floodplain alternatives, the potential for CPOI upwelling in the floodplain was determined not to be significant since groundwater is typically at a depth of 8 inches (20 cm) or more below the ground surface in the wetlands (SYW-10 and 18). However, due to limited available data, additional data would be obtained during the remedial design to assist with determining if upwelling is a significant concern in the floodplains. If it is determined during design that there is upwelling in certain areas of the wetlands or floodplains, then deeper removal of contaminated soils/sediments (beyond that required in the alternative ultimately selected) and /or placement of an isolation cap may be needed prior to placement of the habitat layer to prevent unacceptable migration of contamination by groundwater.

The use of clean materials for the purposes of isolation capping, habitat restoration, and backfilling is discussed further below.

Isolation Capping of Channel Sediments

Isolation capping involves placement of an engineered cap on top of post-excavation, residual contaminated sediments. Two of the alternatives for channel sediments involve capping portions of the lower Ninemile Creek channel to meet the following objectives:

- Provide physical isolation of the contaminated sediments from benthic organisms and other animals and human contact.

- Physically stabilize the sediments to prevent resuspension, contaminant mobilization, and sediment transport.

- Provide chemical isolation of contaminated sediments from advective or diffusive flux into the overlying surface waters.

Specific factors that would be evaluated as part of the design of the engineered cap include erosion, groundwater upwelling, bioturbation, chemical isolation, habitat protection, settlement, static and seismic stability, and placement techniques. The FS and Supplemental FS reports included preliminary evaluations of many of these factors.

The isolation caps, if included as a component of the selected remedy, would be constructed following removal of contaminated sediments and would consist of as many as three layers, each of which would serve a specific purpose; a mixing layer, a chemical isolation layer, and an armor

(erosion) layer. A habitat layer would be placed above the isolation cap as well as in areas dredged/excavated where an isolation cap would not be needed.

Mixing Layer

The first layer of the engineered cap on top of residual contaminated sediments that remain following removal is referred to as the mixing layer, which accounts for mixing of the cap material with the underlying sediments and uneven application during cap placement. A layer of substrate would be placed as a mixing layer where required. The Supplemental FS report assumed a mixing layer thickness of 0.25 to 0.5 ft (7.5 to 15 cm); the actual thickness of the mixing layer would be determined during design.

Chemical Isolation Layer

Above the mixing layer is the chemical isolation layer which "isolates" contaminants in the sediments below the cap. The chemical isolation layer would be a minimum of 1-foot (30-cm) thick. The thickness of the chemical isolation layer is determined based on computer modeling, such that concentrations of contaminants within the sediments beneath the cap do not result in unacceptable levels of exposure to aquatic life at the surface of the cap (which assumes that the cap thickness does not decrease over time [*i.e.*, does not erode]). As shown in Table 3-3 of the Supplemental FS report (see "Description of Geddes Brook/Ninemile Creek Operable Unit 1 Alternatives" section below), the estimated required thicknesses are 1.25 ft (38 cm) for Reach BC and 1.75 ft (53 cm) for Reach CD. During the design phase, the isolation capping model would be rerun as needed based on additional field data to be collected and cap thicknesses and/or removal depths would be revised as appropriate. However, based on practical considerations of constructing an engineered cap in a stream environment and for long-term effectiveness, the thickness of the isolation layer would be designed to be no less than 1 ft (30 cm).

Modeling for chemical isolation performed during the FS and Supplemental FS was used to calculate the maximum allowable CPOI sediment concentrations that can remain beneath the isolation layer of the cap without resulting in unacceptable levels at the base of the habitat (surface) layer of the cap at 1,000 years or steady state[8] (whichever happens first), from chemical upwelling, diffusion, or other transport processes (see the text box entitled "Isolation Capping Model" on page 63). The point of compliance being at the base of the habitat layer is intended to ensure that the isolation portion of the cap is effective in preventing unacceptable concentrations of contaminants (*i.e.*, concentrations greater than the lowest PRG for mercury of 0.15 mg/kg and PRGs for other CPOIs) from entering the habitat restoration layer.

A preliminary estimate of the groundwater upwelling velocity in lower Ninemile Creek (*i.e.*, 100 cm/year in Reach BC and 150 cm/year in Reach CD) was used in the isolation capping model. During the design phase, additional field data would be collected to verify the estimated groundwater upwelling velocity, and the isolation capping model would be rerun as needed (should isolation capping be a component of the selected remedy) and cap thicknesses and/or removal depths would be revised as appropriate.

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[8] Steady state is the point at which the chemical concentrations within the isolation layer would reach their maximum predicted values. The period of time to achieve steady state could be less than or greater than 1,000 years.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Isolation Capping Model

A model was developed to assess the effectiveness of in-situ isolation capping of the channel sediments of the Ninemile Creek portion of OU1 and to estimate the maximum CPOI concentrations that can remain in the sediments beneath the cap without resulting in an exceedance of the PRG concentrations at the top of the cap due to chemical upwelling, diffusion, or other transport processes. In-situ capping involves placement of an engineered cap over contaminated sediment to prevent or limit the movement of contaminated porewater from the sediment into the water column and minimize exposure of benthic organisms to the contaminated sediments. The placement of an isolation cap would include the following:

1. A mixing layer, designed to address the mixing of underlying sediments with the cap material during placement, as well as uneven placement.
2. An isolation layer, designed to prevent or limit vertical chemical migration.
3. An armor layer, designed to protect the isolation layer from erosional processes such as channel flow and ice scour.
4. A habitat layer, designed to provide habitat for fish and benthic macroinvertebrates and allow for bioturbation processes without exposure to contaminated sediment or disruption of the isolation layer material.

This model assumes that the cap is armored, so that erosion of the cap is minimal and does not provide the primary means of contaminant migration.

During the FS, a steady-state cap model was run using an iterative approach to estimate maximum allowable sediment concentrations for key CPOIs for a range of isolation layer thicknesses up to 2 ft (60 cm). These sediment concentrations were then used in each alternative to identify deeper remediation areas necessary for cap effectiveness. The model is discussed in detail in Appendix H of the Geddes Brook/Ninemile Creek FS report.

During the Supplemental FS, a transient cap model was run at 1,000 years to estimate an appropriate isolation layer thickness assuming varying sediment concentrations for mercury, PCBs, hexachlorobenzene, benzo(a)pyrene, and phenol. Upwelling velocities of 100 cm/yr in Reach BC and 150 cm/yr in Reach CD were assumed. Detailed modeling results are provided in Appendix E of the Supplemental FS report, and the results are summarized below.

- Within Reach BC, an isolation layer thickness of 1.25 ft (38 cm) would result in attainment of the PRGs for mercury, PCBs, hexachlorobenzene, benzo(a)pyrene, and phenol under Alternatives 2 and 3.

- Within Reach CD, an isolation layer thickness of 1.75 ft (53 cm) would result in attainment of the PRGs for mercury, PCBs, hexachlorobenzene, benzo(a)pyrene, and phenol under Alternative 2 and, if needed, Alternative 3.

Further work to be completed during design would include collection of additional upwelling data, collection of porewater data, evaluation of active cap materials, evaluation of sorption to cap material, and refinement of model input parameters and consideration of an alternate modeling tool (*e.g.*, numerical model). Final determination of model applications and input assumptions would be made based on these evaluations.

As discussed in the Supplemental FS report, final determination of model applications and input assumptions would be made during design based on available data and the selected remedial approach for the Site. In general, chemical isolation layer designs should be based on an appropriate level of conservatism in the selection of design parameters to address uncertainties. A buffer (or safety) layer is also an approach that can be used to address uncertainties surrounding selection of design parameters. The need for a buffer layer would be determined during design based on the selected remedial approach and on an assessment of the design investigation data.

Armor (Erosion) Layer

An armor or erosion control layer (*e.g.*, gravel) would be included in the cap design/construction above the chemical isolation layer. Erosion mechanisms can be classified into two distinct categories based on sediment bed properties, cohesive sediments (fine-grained with clay particles which tend to bind the sediment particles together) and non-cohesive (larger particles such as sand or gravel which do not interact with each other). Cohesive sediments (*e.g.*, the silts and Solvay wastes in the creek) tend to resist erosion better than would be predicted from their size alone because of their binding action, but once the channel flow reaches the critical water velocity, deposits of cohesive sediments tend to erode out quickly and completely. The particles of sand in non-cohesive sediments (*e.g.*, the sand that would be used in the isolation layer of the cap) would be eroded out of the stream bed as individual particles at their critical water velocities, with the water removing the smaller particles first and leaving larger particles behind. Each deposit of non-cohesive sediments would erode until a layer of larger stone is either encountered or is produced by the current removing smaller grains until only particles larger than the critical size remain. Such a layer would then effectively guard (armor) the sediments below it from any further erosion.

In order to assess the potential for erosion, the USACE's HEC-RAS flood velocity model was run by Honeywell for lower Ninemile Creek, with results indicating that much of the channel is erosional under high-flow conditions and that an armor layer would be required to prevent erosion of the underlying chemical isolation layer under base flow and flood events (see text box entitled "Flood Flow Model" on page 65). An armor layer would be placed beneath the habitat layer, where necessary, to further protect the underlying chemical isolation layer of the cap against erosion from high flows and ice scour. Specific details of the cap configuration, including the thicknesses of each layer, would be determined during the remedial design. It was assumed for the FS report (Parsons, 2005) that the sediment cap would include a 0.5-ft (15-cm) thick erosion protection layer. For the Supplemental FS report (Parsons, 2008a), the combined thickness of the armor layer and habitat layer (see below) was assumed to be 2 ft (60 cm). A determination of the final thickness of the armor layer and whether a portion of the armor layer could be incorporated into the habitat layer would be made during design.

Habitat Layer

A habitat layer would be placed throughout the remediated area whether or not an isolation cap is present.

Where an isolation cap is required, the habitat layer would be placed above the chemical isolation and armor layers. In the aquatic areas (streams and wetlands), the overlying habitat layer would be designed to be compatible with local benthic and other aquatic life forms and would provide suitable substrate to establish aquatic vegetation, where appropriate. In the floodplain areas, the habitat layer would be of sufficient thickness to protect burrowing animals from being exposed to contaminated soils/sediments at depth.

A minimum of 2 ft (60 cm) of clean soil or other suitable material, as determined during design, would be used as the habitat layer in channel and floodplain areas of lower Ninemile Creek where CPOIs exceeding the PRGs remain in the residual soils/sediments. The goal for the concentrations of this clean material for mercury, other CPOIs, and other constituents would be NYSDEC's sediment criteria (including the LEL of 0.15 mg/kg for mercury) in sediments and 6 NYCRR Part 375 unrestricted use soil cleanup objectives (including the objective of 0.18 mg/kg for mercury) in soil. Clean soil would include imported fill materials from off-site sources.

Understanding the Geddes Brook/Ninemile Creek Proposed Plan

Flood Flow Model

The HEC-RAS flood model Version 3.1 was used to evaluate hydraulic effects of the remedial alternatives. Model simulations were completed to provide data on the extent of flooding within the Geddes Brook and Ninemile Creek channels and floodplains and flow velocities, depths, and shear stresses associated with various storm events. These data were then used to evaluate the stability of various substrates (with different thicknesses and sediment type) and channel alignments.

The term "erosion" refers to the ability of the channel sediment to be eroded or moved by flowing water. Sediments will erode when the stream velocity exceeds the critical velocity for moving or eroding sediment particles. The size of the material used as the armoring layer (if required above the isolation layer) must be able to withstand erosive forces associated with the 100-year storm event. In addition, the habitat layer should be able to withstand certain storm conditions, although some of this layer may erode and become re-deposited, which is natural in streams.

The model included lower Ninemile Creek from Onondaga Lake to the confluence with Geddes Brook, and lower Geddes Brook from the confluence with Ninemile Creek to the confluence with the West Flume. Based on results, the material used for the armoring layer could be comprised of either graded gravel or riprap. The results also indicate that lower Geddes Brook and Reach CD of Ninemile Creek can be realigned to create synergies between the remedy and habitat objectives. The modeling effort is discussed in detail in Appendix D of the Supplemental FS report.

The HEC-RAS model would be updated during design based on detailed bathymetric and topographic surveys to be conducted throughout the Site. This updated model would be used during remedial design to ensure that the remedy is protective and stable and meets requirements for protection of existing infrastructure and floodplain areas (*i.e.*, no adverse increase in water elevations or extent of flooding as compared to existing conditions).

The actual make up of the habitat layer would be determined during design. The intention of the habitat layer is to provide the substrate necessary for the restoration of a diversity of habitats throughout the stream corridor. The habitat layer will consist of clean materials, the contents of which will depend on the final habitat goals for the section of the Site. The substrate organic content, grain size and distribution, thickness, and placement may vary depending on the location within the Site. The expected forces of any erosional events on the habitat layer will have to be considered during design. The habitat layer may also be influenced by the species of biota that will be expected in the area after remediation. The placement of large habitat or stream structures, such as boulders, woody debris, or flow diversions, would be considered in the design of the habitat layer.

Overall, natural stream restoration techniques would be used in designing both the channel alignment and the habitat layer with the goal of creating a diversity of stream and near-stream habitats and minimizing hardening of the channel and banks, to the extent feasible. To the greatest extent possible, the existing pool and riffle habitats would be restored within the stream. The details of the habitat layer would have to meet the substantive requirements of 6 NYCRR Part 608.

A habitat restoration plan would be developed as part of the remedial design, and would include a determination of the final thickness and substrate of the habitat layer as well as planting plans and specifications, including the species composition of any plantings or seed mixes (*e.g.*, species native to floodplain forests of the northeast).

Backfilling in Removal Areas

There are several potential reasons for backfilling in the remedial area without the need for a fully engineered isolation cap, including restoration of surface topography after removals, stabilizing

slopes, and creating desirable habitat features. Backfilling would include the use of soils to bring the sediment or ground surface to an appropriate elevation below the habitat layer, but these soils would not necessarily consist of appropriate material for habitat (*e.g.*, inappropriate grain size, or organic content).

In addition, if it is determined by NYSDEC during design that soil excavated during construction of the new Geddes Brook or Ninemile Creek channel alignments (see "Description of Geddes Brook/Ninemile Creek Operable Unit 1 Alternatives" section below) is suitable material, this soil may also be used for backfill (*e.g.*, for depths below the top 2 ft [60 cm] of habitat layer material). Waste materials including Solvay waste or calcite would not be acceptable material for backfill.

DESCRIPTION OF GEDDES BROOK/NINEMILE CREEK OPERABLE UNIT 1 ALTERNATIVES

For the action alternatives, the cleanup criteria are based on the PRGs developed for the Site (see the "Remedial Action Objectives and Preliminary Remediation Goals" section of this Proposed Plan). As discussed therein, screening of CPOIs identified in the RI report, which included COCs and COPCs from the BERA and HHRA, was conducted in the FS, and based on those results, quantitative PRGs were developed for the following CPOIs: mercury, arsenic, lead, total PAHs, benzo(a)pyrene, PCBs, hexachlorobenzene, and phenol. These PRGs address both direct toxicity and bioaccumulation impacts on human health and the environment, including fish tissue and surface water exposure pathways. For mercury, the sediment toxicity PRG concentrations ranged from 0.15 to 2 mg/kg. PRG concentrations for mercury and the other CPOIs are presented in the text boxes in the "Remedial Action Objectives and Preliminary Remediation Goals" section of this Proposed Plan. Calcite was also determined to be a stressor of concern in the BERA. Alternatives in the Supplemental FS report and this Proposed Plan do not explicitly include the removal of visible calcite (ionic waste), but all of the action alternatives would improve the benthic substrate as a by-product of removal (based on CPOIs) and/or placement of a clean habitat layer above sediments/soils within the remedial areas.

The Supplemental FS report and this Proposed Plan evaluate four alternatives for Reaches BC and CD of Ninemile Creek. One of these alternatives (Alternative 1) calls for no action and the other three alternatives call for varying amounts of excavation and capping, backfilling, and placement of a clean habitat layer within the stream channel and floodplains. Detailed descriptions of each of the four alternatives follow:

Alternative 1 – "No Action"

The Superfund program requires that the "no action" alternative be considered as a baseline for comparison with the other alternatives. The "no action" remedial alternative for channel sediments and floodplain soils/sediments does not include any physical remedial measures that address the contamination at the Site[9].

Because this alternative would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA requires 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 the contaminated sediments and floodplain soils/sediments.

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[9] Under the "no action" alternative, the Geddes Brook IRM would, however, still be implemented.

Alternative 1 (Ninemile Creek Reaches BC and CD)

Dredged/Excavated Volume (cy):	0
Mercury Mass Removed (pounds):	0
Capital Cost:	$0
Average O&M Annual Costs:	$0
Present-Worth O&M Costs:	$0
Present-Worth Cost:	$0
Construction Time:	0 years

Alternative 2 – Removal of contaminated Ninemile Creek channel sediments and floodplain soils/sediments in Reaches BC and CD where concentrations exceed 1.3 mg/kg mercury (and PRGs for other CPOIs) up to a depth of 3 ft (90 cm) in the channel and 2 ft (60 cm) in the floodplain, placement of an isolation cap or backfill, and placement of a habitat layer

This alternative is consistent with Alternative C2(C3)/FP2(B3) in the FS report, modified to reflect the new data described in the Supplemental FS report. Specific components of this alternative, as shown in Figure 10, include:

- **Ninemile Creek Channel (Reaches BC and CD):** Remove up to 3 ft (90 cm) of channel sediment in both Reaches BC and CD with mercury concentrations exceeding 1.3 mg/kg and other non-mercury CPOIs exceeding PRGs to meet chemical isolation layer effectiveness. However, sufficient removals would be conducted prior to installation of the isolation cap and habitat layer for cap effectiveness and to allow for passage of flood flows under existing infrastructure (*e.g.*, bridges) and ensure no adverse increases in water elevations and extent of flooding in accordance with applicable requirements, and to provide sufficient water depth for fish passage and canoe access. Place a chemical isolation layer and a habitat layer (which may incorporate an underlying armoring layer) over excavated areas where sediment had been removed but residual sediment concentrations exceed PRGs. For this alternative, the habitat layer is assumed to be 2-ft (60 cm) thick. The underlying chemical isolation layer, where present, would be a minimum of 1-ft (30 cm) thick, except in those locations where additional removals and/or a thicker chemical isolation layer is required for cap effectiveness. Areas where all material in excess of PRGs had been removed would not need capping for isolation but would be backfilled, if needed, with a habitat layer placed at the surface.

- **Ninemile Creek Floodplain (Reaches BC and CD):** Remove up to 2 ft (60 cm) of floodplain soil/sediment with mercury concentrations exceeding 1.3 mg/kg and other non-mercury CPOIs exceeding PRGs. Place up to 2 ft (60 cm) of habitat layer in areas where soil/sediment had been removed. In Reach BC, removals would extend to the armor stone placed by the New York State Department of Transportation (NYSDOT) during construction of NY Route 695 during the late 1960s. This is required so not to destabilize roadways and bridges. Moreover, during that construction, the stream bed was moved, and

therefore contamination would not be expected beneath the armor stone (see discussion in the RI report).

This alternative is estimated to include the removal of 29,000 cy (22,000 m^3) of contaminated sediment and soil, over an area of approximately 8.4 acres (3.4 hectares) within and along Reaches BC and CD. It is estimated that this dredging and excavation would result in the removal of about 450 pounds (200 kg) of mercury from Ninemile Creek (or about 67 percent of the estimated total mercury mass in Reaches BC and CD). Removal areas for Alternative 2 are shown in Figure 13 for channel areas and Figure 14 for floodplain areas.

The contaminated sediments and soils that are removed from the creek and floodplains would be disposed of at the LCP Bridge Street subsite containment system (Option A) or off-site at an existing off-site permitted landfill in the Rochester, New York, area (Option B).

It is estimated that the dredging/excavating, capping, backfilling, and habitat layer placement components of this alternative, along with dewatering, water treatment, and transport/disposal of sediments and soils at the LCP Bridge Street subsite, would take one year.

An institutional control in the form of an environmental easement, including restrictions on dredging/excavating in the areas where residual contamination would remain beneath the habitat layer, would be included as part of this alternative.

Because this alternative would result in contaminants remaining on-site above levels that would permit unlimited use and unrestricted exposure to site media, CERCLA requires 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 sediments and floodplain soils/sediments.

Alternative 2 (Ninemile Creek Reaches BC and CD)

Dredged/Excavated Volume for Disposal (cy):	29,000
Mercury Mass Removed (pounds):	450
Capital Cost:	$9,200,000
Average O&M and Periodic Annual Costs:	$88,000
Present-Worth O&M and Periodic Costs:	$1,100,000
Present-Worth Cost:	$10,300,000
Construction Time:	1 year

Note: The costs above are based on disposal at the LCP Bridge Street subsite (Option A). The estimated cost for this Ninemile Creek alternative, assuming off-site disposal (Option B), for the volume above is $12.9 million.

Alternative 3 – Removal, placement of an isolation cap or backfill, and placement of a habitat layer

This alternative, which is included in the Supplemental FS report (Parsons, 2008a), provides for more removal of contaminated channel sediments and floodplain soils/sediments at generally a greater depth, and a greater footprint based on steep banks (remedial area), than Alternative 2. Within the remedy footprint, this alternative addresses the RAOs and PRGs for mercury and other CPOIs.

Specific components of this alternative, as shown in Figure 11, are summarized below. Because Alternative 3 tailors the remedial approach to specific areas of the Site, the summary below includes separate discussions corresponding to specific areas of the Ninemile Creek channel and floodplain.

- **Ninemile Creek Channel (Upper Reach CD)**: Remove approximately 3 to 6 ft (0.9 to 1.8 m) of contaminated sediment from the upper Reach CD channel[10] to allow for channel remediation, which includes channel realignment and habitat restoration. These removals would also need to ensure that there would be no adverse increases in water elevations and extent of flooding in accordance with applicable requirements. Upstream of the large island, approximately 3 to 4 ft (0.9 to 1.2 m) of sediment would be removed. In the vicinity of the large island, as shown in Figure 11, the southern channel would be widened and deepened to carry the entire creek flow and the northern channel would be backfilled and a habitat layer placed with clean material, to create a floodplain/wetland buffer between Wastebeds 9 and 10 and Ninemile Creek. The exact channel alignment, depth, and width would be determined in design using natural channel design techniques to establish a stable channel with minimal channel and bank hardening, to the extent feasible. A habitat layer would be installed in the new channel. For purposes of this Proposed Plan, the habitat layer is assumed to be at least 2-ft (60-cm) thick. A preliminary hydrodynamic analysis completed for the Supplemental FS indicates that a 4-ft (1.2-m) deep (on average) channel would be required to convey the creek through this reach. Excavations to obtain sufficient finished channel dimensions and to provide for a habitat layer would result in about 6 ft (1.8 m) of removal in this portion of the channel adjacent to the large island.

  Within the engineering/feasibility constraints of these removals, the need for an isolation cap within Reach CD would be eliminated or minimized[11]. The nature and vertical extent of

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[10] The portions of Reach CD designated as upper Reach CD and lower Reach CD are shown in Figure 15 for this alternative. Upper Reach CD includes approximately 600 ft (180 m) along the large island and 600 ft (180 m) upstream of the large island. Lower Reach CD extends approximately 1,000 ft (300 m) downstream of the large island.

[11] Based on the available data for the upper portion of Reach CD, it appears that the vertical distribution of mercury (that would warrant an isolation cap) in this area is generally limited to the uppermost several feet of stream sediments. Therefore, one of the design goals for this portion of Ninemile Creek would be to minimize, via sediment removal, the areal extent of stream channel where an isolation layer would be required. A Pre-Design Investigation (PDI) would be performed to gather additional channel sediment data from Reach CD. The data would be reviewed during design to determine the appropriate depth of sediment removal (*e.g.*, within the upper portion of Reach CD). This would include an evaluation of the vertical and areal distribution of mercury, potential post-removal residual concentrations, the potential thickness and type of backfill materials that would be placed over remaining sediments and forming the base for the habitat layer, potential sheeting and dewatering requirements associated with differing removal depths, and potential stability concerns during construction. The evaluation would determine whether or not an isolation layer would be needed

contamination in upper Reach CD may not require the installation of a chemical isolation layer following these removals (based on an evaluation of design and post-excavation sampling data); however, if required based on evaluation of these data, the habitat layer would be underlain with a chemical isolation layer. For the purposes of the Supplemental FS, it was determined that the underlying chemical isolation layer would need to be 1.75-ft (53-cm) thick in Reach CD, where needed, to meet the lowest PRG for mercury and the PRGs for other CPOIs at the bottom of the habitat layer at 1,000 years or steady state (whichever happens first).

- **Ninemile Creek Channel (Lower Reach CD):** Relocate lower Reach CD (which currently extends from just downstream of the large island to the downstream end of Reach CD) to the southern portion of the floodplain to create a floodplain/wetland buffer between the wastebeds and Ninemile Creek, as shown in Figure 11. This removal might require excavations as deep as 12 ft (3.7 m) (see Appendix C of the Supplemental FS report) in order to provide capacity for water flow in the new channel. Sufficient removals would be conducted to ensure no adverse increases in water elevations and extent of flooding in accordance with applicable requirements. The exact channel alignment, depth, and width would be determined in design using natural channel design techniques to establish a stable channel with minimal channel and bank hardening, to the extent feasible. Install a habitat layer (as described above) in the new channel. Based on the removals required for the new channel, it is not anticipated that a chemical isolation layer would be needed below the habitat layer.

- **Ninemile Creek Channel (Reach BC):** Remove an average of 3 ft (90 cm) of contaminated sediment from the Reach BC channel where required to allow for the installation of an isolation cap and a suitable habitat layer. Place a chemical isolation layer (assumed to be 1.25-ft [38-cm] thick for the purposes of the Supplemental FS to meet all PRGs for mercury and other CPOIs) and a habitat layer (as described above) within the entire Reach BC channel area. Sufficient removals would be conducted prior to installation of the isolation cap and habitat layer for cap effectiveness and to allow for passage of flood flows under existing infrastructure and ensure no adverse increases in water elevations and extent of flooding in accordance with applicable requirements, and to provide sufficient water depth for fish passage and canoe access.

- **Ninemile Creek Floodplain (Reach CD):** Remove 2 ft (60 cm) of floodplain soil/sediment in the areas shown in Figure 11. Backfill the former lower Reach CD channel and floodplain adjacent to the wastebeds, and place a habitat layer of clean material at the surface.

- **Ninemile Creek Channel and Floodplain Hot-spot Removal (Reach CD):** Alternative 3 includes hot-spot removal in sediments and floodplain areas. This hot-spot removal enhances the reliability of this alternative by targeting areas of relatively high concentrations

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beneath the habitat layer in any portion or portions of this reach in lieu of additional sediment removal. It would not be considered feasible to substitute additional sediment removal depth for an isolation layer in a specific area if the additional removal would require or cause: disproportionate additional equipment use or infrastructure (*e.g.*, sheeting, water management equipment, materials); or a major extension to the overall construction schedule. It also would not be considered feasible if the required depth of removal would exceed 2 ft (60 cm) beyond that needed to otherwise remove sediments for the purpose of: hot-spot removal for chemical isolation layer effectiveness; to place the isolation layer, erosion protection layer, and habitat layer; and to reconstruct the stream channel with the appropriate depths and slopes for maintaining stream flows and appropriate habitats.

of mercury and other CPOIs[12], resulting in reduced residual contaminant concentrations in these areas.

These hot spots exist within the top 3 to 6 ft (0.9 to 1.8 m) in the southern channel along the large island, at mercury concentrations up to 118 mg/kg (*e.g.*, core locations TN-13-3, TN-14-3, and TN-15-3; see Appendix C of the Supplemental FS report). In addition to these areas, two additional hot-spot areas will be excavated which are located in the area of the existing southern channel adjacent to the middle and downstream islands in Reach CD and an adjacent area in the portion of the floodplain just to the south of this channel area (see Figure 11). These hot-spot areas are characterized by elevated mercury concentrations relative to the surrounding channel and floodplain areas. The hot-spot removal would consist of excavating channel sediments and floodplain soil/sediments to a depth where the residual concentrations would be similar to concentrations in the surrounding area. Based on available data from the RI/FS and Supplemental FS report, these hot-spot removals cover approximately 0.6 acre (0.2 hectare) within the channel and floodplain. Estimated depths of removal in the channel in this area range from 3 to 5 ft (0.9 to 1.5 m), removing sediments with mercury concentrations up to 68 mg/kg. The estimated depths of excavation in the floodplain in this area also range from 3 to 5 ft (0.9 to 1.5 m), removing sediments/soil with mercury concentrations up to 43 mg/kg. These hot-spot removals would cause the residual mercury concentrations in this area to be generally consistent with those of the rest of this reach at depth.

These areas would be backfilled and a habitat layer of clean material would be placed at the surface. A determination of the final extent and depth of the hot-spot removals would be made during remedial design. Additional information on hot-spot areas, depths, and volumes can be found in Appendix C of the Supplemental FS report.

Also, additional contaminated soil/sediment removals may be conducted in other areas to minimize the potential for contaminant migration into Ninemile Creek or into areas that would likely be maintained as or converted to wetlands. The extent of this additional removal, if any, would be determined during design based on the residual concentrations and further analyses.

As noted in the Supplemental FS report, floodplain restoration areas include both wetland and upland areas within the remedial boundaries. Final delineations of pre- and post-remediation wetland and upland areas would be determined during design following completion of the existing wetlands delineation. One of the design goals would be no net loss of wetland areas following remediation.

- **Ninemile Creek Floodplain (Reach BC):** Remove all floodplain soil/sediment (approximately 0 to 3 ft [0 to 90 cm] in depth, 1 ft [30 cm] typical) overlying structural stone between the Ninemile Creek waterline and the break in elevation at the top of the bank along the entire length of Reach BC. As discussed under Alternative 2, the excavation would not extend below the structural armor stone. Restore removal areas with

[12] As discussed in the RI report, the CPOIs other than mercury have the same general distribution as mercury, although the degree to which they are elevated over upstream conditions, and the extent to which they are found are less than for mercury. Therefore, mercury represents the best measure of the extent of contamination released from the Honeywell LCP Bridge Street subsite. In addition, only mercury presents areas of contiguous sample locations which contain concentrations much (*i.e.*, a factor of ten or more) greater than the concentrations in the surrounding area (*i.e.*, hot spots).

approximately 1 ft (30 cm) of vegetated habitat layer, on top of the structural stone, along the entire length of Reach BC, from the water line to the top of the bank.

This alternative is estimated to encompass the removal of 59,000 cy (45,000 m^3) of contaminated sediment and soil, for disposal, over an area of approximately 14.7 acres (6 hectares) within and along Reaches BC and CD. It is estimated that this dredging and excavation would result in the removal of about 535 pounds (242 kg) of mercury from the Ninemile Creek channel and floodplain (or about 80 percent of the estimated total mercury mass in the Reaches BC and CD channel and floodplain [about 670 pounds {300 kg}]). Note that this estimate of mercury mass removal (535 pounds [242 kg]) includes about 370 pounds (167 kg) of mercury from the Reach CD channel and floodplain (55 percent of the total mercury mass in the Reaches BC and CD channel and floodplain), about 150 pounds (68 kg) of mercury from the Reach BC channel (22 percent of the total mass in the Reaches BC and CD channel and floodplain), and about 15 pounds (7 kg) from the Reach BC floodplain (3 percent of the total mass in the Reaches BC and CD channel and floodplain). For the Reach BC channel, the estimated mass removed is based on an average of 3 ft (90 cm) of removal over the entire reach.

In addition, approximately 22,000 cy (17,000 m^3) of the floodplain soils that would be excavated at depths below 3 ft to construct the new channel would be tested and, if found suitable, would be re-used on site.

Removal areas for Alternative 3 are shown in Figure 15 for channel areas and Figure 16 for floodplain areas.

The contaminated sediments and soils that are removed from the creek and floodplains would be disposed of at the LCP Bridge Street subsite containment system (Option A) or off-site at an existing off-site permitted landfill in the Rochester, New York, area (Option B).

It is estimated that the dredging/excavating, capping, backfilling, and habitat layer placement components of this alternative, along with dewatering, water treatment, and transport/disposal of sediments and soils at the LCP Bridge Street subsite, would take two years.

An institutional control in the form of an environmental easement, including restrictions on dredging/excavating in the areas where residual contamination would remain beneath the habitat layer, would be included as part of this alternative.

Because this alternative would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA requires 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 sediments and floodplain soils/sediments.

Alternative 3 (Ninemile Creek Reaches BC and CD)

Dredged/Excavated Volume for Disposal (cy):	59,000 (not including approximately 22,000 cy for potential re-use on site)
Mercury Mass Removed (pounds):	535
Capital Cost:	$18,900,000
Average O&M and Periodic Annual Costs:	$105,000
Present-Worth O&M and Periodic Costs:	$1,300,000
Present-Worth Cost:	$20,200,000
Construction Time:	2 years

Note: The costs above are based on disposal at the LCP Bridge Street subsite (Option A). The estimated cost for this Ninemile Creek alternative, assuming off-site disposal (Option B), for the volume above is $27.1 million.

Alternative 4 – Full removal of Ninemile Creek channel sediments and floodplain soils/sediments in Reaches BC and CD to a depth to meet criteria (0.15 mg/kg mercury and PRGs for other CPOIs) and placement of backfill and habitat layer

This alternative is consistent with Alternative C3(E)/FP3(E) in the FS, modified to reflect the new information described in the Supplemental FS report. Specific components of this alternative, as shown in Figure 12, include:

- **Ninemile Creek Channel (Reaches BC and CD):** 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 (1.8 m), with a maximum depth of about 16 ft (5 m). Backfill areas of removal and place a habitat layer with clean soil at the surface.

- **Ninemile Creek Floodplain (Reaches BC and CD):** Remove floodplain soil/sediment with mercury concentrations exceeding 0.15 mg/kg and other non-mercury CPOIs exceeding PRGs. Backfill the removal areas and place a habitat layer with clean soil to previous ground surface or a shallower depth to provide terrestrial or wetland habitat. As discussed above for Alternatives 2 and 3, removal in the Reach BC floodplain would be limited to soils above the structural armor stone.

This alternative is estimated to include the removal of 73,000 cy (56,000 m^3) of contaminated sediment and soil, over an area of approximately 14.7 acres (6 hectares) within and along Reaches BC and CD. It is estimated that this dredging and excavation would result in the removal of about 670 pounds (300 kg) of mercury from Ninemile Creek (or 100 percent of the estimated total mercury mass in Reaches BC and CD based on the lowest PRG for mercury). Removal areas for Alternative 4 are shown in Figure 17 for channel areas and Figure 18 for floodplain areas.

The remedial design will need to evaluate appropriate roadway, bridge, and rail structural stability and safety-related considerations, especially in Reach BC. These considerations may impose limitations on the depths and footprints of removals in the vicinity of transportation structures. As

a result, some isolation capping may be needed and therefore removal of 100 percent of the mass of mercury and other CPOIs may not be achievable.

The contaminated sediments and soils that are removed from the creek and floodplains would be disposed of at the LCP Bridge Street subsite containment system (Option A) or off-site at an existing off-site permitted landfill in the Rochester, New York, area (Option B).

It is estimated that the dredging/excavating, backfilling, and habitat layer placement components of this alternative, along with dewatering, water treatment, and transport/disposal of sediments and soils at the LCP Bridge Street subsite, would take three years.

Institutional controls may be needed for Alternative 4 depending upon transportation structure safety considerations that may impose limitations on excavations in the vicinity of highways, bridges, and rail lines which could require the installation of an isolation cap in these areas.

Alternative 4 (Ninemile Creek Reaches BC and CD)

Dredged/Excavated Volume for Disposal (cy):	73,000
Mercury Mass Removed (pounds):	670
Capital Cost:	$29,200,000
Average O&M and Periodic Annual Costs:	$60,000
Present-Worth O&M and Periodic Costs:	$800,000
Present-Worth Cost:	$30,000,000
Construction Time:	3 years

Note: The costs above are based on disposal at the LCP Bridge Street subsite (Option A). The estimated cost for this Ninemile Creek alternative, assuming off-site disposal (Option B), for the volume above is $38.7 million.

COMPARATIVE ANALYSIS OF DISPOSAL OPTIONS AND REMEDIAL ALTERNATIVES

During the detailed evaluation of remedial alternatives, each alternative is assessed against nine evaluation criteria: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; support agency acceptance; and community acceptance. The evaluation criteria are described below. A comparative analysis of the disposal options and remedial alternatives was performed, based on these nine criteria, and is presented in this section of the Proposed Plan.

The following ***"threshold criteria"*** are the most important and must be satisfied by any alternative in order to be eligible for selection:

1. ***Overall protection of human health and the environment*** addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. ***Compliance with ARARs*** addresses whether or not a remedy would meet all of the applicable or relevant and appropriate requirements of federal and state environmental statutes and regulations or provide grounds for invoking a waiver. Other federal or state advisories, criteria, or guidance are to-be-considered (TBCs). TBCs are not required by the NCP, but may be very useful in determining what is protective of a site or how to carry out certain actions or requirements.

The following ***"primary balancing criteria"*** are used to make comparisons and to identify the major tradeoffs among alternatives:

3. ***Long-term effectiveness and permanence*** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. ***Reduction of toxicity, mobility, or volume through treatment*** is the anticipated performance of the treatment technologies a remedy may employ, with respect to these parameters.

5. ***Short-term effectiveness*** addresses the period of time needed to achieve protection from any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. ***Implementability*** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. ***Cost*** includes estimated capital, operation and maintenance (O&M), and present-worth costs. Present-worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The following ***"modifying criteria"*** are used in the final evaluation of the remedial alternatives after the formal comment period, and may prompt modification of the preferred remedy that is presented in this Proposed Plan:

8. ***Support Agency acceptance*** indicates whether, based on its review of the RI/FS reports and Proposed Plan, NYSDOH concurs with, opposes, or has no comments on the preferred remedy.

9. ***Community acceptance*** refers to the public's general response to the alternatives described in the RI/FS reports and Proposed Plan.

A comparative analysis of the disposal options and the alternatives based upon the evaluation criteria noted above follows.

DISPOSAL OPTIONS

As discussed above in the "Description of Alternatives" section, the two disposal options evaluated in the FS and Supplemental FS include consolidating contaminated channel sediments and floodplain soils/sediments within the containment system at Honeywell's nearby LCP Bridge Street subsite (Option A) and disposing of contaminated channel sediments and floodplain soils/sediments at an existing off-site permitted landfill in the Rochester, New York, area (Option B).

Criterion 1: Overall Protection of Human Health and the Environment

Both disposal options would provide similar and adequate overall protection of human health and the environment by containing contaminated sediments and soils under a low-permeability cap and reducing or eliminating risks associated with direct contact with contaminated material.

Criterion 2: Compliance with ARARs

Both disposal options would be equally compliant with location-specific and action-specific ARARs.

Criterion 3: Long-Term Effectiveness and Permanence

Both disposal options would provide similar levels of acceptable long-term effectiveness and permanence. Consolidation of the removed material at the LCP Bridge Street subsite containment system or at an approved commercial facility would result in the permanent containment of contaminated channel sediments and floodplain soils/sediments. For the disposal option at the Honeywell LCP Bridge Street subsite, the contaminated channel sediments and floodplain soils/sediments would provide needed fill material for site closure.

Criterion 4: Reduction of Toxicity, Mobility, or Volume through Treatment

Consolidation within the containment system at the Honeywell LCP Bridge Street subsite or removal to a commercial facility off site would reduce the mobility of mercury and other CPOIs, although not through treatment. The reduction in mobility would be the same for consolidation at the Honeywell LCP Bridge Street subsite and removal to an approved commercial facility. Containment at either of the facilities would not reduce the toxicity or volume of mercury or other CPOIs in the removed channel sediments and floodplain soils/sediments.

Criterion 5: Short-Term Effectiveness

Consolidation and containment at the LCP Bridge Street subsite would provide the highest level of short-term effectiveness. The dominant short-term impact of off-site disposal of excavated sediments and soils from Ninemile Creek is truck traffic, which presents potential issues for noise, dust/exhaust, traffic congestion, and safety concerns for the local community. For consolidation and containment at the LCP Bridge Street subsite, truck traffic would be routed approximately one to two miles from the location of the dredging/excavation activities at the Site (depending on the reach where the soils/sediments are being removed) via easily accessible non-residential roads suitable for truck traffic. Therefore, this disposal option would have limited direct impact on the local community since the haul route is short and no residential roads would be used.

For disposal at an off-site landfill (assumed to be in the Rochester area, approximately 75 miles [120 km] away), the heavy truck traffic would have to use public roadways to transport the excavated sediments and soils. The remedial alternatives for Ninemile Creek would involve the disposal of 29,000 cy (22,000 m^3) of sediments and soils for Alternative 2, 59,000 cy (45,000 m^3) for Alternative 3, and 73,000 cy (56,000 m^3) for Alternative 4. Assuming 15 cy (11 m^3) per truckload, and the need for two trips (loaded and empty), the three action alternatives would require approximately 3,900 (Alternative 2), 7,900 (Alternative 3), and 9,700 (Alternative 4) truck trips through the community.

An added factor for this criterion is that the final closure for the containment system at the Honeywell LCP Bridge Street subsite requires additional fill to bring the final cap up to grade. If the sediments and soils from Ninemile Creek are used for this purpose, then an equal volume of fill material from off-site sources would not be required. Thus, if the sediments and soils from Ninemile Creek are disposed of at an off-site landfill, then an equal number of additional truck trips must be routed through the community for that volume as needed fill for the Honeywell LCP Bridge Street subsite. Therefore, on-site disposal directly avoids 3,900 to 9,700 truck trips through the community, but it also indirectly allows the avoidance of an additional 3,900 to 9,700 truck trips through the community for closure of the containment system at the LCP Bridge Street subsite. Thus, the use of an off-site landfill for disposal would cause a total of approximately 8,000 (Alternative 2), 16,000 (Alternative 3), or 19,000 (Alternative 4) truck trips on public roadways, all of which can be avoided by the use of the containment system at the Honeywell LCP Bridge Street subsite.

Criterion 6: Implementability

Both options are readily implementable technically and administratively. However, due to the shorter travel distances involved, consolidation at the Honeywell LCP Bridge Street subsite is slightly more implementable than consolidation to an off-site commercial facility in the Rochester area, such as the High Acres Landfill or the Ontario County Landfill.

Criterion 7: Cost

As shown in the tables in the “Description of Alternatives” section above, the total present-worth costs for off-site disposal for the Ninemile Creek OU1 alternatives evaluated in this Proposed Plan are approximately 25 to 35 percent greater than costs for disposal at the LCP Bridge Street subsite containment system (*i.e.*, $12.9 million versus $10.3 million for Alternative 2, $27.1 million versus $20.2 million for Alternative 3, and $38.7 million versus $30 million for Alternative 4). As presented in Appendix F of the Supplemental FS report, the unit cost (*i.e.*, price per cubic yard) for disposal at an off-site landfill ($146/cy) is approximately four times higher than for consolidation and disposal at the LCP Bridge Street subsite ($36/cy).

Criterion 8: Support Agency Acceptance

NYSDOH has reviewed this Proposed Plan and concurs with the preferred disposal option.

Criterion 9: Community Acceptance

Community acceptance of the preferred disposal option will be assessed in the ROD following review of the public comments received on the Geddes Brook/Ninemile Creek RI/FS reports and this Proposed Plan.

Preferred Disposal Option

Based upon the above analysis, Option A, consolidation and containment at the LCP Bridge Street subsite, is the preferred sediment management option based on consideration of the primary and balancing criteria and the cost disparity between consolidation within the LCP Bridge Street containment system and consolidation at a Rochester area commercial facility. On-site management at the existing LCP Bridge Street subsite containment system is a proven and reliable technology for sediment and waste management that protects human health and the environment. The consolidated sediments and soils would be contained at the LCP Bridge Street subsite beneath a 6 NYCRR Part 360 equivalent low-permeability cap covering approximately 18 acres (7 hectares). The area is currently surrounded by a subsurface barrier (slurry) wall to contain contaminated groundwater that would be collected and treated. Additional information on the cap and containment/collection system can be found in the ROD and the remedial design documents for the LCP Bridge Street subsite.

The contaminated channel sediments and/or floodplain soils/sediments would provide needed fill material for the LCP Bridge Street subsite closure and would not negatively impact the property's future development potential. The LCP Bridge Street subsite cap area would be maintained and monitored in the same manner whether or not it contains contaminated materials from the Geddes Brook/Ninemile Creek site. As discussed above, management of the dredged/excavated channel sediments and floodplain soils/sediments in a containment system at the LCP Bridge Street subsite would also be more cost-effective than off-site disposal for the removal volumes needed and would involve fewer impacts on the community (*e.g.*, less truck traffic, lower potential for risks of an accident or spill during transport).

Therefore, the following discussion of the comparison of the remedial alternatives against the evaluation criteria assumes that the dredged/excavated channel sediments and floodplain soils/sediments would be disposed of at the LCP Bridge Street subsite containment system.

REMEDIAL ALTERNATIVES

Criterion 1: Overall Protection of Human Health and the Environment

Alternative 1, the "no action" alternative, would not actively address risks to human health and the environment posed by contaminated sediments, soils, water, and biota in Ninemile Creek because it would not reduce or control risk to receptors or the further transport of CPOIs at the Site. The RAOs and PRGs would not be met under this alternative.

All of the alternatives, with the exception of Alternative 1, would achieve the RAOs established for the Site. However, Alternative 2 would not achieve all of the PRGs. The three action alternatives (Alternatives 2 through 4) would be protective of human health and the environment because they would reduce or eliminate existing and potential future adverse ecological effects on fish and wildlife resources and potential risks to humans (RAO 2), achieve, to varying degrees, CPOI concentrations in fish tissue that are protective of humans and wildlife that consume fish (PRG 3), achieve, to varying degrees, CPOI concentrations in channel sediments that are protective of human health and fish and wildlife resources (PRG 2), and reduce, contain, or control CPOI concentrations in erodible channel sediments (RAO 1 and PRG 1). The remediation of sediments and soils under these alternatives is expected to achieve surface water quality standards for CPOIs (RAO 3 and PRG 4).

Alternative 2 is predicted to slightly exceed the post-remediation surface area-weighted average concentration (SWAC)-based mercury target for floodplain soil/sediment in Reach BC and the post-remediation SWAC-based target for PCBs (wildlife bioaccumulation screening value) in Reaches BC and CD channel sediments, but would meet all other SWAC-based sediment targets for protection of bioaccumulation and direct contact (by humans). Alternatives 3 and 4 would 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 mercury concentrations in fish and, consequently, reduced risk to humans and ecological receptors from fish consumption.

Alternatives 2 through 4 would 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 these alternatives. The reduction in PCB and PCDD/PCDF concentrations in sediment as a result of these alternatives 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.

In the Ninemile Creek channel, Alternative 2 provides protectiveness by removal of material with concentrations that exceed 1.3 mg/kg mercury and point-by-point targets for all other CPOIs within the top 3 ft (90 cm) and replacement with a chemical isolation layer and a habitat layer. This alternative would also address 76 percent and 69 percent of the Ninemile Creek surface that exceeds 0.5 and 0.15 mg/kg mercury, respectively (resulting from exceedances of PRGs for other CPOIs).

Alternative 3 through a combination of removals, capping, backfilling, and/or habitat layer placement addresses all of the point-by-point sediment targets for mercury in the stream channel. Alternative 4 also addresses all of the sediment target values for mercury in the channel via removal of all sediment to achieve a residual of less than 0.15 mg/kg mercury (*i.e.*, essentially to concentrations near or below background).

In the Ninemile Creek floodplain, Alternative 2 provides a degree of protectiveness by removal of up to 2 ft (60 cm) 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 (60 cm) of clean soil. This alternative would also address 54 percent and 35 percent of the floodplain that exceeds 0.5 and 0.15 mg/kg mercury, respectively (resulting from exceedances of PRGs for other CPOIs).

Following removals and placement of a clean habitat layer, Alternatives 3 and 4 address 100 percent of the surficial floodplain exceeding point-by-point sediment targets.

Although not targets, NYSDEC's 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. For the top 2 ft (60 cm) of soil/sediment, Alternative 2 is not as effective as Alternatives 3 and 4 in addressing these screening criteria. Alternative 2 would address 93, 91, and 99 percent of the Ninemile Creek channel and 82, 88, and 87 percent of the floodplain exceeding these three criteria, respectively. Alternatives 3 and 4 would address 100 percent of the area exceeding these three criteria in the Ninemile Creek channel and floodplain. As discussed in Appendix A of the Supplemental FS report, 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 Site.

Certain institutional controls would be needed for Alternatives 2 and 3 to ensure that any future construction or other activities do not remove or disrupt the isolation caps and/or habitat layer.

These types of institutional controls may also be needed for Alternative 4 depending upon transportation structure safety considerations that may impose limitations on excavations in the vicinity of highways, bridges, and rail lines which could require the installation of an isolation cap in these areas.

Alternative 3 would achieve the RAOs established for the Site. Alternative 3 would be protective of benthic macroinvertebrates, because for the top 2 ft (60 cm) of channel sediment and floodplain soil/sediment (which are predominantly wetlands), it would meet all sediment toxicity targets for mercury in all areas. As previously discussed, the goal is that the concentrations of the clean material used for the habitat layer within the top 2 ft (60 cm) would meet the lowest PRG for mercury in channel sediment areas (0.15 mg/kg) and the Part 375 unrestricted use soil cleanup objectives for floodplain areas. This alternative would also meet the sediment toxicity targets for arsenic, lead, total PAHs, PCBs, hexachlorobenzene, and phenol within the habitat layer.

Alternative 4 would achieve the RAOs established for the Site. Implementation of Alternative 4 would be expected to remove all of the contamination from the Site, to the extent feasible. Following the removals, channel and floodplain areas would be backfilled and a habitat layer with clean soil placed. As discussed earlier, some isolation capping may be needed in Reach BC in consideration of limitations on excavations in the vicinity of highways, bridges, and rail lines. Similar to Alternative 3, Alternative 4 would be protective of benthic macroinvertebrates because for the top 2 ft (60 cm) of soil/sediment, the goal is to meet all four sediment toxicity targets for mercury and meet sediment toxicity targets for arsenic, lead, total PAHs, PCBs, hexachlorobenzene, and phenol.

Criterion 2: Compliance with ARARs

As there are currently no federal or state promulgated standards for contaminant levels in sediments, the sediment PRGs would be used as TBC criteria. For soils, New York State has recently issued soil cleanup objectives for remedial programs (6 NYCRR Part 375.6). The unrestricted use soil cleanup objectives represent the concentration of a contaminant in soil which, when achieved at a site, would require no use restrictions on the site for the protection of public health, groundwater and ecological resources due to the presence of contaminants in the soil. For surface water, New York State has promulgated standards which are enforceable standards for various surface water contaminants.

In general, Alternatives 2 to 4 would be expected to comply with all of the designated chemical-specific ARARs to the extent practicable, while Alternative 1 (no action) would not, since there would be no active remediation associated with the sediments or soils.

As discussed in the RI/FS, for surface water, two of the four New York 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. The New York State surface water quality standards for mercury for protection of wildlife is 2.6 ng/L dissolved mercury and the standard for protection of human health (via fish consumption) is 0.7 ng/L dissolved mercury. As discussed previously, dissolved total mercury was not detected in lower Ninemile Creek and was detected at 1.4 ng/L in lower Geddes Brook and up to 57 ng/L in the West Flume during low-flow conditions in 1998. The remediation of the LCP Bridge Street subsite (including the West Flume and associated ditches and wetland areas), and following remediation of lower Geddes Brook and lower Ninemile Creek, it would be expected that concentrations of dissolved mercury would be less than the standards during low-flow conditions. Data for dissolved mercury are not available during high-flow conditions. If the post-remediation monitoring indicated that, due to other sources, it was technically

impracticable to consistently meet these standards during high flows, an ARAR waiver might be needed.

During remedy implementation, any short-term exceedances of surface water ARARs in Ninemile Creek or Geddes Brook due to dredging/excavation or capping would be expected to be limited to the area in the vicinity of the work zone. Sufficient engineering controls would be utilized during dredging/excavation and capping to prevent or minimize exceedances of surface water ARARs outside of the work zone. Furthermore, compliance with the discharge limits (to be established by NYSDEC if needed) should ensure that there are no exceedances of surface water ARARs caused by the discharge from on-site water treatment.

The primary location-specific ARARs applicable to the remediation are ECL Article 24 Freshwater Wetlands, ECL Article 15 Use and Protection of Waters, and Clean Water Act (CWA) Section 404. For freshwater wetlands, 6 NYCRR Part 663 regulates activities conducted in or adjacent to regulated wetlands. Article 15 is implemented by 6 NYCRR Part 608 which regulates alterations to beds and banks of streams such as dredging and filling.

CWA Section 404 includes requirements related to the discharge of dredged or fill material into navigable waters of the U.S. and prohibits activities which adversely affect an aquatic ecosystem, including wetlands. In addition, Superfund actions must meet EPA's 1985 Policy on Floodplains and Wetland Assessments for CERCLA Actions, and EPA's Protection of Wetlands Executive Order 11990. The policy memorandum discusses situations that require preparation of a floodplains or wetlands assessment, and the factors that should be considered in preparing an assessment, for response actions taken pursuant to Section 104 or 106 of CERCLA. Executive Order 11990 addresses long- and short-term adverse impacts associated with the destruction or modification of wetlands and seeks to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

Since all of the alternatives except the "no action" alternative include dredging/excavation and capping and/or backfilling, and habitat layer placement within the creek, the final design of the remedy must meet the substantive requirements of the applicable regulations. Alternatives that restore appropriate habitat and function, do not result in unacceptable changes in water depth or the loss of stream surface area, and do not diminish natural resource values throughout the creek would more readily meet the requirements. All of the alternatives except the "no action" alternative are expected to comply with all of the designated location-specific and action-specific ARARs, to varying degrees. The development of a habitat restoration plan is essential to provide an evaluation of the selected alternative's ability to meet the requirements of Articles 15 and 24 and develop appropriate bathymetry and habitat restoration requirements for each reach.

Although there are no chemical-specific ARARs for sediment, the two lowest PRGs for mercury in sediments (0.15 and 0.5 mg/kg) would not be met in portions of the Site under Alternative 2. Since the entire area of the Site within the well-defined steep banks would be remediated under Alternatives 3 and 4, with use of clean soils in both channel and floodplain areas at the surface, the goal of concentrations within the top 2 ft (60 cm) would be less than the lowest mercury PRG of 0.15 mg/kg for sediments within the entire remedial area.

The NYSDEC Part 375 unrestricted use soil cleanup objective of 0.18 mg/kg for mercury would apply to clean surface soil being placed in those areas of the floodplain not expected to be wetland (*i.e.*, upland). Alternative 1 ("no action") would not comply with the Part 375 unrestricted use soil cleanup objective in the floodplain soils, since there would be no active remediation. Under Alternative 2, the NYSDEC Part 375 unrestricted use soil cleanup objective of 0.18 mg/kg for

mercury would not be met in areas not being remediated (*i.e.*, areas having mercury concentrations between 0.18 and 1.3 mg/kg at the floodplain surface). For Alternatives 3 and 4, it would be expected that all ARARs and PRGs (TBCs) for CPOIs would be met.

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

Criterion 3: Long-Term Effectiveness and Permanence

Alternative 1 would be neither effective in the long-term nor permanent because the potential for further 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 time frame.

Alternatives 2, 3, and 4 all provide long-term effectiveness and permanence. All caps and habitat layers used in Alternatives 2 and 3, and potentially limited capping near structures in Alternative 4, 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 cap placement/installation to provide for the long-term effectiveness of the cap system. Proven techniques are available to provide for the adequacy and reliability of the remedy through its design and construction, and implementation of a long-term operation and maintenance program.

A discussion of additional factors related to this evaluation criterion is provided below.

Permanence and Adequacy and Reliability of Controls

Alternative 4 provides the greatest permanence by removing more of the sediments and soils that exceed toxicity-based cleanup criteria than the other alternatives. Alternatives 2 and 3 incorporate removal of contaminated sediments and soils prior to capping. Alternative 3 would remove about twice as much sediment and soil as Alternative 2, and approximately 20 percent less than Alternative 4. Alternatives 2 and 3 include an isolation cap (sediments) and habitat layer (floodplain soils), which are key components of these alternatives' protectiveness. Alternative 4 may include some limited isolation capping in Reach BC around structures.

As the extent of isolation capping decreases relative to Alternatives 4, 3, and 2, the relative degree of permanence and reliability of the given alternative increases. Therefore, Alternative 4, which would attempt to remove the maximum amount of contaminated sediments and soils is regarded as the most permanent and reliable. However, insofar as Alternative 4 may still need to include some isolation capping and the extent of isolation capping under Alternative 3 is uncertain in portions of the Site and may be very limited, the difference in degrees of permanence and reliability between these two alternatives is also unclear. Alternative 2, which specifies isolation capping based upon the corresponding cleanup target values is clearly less permanent and reliable than Alternatives 3 and 4.

For the contaminated sediments and soils that would be left at the Site under Alternatives 2 and 3, and potentially Alternative 4, the isolation cap would be designed to ensure long-term chemical isolation, including provisions to prevent ice scour and other types of erosion and provisions to ensure structural integrity. There would be development and implementation of a monitoring and

maintenance program to ensure that the integrity and effectiveness of the cap and habitat layer are maintained. Therefore, although complete removal of contaminated sediments, to the extent practicable, would be most permanent and reliable, capping as needed would still achieve a high degree of permanence and reliability.

Reduction of Residual Risk

Residual risk in Ninemile Creek can be evaluated on the basis of direct toxicity, bioaccumulation, and potential for recontamination. Since Alternative 1 would involve no active remedial measures, it would not effectively reduce residual risk.

Alternative 2 would remediate all areas which exceed the mercury PRG of 1.3 mg/kg, leaving some areas below 1.3 mg/kg unremediated. Alternatives 3 and 4 would address all areas exceeding the lowest mercury PRG of 0.15 mg/kg within all channel areas and within the well-defined steep banks of the floodplain.

The cleanup criteria address sediment toxicity to benthic macroinvertebrates. For those areas that are capped, concentrations of CPOIs in the clean habitat layer overlying the isolation cap are expected to remain low enough to reduce toxicity. Based on this criterion of direct toxicity, all three action alternatives would be protective. However, Alternatives 3 and 4 are similar in that they would provide a greater degree of confidence in the protectiveness of the alternative, as compared to Alternative 2.

Alternatives 3 and 4 would also meet the bioaccumulation-based PRGs. Mercury concentration goals in sediments of 0.8 mg/kg and in soil of 0.6 mg/kg were developed for the Site to address bioaccumulation concerns (see the text boxes entitled “Sediment Quality Values for Channel Sediments and Floodplain Soils/Sediments to Protect from Bioaccumulation and Direct Contact” [pages 56 and 57]). To determine whether the alternatives (which were developed based on direct toxicity goals) meet the bioaccumulation goals for mercury, the estimated post-remediation SWAC in each reach for each alternative was compared to the 0.8 mg/kg or 0.6 mg/kg goals. This was done on an area-weighted basis (*i.e.*, by reach rather than point-to-point) since animals that bioaccumulate mercury, such as fish, are not limited to a specific location of the Site. Bioaccumulation-based PRGs, based on NYSDEC sediment screening criteria, were also evaluated for PCBs (0.03 mg/kg) and hexachlorobenzene (0.25 mg/kg) in channel sediments. A direct contact-based PRG for benzo(a)pyrene (1.3 mg/kg) was also evaluated.

The predicted post-remediation SWACs in Reaches BC and CD for Alternatives 3 and 4 would meet the bioaccumulation-based or direct-contact-based PRGs for mercury, PCBs, benzo(a)pyrene, and hexachlorobenzene assuming 1.25-ft (38-cm) and 1.75-ft (53-cm) thick isolation layers in Reaches BC and CD for Alternative 3. For Alternative 2, the predicted post-remediation SWACs for mercury in Reaches BC and CD in channel sediments would meet the bioaccumulation-based PRGs assuming 1.25-ft (38-cm) and 1.75-ft (53-cm) thick isolation layers in Reaches BC and CD (see Table 3-3 of the Supplemental FS report). However, the predicted post-remediation SWACs for PCBs in Reaches BC (0.04 mg/kg) and CD (0.05 mg/kg) channel sediments for Alternative 2 would slightly exceed the bioaccumulation-based PRG for PCBs in sediment (0.03 mg/kg). For floodplain soils, the predicted post-remediation SWAC for mercury in Reach BC under Alternative 2 would slightly exceed the soil-based PRG of 0.6 mg/kg (see Table 3-4 of the Supplemental FS report). Post-remediation SWACs were not estimated in the floodplains for Alternative 3 because the entire floodplain area would be covered with clean fill materials that met bioaccumulation-based PRGs. Post-remediation SWACs were also not estimated for Alternative 4 because attainment of the associated mercury toxicity-based PRG of 0.15 mg/kg

would result in concentrations at or below background that would also meet the bioaccumulation-based PRGs. Thus, Alternatives 3 and 4 provide a greater degree of confidence in the protectiveness of the alternative with respect to reduction of residual risk, as compared to Alternative 2.

Criterion 4: Reduction of Toxicity, Mobility, or Volume through Treatment

No treatment would be performed under Alternative 1; therefore, there would be no reduction of toxicity, mobility, or volume through treatment.

As discussed in the "Description of Alternatives" section, there would be on-site treatment of water generated from excavated sediment and soil using a temporary treatment system for the action alternatives. However, this treatment is not expected to reduce the concentrations of mercury and other CPOIs within the sediments and soils.

Implementation of Alternative 2 would result in the removal of approximately 29,000 cy (22,000 m^3) of contaminated sediments and soils and approximately 450 pounds (200 kg) of mercury from Reaches BC and CD of Ninemile Creek (approximately 67 percent of the total mercury mass in Reaches BC and CD channel and floodplains), significantly reducing the toxicity, mobility, and volume of contaminated sediments and soils. The isolation cap and habitat layer, installed following the removals, would reduce the mobility of residual concentrations in sediments and soils, although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal/isolation and containment rather than treatment.

Implementation of Alternative 3 would result in the removal of approximately 59,000 cy (45,000 m^3) of contaminated sediments and soils and approximately 535 pounds (242 kg) of mercury from Reaches BC and CD of Ninemile Creek (approximately 80 percent of the total mercury mass in Reaches BC and CD channel and floodplains), significantly reducing the toxicity, mobility, and volume of contaminated sediments and soils. Note that this estimate of mercury mass removal (535 pounds [242 kg]) includes about 370 pounds (167 kg) of mercury from the Reach CD channel and floodplain (55 percent of the total mercury mass in the Reaches BC and CD channel and floodplain), 150 pounds (68 kg) of mercury from the Reach BC channel (22 percent of the total mass in the Reaches BC and CD channel and floodplain), and 15 pounds (7 kg) from the Reach BC floodplain (3 percent of the total mass in the Reaches BC and CD channel and floodplain). For the Reach BC channel, the estimated mass removed is based on an average of 3 ft (90 cm) of removal over the entire reach.

For Alternative 3, the residuals that would remain following removals in Reach CD (generally less than 1 mg/kg to about 5 mg/kg) would typically be one to two orders-of-magnitude lower than the maximum concentrations currently found at the Site (over 100 mg/kg). The habitat layer, installed following the removals, would comprehensively cover the Site and reduce the mobility of residual concentrations in sediments and soils, although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal/isolation and containment rather than treatment.

Implementation of Alternative 4 would result in the removal of approximately 73,000 cy (56,000 m^3) of contaminated sediments and soils and approximately 670 pounds (300 kg) of mercury from Reaches BC and CD of Ninemile Creek (100 percent of the mercury mass in Reaches BC and CD channel and floodplains above the lowest PRG), significantly reducing the toxicity, mobility, and volume of contaminated sediments and soils, although the reduction of toxicity, mobility, and volume at the point of exposure is achieved through removal and containment rather than treatment.

Alternative 3 would remove about twice as much contaminated sediment and soil as Alternative 2, and approximately 20 percent less than Alternative 4 (59,000 cy [45,000 m^3] compared to 73,000 cy [56,000 m^3]). Thus, on the basis of the amount of contaminated sediment and soil removed and placed in a secure facility, Alternative 2 would result in much less reduction in mobility and toxicity than Alternatives 3 and 4, while Alternative 3 would result in a slightly lower reduction in mobility and toxicity than Alternative 4.

Alternatives 2 and 3 also include the placement of an isolation cap beneath the habitat layer in the channel and a clean habitat layer in the floodplain to isolate any residual concentrations of mercury (or other contaminants). These layers would be engineered to withstand foreseeable erosion/disruption of the cover system. In addition, the concentrations of the residual contamination beneath the cap and habitat layer would be significantly lower than the existing maximum concentrations, providing for some reduction in the toxicity and mobility of those residuals. Because Alternative 3 provides for a clean habitat layer throughout the entire remedial area with an isolation cap, where needed, and removes more of the existing contamination (including hot-spot removal and relocation of a portion of Reach CD into cleaner areas), Alternative 3 would result in a greater reduction in toxicity and mobility of the Site contamination than Alternative 2. However, as the residual sediments and soils would be left in the environment and therefore present some small risk of releases higher than predicted, Alternative 4, which relies on removal, to the extent practicable, to a depth to meet cleanup criteria, would be expected to present a slightly greater reduction in toxicity, mobility, and volume of contaminated sediments and soils than Alternative 3. However, insofar as Alternative 4 may still need to include some isolation capping and the extent of isolation capping under Alternative 3 is uncertain in portions of the Site and may be very limited, the difference in degrees of reduction in toxicity, mobility, and volume between these two alternatives is also unclear. Alternative 2, which specifies isolation capping based upon the corresponding cleanup target values, clearly provides less reduction in toxicity, mobility, and volume than Alternatives 3 and 4.

EPA's Preference for Treatment

The NCP states that EPA expects to use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430 [a][1][iii][A]). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for the migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

As noted above, the contaminated sediments and soils within the Site contain hazardous substances, pollutants, or contaminants that have migrated from the LCP Bridge Street subsite. Although contaminated sediments/soils are present at the Site, the concentrations are generally lower than the levels found on the LCP Bridge Street subsite. Thus, these contaminated sediments and soils would not be considered "source materials" or "principal threat wastes." Although non-aqueous phase liquids (NAPLs) were evident in four sediment samples from lower Geddes Brook and lower Ninemile Creek based on sediment coring conducted during the RI/FS (see RI report Section 5.2.3.6), the amount of NAPLs observed were small and would not constitute a significant source. However, the implementation of these alternatives would include the off-site treatment and/or disposal of NAPLs, if any, that may be segregated during the dredging/handling process.

Criterion 5: Short-Term Effectiveness

Environmental Impacts

Alternative 1 ("no action" alternative) does not include any active remediation and, therefore, would not present any potential adverse impacts to on-site workers, the environment, or the community as a result of its implementation. However, as previously noted, unacceptable risks to human health and the environment posed by contaminated sediments and soils, water, and fish in the creeks would continue to occur.

In general, short-term effectiveness risks are proportional to the volume of materials excavated and the duration of work. Thus, these impacts are least for Alternative 2 and greatest for Alternative 4. The estimated volumes of materials to be excavated from Ninemile Creek for Alternatives 2, 3, and 4 are approximately 29,000 cy (22,000 m^3), 59,000 cy (45,000 m^3), and 73,000 cy (56,000 m^3), respectively. The estimated remedial construction durations for Alternatives 2, 3, and 4 are approximately one, two, and three years, respectively.

For all of the action alternatives, potential short-term risks associated with sediment dredging and related activities in the channel include resuspension of channel sediment, related potential impacts to water quality, and temporary loss of aquatic and upland habitats within and near work areas. For Alternatives 2, 3, and 4, the durations of sediment dredging and associated installation and removal of sheet piling, where needed, for Ninemile Creek Reaches BC and CD would be approximately 13 weeks, 44 weeks (two construction seasons), and 90 weeks (three construction seasons), respectively.

As a result of its deeper removals (up to a depth of 16 ft [5 m] into the sediments), Alternative 4 would require installation and removal of significantly (around ten times) more sheet pile than Alternative 3, which contributes added short-term risks of potential adverse water quality impacts relative to Alternatives 2 and 3. Under each action alternative, the short-term risks of water quality impacts would be mitigated through the use of best management dredge practices (*e.g.*, the use of environmental buckets where feasible), silt curtains placed downstream from the dredge site, and potentially other resuspension controls, including temporary stream diversions. Under Alternative 3, flow diversion into the relocated channel prior to excavation in the adjacent contaminated work areas affords a more reliable means for reducing the potential for resuspension and mobilization of contaminated sediments.

Additional information on construction scheduling for these alternatives can be found in Appendix F of the Supplemental FS report.

Other short-term risks associated with sediment dredging, floodplain soil/sediment excavation, and installation of a cap and habitat layer, 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 sediment/soil consolidation area. These types of risks, however, are common to many remedial and heavy construction projects and would be mitigated to the extent feasible.

The sediment and soil removals under the action alternatives 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 temporary and offset by the positive long-term effects of clean materials for benthic habitat.

Community Impacts

Alternatives 2, 3, and 4 could present some limited adverse impacts to on-site workers through dermal contact and inhalation related to dredging activities. Noise from the dredging/excavation work processes could present some limited adverse impacts to on-site workers and nearby residents, although the nearest residents are over half-a-mile away and would likely not be affected. In addition, post-dredging sampling activities may pose some risk to on-site workers. Another potential adverse impact associated with dredging would be odors associated with the dredged sediments. The risks to on-site workers and nearby residents under all of the alternatives could be mitigated by following appropriate health and safety protocols, exercising sound engineering practices, and utilizing proper protective equipment.

Alternatives 2, 3, and 4 would require the transport of increasing amounts of material, which may involve use of local roadways and would cause increased traffic. For transport of dredged/excavated sediments from Reaches BC and CD of Ninemile Creek to the LCP Bridge Street subsite containment system, it is anticipated that only non-residential roads suitable for truck traffic would be used. During remedial design, various means would be evaluated to minimize potential adverse impacts (*e.g.*, traffic, odors associated with dredged sediments) on the community.

The public would be excluded from the work areas of Ninemile Creek during remediation, with the duration of this impact estimated as one, two, and three years for Alternatives 2, 3, and 4, respectively.

Criterion 6: Implementability

No remedial actions would be implemented in Ninemile Creek under Alternative 1.

Sediment dredging, floodplain soil excavation, and placing clean materials on floodplains and through surface water have been implemented at other sites. Construction of temporary haul roads, removal of floodplain soil/sediment, construction and operation of sediment dewatering 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. The dredging would be moderately difficult to implement due to the challenges of accurate removal and mitigating re-suspension of sediment and potential impacts to water quality. However, accurate dredge cuts can be made using modern dredging/excavation equipment. In addition, 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), silt curtains downstream from the dredge site, and potentially other resuspension controls, including temporary stream diversions.

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 cap and habitat layer materials in these discrete areas.

For Alternative 2, it is not anticipated that sheet pile would be required to remove sediment and install the isolation cap, which would include removals generally less than 4 ft (1.2 m).

The implementability of Alternative 3 would be similar to Alternative 2, as discussed above. However, Alternative 3 includes the realignment of Reach CD to facilitate remedy implementation (*i.e.*, relocate the channel to an area where the soils at depth are anticipated to be uncontaminated to eliminate or minimize the need for an isolation cap) and to create a vegetated buffer for the stream from the wastebeds. A goal of the restoration and establishment of the new channel would include providing connectivity of the stream with the surrounding floodplain and the establishment of diverse habitats (*e.g.*, vernal pools, forested floodplains).

For Alternative 3, removal of contaminated sediment from a large portion of Ninemile Creek would be performed by excavation after the creek surface water has been diverted. Diversion of creek water and excavation of new or widened/deepened 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. The deep excavations associated with the construction of the new channel alignment within the floodplain of Reach CD would be performed by sloping of the excavation side walls, mitigating or eliminating the need for extensive sheeting under Alternative 3.

Sediment removal by dredging is anticipated in Reach CD upstream of and near the large island and in Reach BC. As discussed for Alternative 2, dredging would be moderately difficult to implement, and potentially more difficult to implement than Alternative 2 due to the deeper removals. However, it is not anticipated that extensive sheet pile would be needed to complete the channel removals in most of the areas (in general, less than 6 ft [1.8 m] removals are anticipated within the existing channel).

For Alternative 4, removal of contaminated sediment from Ninemile Creek to reach the PRGs would require removals to depths averaging 6 ft (1.8 m), and up to 16 ft (5 m). Removals to such depths would require structural support to prevent failure of the creek banks and adjacent infrastructure. Safety considerations might preclude excavations in the immediate vicinity of bridge piers or footings below certain depths under Alternative 4 and therefore require installation of an isolation cap in such areas. As a result, Alternative 4 may not be fully implementable in portions of Reach BC.

Criterion 7: Cost

The cost estimates for both channel sediments and floodplain soils/sediments presented in this Proposed Plan are based upon capital (construction) costs and the present-worth of the annual O&M costs calculated using a discount rate of 7 percent and a 30-year time interval. The actual costs would vary depending on the specifications contained in the detailed remedial design. Further, the actual costs would also vary because the cost estimates provided are developed conservatively and have an accuracy of +50 percent to -30 percent, to comply with the 1988 EPA guidance document, “Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.”

In general, the cost of each alternative increases with increases in the footprint of the remediated area and with the volumes and depths of sediments and soils removed, as follows:

- There is no cost associated with Alternative 1, the “no action” alternative.

- The estimated present-worth cost for Ninemile Creek Reaches BC and CD for Alternative 2, which includes partial removal of contaminated channel sediments and floodplain soils/sediments and construction of an isolation cap and habitat system, is $10,300,000.

- The estimated present-worth cost for Ninemile Creek Reaches BC and CD for Alternative 3, which includes a greater volume of removal of contaminated channel sediments and floodplain soils/sediments as compared to Alternative 2 and a larger remedial footprint (but the same as Alternative 4), is $20,200,000.

- The estimated present-worth cost for Ninemile Creek Reaches BC and CD for Alternative 4, which includes full removal (versus partial removal and capping) of contaminated channel sediments and floodplain soils/sediments, is $30,000,000.

Costs for Alternatives – Ninemile Creek Reaches BC and CD

Alternative	Capital Cost	Average O&M and Periodic Annual Cost	Present-Worth O&M and Periodic Cost	Present-Worth Cost
1	$0	$0	$0	$0
2	$9,200,000	$88,000	$1,100,000	$10,300,000
3	$18,900,000	$105,000	$1,300,000	$20,200,000
4	$29,200,000	$60,000	$800,000	$30,000,000

Criterion 8: Support Agency Acceptance

NYSDOH has reviewed this Proposed Plan and concurs with the preferred remedy.

Criterion 9: Community Acceptance

Community acceptance of the preferred remedy will be assessed in the ROD following review of the public comments received on the Geddes Brook/Ninemile Creek RI/FS reports and this Proposed Plan.

PREFERRED REMEDY – ALTERNATIVE 3, REMOVAL, PLACEMENT OF AN ISOLATION CAP OR BACKFILL, AND PLACEMENT OF A HABITAT LAYER

The preferred remedy, Alternative 3, for the Ninemile Creek portion of Operable Unit 1, along with the pending Geddes Brook IRM, addresses the RAOs and PRGs for mercury and other CPOIs and would result in a long-term reduction in the toxicity, mobility, and volume of the key contaminants in Geddes Brook and Ninemile Creek, namely, mercury, arsenic, lead, hexachlorobenzene, phenol, PAHs, PCBs, and dioxins/furans. Alternative 3 is preferred over Alternative 4 because it provides

the same overall protection of human health and the environment and compliance with ARARs as Alternative 4 but at significantly less cost ($20.2 million versus $30 million). Alternative 3 also presents less short-term risks and is more implementable than Alternative 4. While Alternative 3 relies on aquatic isolation capping in some areas of Ninemile Creek, the design, construction, monitoring, and maintenance of the isolation caps would ensure their reliability and long-term effectiveness. Also, some isolation capping could be needed in Reach BC under Alternative 4 as well, due to excavation restrictions that may be required for safety reasons in the vicinity of highway and railroad bridge piers/footings.

The preferred remedy addresses all areas of OU1, as described in this Proposed Plan, such that the top 2 ft (60 cm) of sediments and soils would consist of clean material. The goal for the concentrations of this clean material for mercury, other CPOIs, and other constituents would be NYSDEC's sediment criteria (including the LEL of 0.15 mg/kg for mercury) in sediments and 6 NYCRR Part 375 unrestricted use soil cleanup objectives (including the objective of 0.18 mg/kg for mercury) in soils. Clean soil would include imported fill materials from off-site sources. Also, if it is determined by NYSDEC during design that soil excavated during construction of the new Geddes Brook or Ninemile Creek channel alignments is suitable material, this soil may be used for backfill (*e.g.*, for depths below the top 2 ft [60 cm] of habitat layer material). The preferred remedy would also attain a 0.8 mg/kg site-specific BSQV for mercury in sediments for protection of wildlife consumption of fish and 0.6 mg/kg site-specific BSQV for mercury in floodplain soils for protection of wildlife consumption of terrestrial invertebrates. The preferred remedy is also intended to achieve fish tissue mercury concentrations ranging from 0.1 mg/kg, which is for protection of ecological receptors, to 0.3 mg/kg, which is based on EPA's methylmercury National Recommended Water Quality criterion for the protection of human health from elevated risks due to consumption of organisms.

Specific components of the preferred remedy, as shown in Figure 11, are summarized below.

- **Ninemile Creek Channel (Upper Reach CD)**: Remove approximately 3 to 6 ft (0.9 to 1.8 m) of contaminated sediment from the upper Reach CD channel to allow for channel remediation, which includes channel realignment and habitat restoration. These removals would also need to ensure that there would be no adverse increases in water elevations and extent of flooding in accordance with applicable requirements. Upstream of the large island, approximately 3 to 4 ft (0.9 to 1.2 m) of sediment would be removed. In the vicinity of the large island, as shown in Figure 11, the southern channel would be widened and deepened to carry the entire creek flow and the northern channel would be backfilled and a habitat layer placed with clean material, to create a floodplain/wetland buffer between Wastebeds 9 and 10 and Ninemile Creek. The exact channel alignment, depth, and width would be determined in design using natural channel design techniques to establish a stable channel with minimal channel and bank hardening, to the extent feasible. A habitat layer would be installed in the new channel. For purposes of this Proposed Plan, the habitat layer is assumed to be at least 2-ft (60-cm) thick. A preliminary hydrodynamic analysis completed for the Supplemental FS indicates that a 4-ft (1.2-m) deep (on average) channel would be required to convey the creek through this reach. Excavations to obtain sufficient finished channel dimensions and to provide for a habitat layer would result in about 6 ft (1.8 m) of removal in this portion of the channel adjacent to the large island.

Within the engineering/feasibility constraints of these removals, the need for an isolation cap within Reach CD would be eliminated or minimized[13]. The nature and vertical extent of contamination in upper Reach CD may not require the installation of a chemical isolation layer following these removals (based on an evaluation of design and post-excavation sampling data); however, if required based on evaluation of these data, the habitat layer would be underlain with a chemical isolation layer. For the purposes of the Supplemental FS, it was determined that the underlying chemical isolation layer would need to be 1.75-ft (53-cm) thick in Reach CD, where needed, to meet the lowest PRG for mercury and the PRGs for other CPOIs at the bottom of the habitat layer at 1,000 years or steady state (whichever happens first).

- **Ninemile Creek Channel (Lower Reach CD):** Relocate lower Reach CD (which currently extends from just downstream of the large island to the downstream end of Reach CD) to the southern portion of the floodplain to create a floodplain/wetland buffer between the wastebeds and Ninemile Creek, as shown in Figure 11. This removal might require excavations as deep as 12 ft (3.7 m) (see Appendix C of the Supplemental FS report) in order to provide capacity for water flow in the new channel. Sufficient removals would be conducted to ensure no adverse increases in water elevations and extent of flooding in accordance with applicable requirements. The exact channel alignment, depth, and width would be determined in design using natural channel design techniques to establish a stable channel with minimal channel and bank hardening, to the extent feasible. Install a habitat layer (as described above) in the new channel. Based on the removals required for the new channel, it is not anticipated that a chemical isolation layer would be needed below the habitat layer.

- **Ninemile Creek Channel (Reach BC):** Remove an average of 3 ft (90 cm) of contaminated sediment from the Reach BC channel where required to allow for the installation of an isolation cap and a suitable habitat layer. Place a chemical isolation layer (assumed to be 1.25-ft [38-cm] thick for the purposes of the Supplemental FS to meet all PRGs for mercury and other CPOIs) and a habitat layer (as described above) within the entire Reach BC channel area. Sufficient removals would be conducted prior to installation of the isolation cap and habitat layer for cap effectiveness and to allow for passage of flood flows under

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[13] Based on the available data for the upper portion of Reach CD, it appears that the vertical distribution of mercury (that would warrant an isolation cap) in this area is generally limited to the uppermost several feet of stream sediments. Therefore, one of the design goals for this portion of Ninemile Creek would be to minimize, via sediment removal, the areal extent of stream channel where an isolation layer would be required. A Pre-Design Investigation (PDI) would be performed to gather additional channel sediment data from Reach CD. The data would be reviewed during design to determine the appropriate depth of sediment removal (*e.g.*, within the upper portion of Reach CD). This would include an evaluation of the vertical and areal distribution of mercury, potential post-removal residual concentrations, the potential thickness and type of backfill materials that would be placed over remaining sediments and forming the base for the habitat layer, potential sheeting and dewatering requirements associated with differing removal depths, and potential stability concerns during construction. The evaluation would determine whether or not an isolation layer would be needed beneath the habitat layer in any portion or portions of this reach in lieu of additional sediment removal. It would not be considered feasible to substitute additional sediment removal depth for an isolation layer in a specific area if the additional removal would require or cause: disproportionate additional equipment use or infrastructure (*e.g.*, sheeting, water management equipment, materials); or a major extension to the overall construction schedule. It also would not be considered feasible if the required depth of removal would exceed 2 ft (60 cm) beyond that needed to otherwise remove sediments for the purpose of: hot-spot removal for chemical isolation layer effectiveness; to place the isolation layer, erosion protection layer, and habitat layer; and to reconstruct the stream channel with the appropriate depths and slopes for maintaining stream flows and appropriate habitats.

existing infrastructure and ensure no adverse increases in water elevations and extent of flooding in accordance with applicable requirements, and to provide sufficient water depth for fish passage and canoe access.

- **Ninemile Creek Floodplain (Reach CD):** Remove 2 ft (60 cm) of floodplain soil/sediment in the areas shown in Figure 11. Backfill the former lower Reach CD channel and floodplain adjacent to the wastebeds, and place a habitat layer of clean material at the surface.

- **Ninemile Creek Channel and Floodplain Hot-spot Removal (Reach CD):** The preferred remedy includes hot-spot removal in sediments and floodplain areas. This hot-spot removal enhances the reliability of the preferred remedy by targeting areas of relatively high concentrations of mercury and other CPOIs[14], resulting in reduced residual contaminant concentrations in these areas.

  These hot spots exist within the top 3 to 6 ft (0.9 to 1.8 m) in the southern channel along the large island, at mercury concentrations up to 118 mg/kg (*e.g.*, core locations TN-13-3, TN-14-3, and TN-15-3; see Appendix C of the Supplemental FS report). In addition to these areas, two additional hot-spot areas will be excavated which are located in the area of the existing southern channel adjacent to the middle and downstream islands in Reach CD and an adjacent area in the portion of the floodplain just to the south of this channel area (see Figure 11). These hot-spot areas are characterized by elevated mercury concentrations relative to the surrounding channel and floodplain areas. The hot-spot removal would consist of excavating channel sediments and floodplain soil/sediments to a depth where the residual concentrations would be similar to concentrations in the surrounding area. Based on available data from the RI/FS and Supplemental FS report, these hot-spot removals cover approximately 0.6 acre (0.2 hectare) within the channel and floodplain. Estimated depths of removal in the channel in this area range from 3 to 5 ft (0.9 to 1.5 m), removing sediments with mercury concentrations up to 68 mg/kg. The estimated depths of excavation in the floodplain in this area also range from 3 to 5 ft (0.9 to 1.5 m), removing sediments/soil with mercury concentrations up to 43 mg/kg. These hot-spot removals would cause the residual mercury concentrations in this area to be generally consistent with those of the rest of this reach at depth.

  These areas would be backfilled and a habitat layer of clean material would be placed at the surface. A determination of the final extent and depth of the hot-spot removals would be made during remedial design. Additional information on hot-spot areas, depths, and volumes can be found in Appendix C of the Supplemental FS report.

  Also, additional contaminated soil/sediment removals may be conducted in other areas to minimize the potential for contaminant migration into Ninemile Creek or into areas that would likely be maintained as or converted to wetlands. The extent of this additional

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[14] As discussed in the RI report, the CPOIs other than mercury have the same general distribution as mercury, although the degree to which they are elevated over upstream conditions, and the extent to which they are found are less than for mercury. Therefore, mercury represents the best measure of the extent of contamination released from the Honeywell LCP Bridge Street subsite. In addition, only mercury presents areas of contiguous sample locations which contain concentrations much (*i.e.*, a factor of ten or more) greater than the concentrations in the surrounding area (*i.e.*, hot spots). Sampling during the pre-design investigation and cap modeling would include the other CPOIs (as well as mercury) to ensure that the remedy is protective for all CPOIs.

removal, if any, would be determined during design based on the residual concentrations and further analyses.

- **Ninemile Creek Floodplain (Reach BC):** Remove all floodplain soil/sediment (approximately 0 to 3 ft [0 to 90 cm] in depth, 1 ft [30 cm] typical) overlying structural stone between the Ninemile Creek waterline and the break in elevation at the top of the bank along the entire length of Reach BC. The excavation would not extend below the structural armor stone. Restore removal areas with approximately 1 ft (30 cm) of vegetated habitat layer, on top of the structural stone, along the entire length of Reach BC, from the water line to the top of the bank.

The preferred remedy is estimated to encompass the removal of 59,000 cy (45,000 m^3) of contaminated sediment and soil, for disposal, over an area of approximately 14.7 acres (6 hectares) within and along Reaches BC and CD. It is estimated that this dredging and excavation would result in the removal of about 535 pounds (242 kg) of mercury from the Ninemile Creek channel and floodplain (or about 80 percent of the estimated total mercury mass in the Reaches BC and CD channel and floodplain [about 670 pounds {300 kg}]). Note that this estimate of mercury mass removal (535 pounds [242 kg]) includes about 370 pounds (167 kg) of mercury from the Reach CD channel and floodplain (55 percent of the total mercury mass in the Reaches BC and CD channel and floodplain), about 150 pounds (68 kg) of mercury from the Reach BC channel (22 percent of the total mass in the Reaches BC and CD channel and floodplain), and about 15 pounds (7 kg) from the Reach BC floodplain (3 percent of the total mass in the Reaches BC and CD channel and floodplain). For the Reach BC channel, the estimated mass removed is based on an average of 3 ft (90 cm) of removal over the entire reach.

When the estimated removal of mercury mass within the channel and floodplain of Reaches BC and CD of Ninemile Creek under this preferred remedy (535 pounds [242 kg]) is combined with the estimated removal of mercury mass within the channel and floodplain of lower Geddes Brook pursuant to the pending IRM (1,000 pounds [450 kg]), it is estimated that greater than 90 percent of the total mercury mass within OU1 would be removed.

In addition, approximately 22,000 cy (17,000 m^3) of the floodplain soils that would be excavated at depths below 3 ft to construct the new channel would be tested and, if found suitable, would be re-used on site.

Removal areas for the preferred remedy are shown in Figure 15 for channel areas and Figure 16 for floodplain areas.

For areas of the Site (*i.e.*, Reach BC and possibly a portion of Reach CD) where a chemical isolation layer would be needed, this layer would be a minimum of 1-foot (30-cm) thick. The thickness of the chemical isolation layer would be determined based on computer modeling, such that concentrations of contaminants within the sediments beneath the cap do not result in unacceptable levels of exposure to aquatic life at 1,000 years or steady state at the surface of the cap (which assumes that the cap thickness does not decrease over time [*i.e.*, does not erode]). The point of compliance, with respect to ensuring that the isolation portion of the cap is effective in preventing unacceptable concentrations of contaminants (*i.e.*, concentrations greater than the lowest PRG for mercury of 0.15 mg/kg and PRGs for other CPOIs) from entering the habitat layer, would be at the bottom of the habitat layer. During the design phase, additional field data would be collected to verify the estimated groundwater upwelling velocities used in the Supplemental FS, and the isolation capping model would be rerun as needed and cap thicknesses and/or removal depths would be revised as appropriate. However, as stated above, the isolation layer would be a minimum

of 1-ft (30-cm) thick. In general, chemical isolation layer designs would be based on an appropriate level of conservatism in the selection of design parameters to address uncertainties. A buffer (or safety) layer is also an approach that can be used to address uncertainties surrounding selection of design parameters. The need for a buffer layer would be determined during design based on the selected remedial approach and on an assessment of the design investigation data.

Contaminated sediments and soils removed from the creek and floodplain would be disposed of at Honeywell's LCP Bridge Street subsite containment system, which was designed and constructed, and is being monitored pursuant to the requirements of a September 2000 ROD. Consolidation and disposal in this manner is a proven and reliable technology for management of contaminated sediments, soils, and wastes to protect human health and the environment. The consolidated sediments and soils would be contained at the LCP Bridge Street subsite beneath a 6 NYCRR Part 360 equivalent low-permeability cap covering approximately 18 acres (7 hectares). The area is currently surrounded by a subsurface barrier (slurry) wall to contain contaminated groundwater that would be collected and treated.

Treatment of water generated by dredging and excavating sediments and soils and corresponding sediment/soil dewatering would be conducted at a location in the vicinity of the Site. The actual location of the treatment plant, discharge requirements, and point of discharge would be determined as part of the remedial design.

The preferred remedy includes the realignment of Reach CD to facilitate remedy implementation (*i.e.,* relocate the channel to an area where the soils at depth are anticipated to be uncontaminated to eliminate or minimize the need for an isolation cap) and to create a vegetated buffer for the stream from the wastebeds. The design and construction of the remedy, including habitat restoration, would need to meet the substantive requirements for permits associated with the disturbance to state and federal regulated wetlands (*e.g.*, 6 NYCRR Part 663, Freshwater Wetlands Permit Requirements) and navigable waters (*e.g.*, 6NYCRR Part 608, Use and Protection of Waters).

Restoration of the stream bed and banks, wetlands, and floodplains would be performed following sediment and soil removal and placement of cap, backfill, and habitat layer material. The remedy includes a site-wide habitat restoration plan to determine the specific restoration details for each section of the Site. The specific thickness(es) and type(s) of substrate material to be used for the habitat layer would be developed in the restoration plan. Goals of the habitat restoration plan, to be developed during remedial design following issuance of the ROD, will include, but will not be limited to, providing connectivity of the stream with the surrounding floodplain, the establishment of diverse habitats (*e.g.*, vernal pools, forested floodplains), and no net loss of wetland areas following remediation.

A comprehensive wetlands and floodplains assessment, as described under EPA's Policy on "Floodplains & Wetlands Assessments for CERCLA Actions" (1985) would be conducted prior to issuance of the ROD and would be updated as appropriate during remedial design.

A long-term monitoring program would be developed during remedial design. It would be implemented to assess the ability of the remedy to achieve the RAOs and PRGs, monitor restoration success, and to ensure that the remedial technologies are performing as specified in the remedial design. Types of monitoring could include stream, wetland, and floodplain sampling before, during, and following remediation, biological tissue sampling (*e.g.*, fish, invertebrates), success of vegetation establishment, environmental effect measurements (*e.g.*, community

analysis), surface water and sediment sampling, and containment system monitoring (*e.g.*, groundwater) to determine its chemical and structural integrity.

A long-term operations and maintenance program would be developed and implemented to include the inspection of the various components of the remedy, and the performance of any repairs (*e.g.*, bank stabilization, replacement of the isolation cap or habitat layer) that might be necessary to ensure the effectiveness of the remediation. The scope of the program would be determined during remedial design.

Remedial design would include the collection of additional site data (*e.g.*, sediment cores, soil borings) to delineate in detail the various areas in which remedial activities would be performed consistent with the requirements of the selected remedy, including the final determination of dredging/excavation areas and volumes. The specific types of dredging and excavation methods would be determined during design. Also, treatability studies (*e.g.*, water treatment) would be performed if necessary.

The design and construction of the remedy would also need to meet all applicable requirements and regulations regarding water flow and flooding.

A Phase 1A Cultural Resource Assessment for various areas, including the Site, was completed by Honeywell in 2003. Based on the results of the Phase 1A assessment, Phase 1B cultural resources work would be conducted in appropriate areas of lower Geddes Brook and lower Ninemile Creek prior to remediation.

An institutional control in the form of an environmental easement, including restrictions on dredging/excavating in the areas where residual contamination would remain beneath the habitat layer, would be included as part of the preferred remedy. It is unlikely that the floodplain portion of OU1 would be developed in the future since the area is predominantly regulated wetlands. In addition, although they are voluntary, and so are not considered true institutional controls, the New York State Department of Health fish consumption advisories for Onondaga Lake and its tributaries, including Geddes Brook and Ninemile Creek, would continue. It would be certified on an annual basis that the institutional controls are in place and that remedy-related OM&M is being performed.

The estimated cost for the preferred remedy for Reaches BC and CD of lower Ninemile Creek is $20,200,000. This total cost estimate is comprised of capital costs of $18,900,000 and annual O&M and periodic costs of $105,000 per year (or $1,300,000 in present-worth O&M and periodic costs). The pending Geddes Brook IRM (both channel and floodplain) is estimated to cost $13,200,000.

The cost estimates presented in this Proposed Plan are based upon capital (construction) costs and the present-worth of the annual O&M costs calculated using a discount rate of 7 percent and a 30-year time interval. The actual costs would vary depending on the specifications contained in the detailed remedial design. Further, the actual costs would also vary because the cost estimates provided are developed conservatively and have an accuracy of +50 percent to -30 percent, to comply with the 1988 EPA guidance document, “Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.”

As discussed above in the “Honeywell Facilities and Disposal Areas Near Geddes Brook/Ninemile Creek” section of this Proposed Plan, closure of Wastebeds 9 through 15 is currently being evaluated by NYSDEC’s Solid Waste Program. As part of this evaluation, NYSDEC has provided Honeywell with a proposal for additional work on the wastebeds side of Ninemile Creek within the

Geddes Brook/Ninemile Creek site (*i.e.*, along Reaches BC and CD) such that wastebed closure work in this area should be expedited and completed such that there is no delay with respect to the backfilling and restoration pursuant to this preferred remedy for Geddes Brook/Ninemile Creek OU1.

It is estimated that the dredging/excavating, capping, backfilling, and habitat layer placement components of the preferred remedy along with dewatering, water treatment, and transport/disposal of sediments and soils at the LCP Bridge Street subsite would take approximately two years.

Because this preferred remedy would result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure to site media, CERCLA requires that the site be reviewed at least once every five years. The five-year review will evaluate the results from monitoring programs established as part of this remedy to ensure that the remedy remains protective of human health and the environment. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contaminated sediments and floodplain soils/sediments.

BASIS FOR THE REMEDY PREFERENCE

Alternative 3 would be protective of benthic macroinvertebrates, because for the top 2 ft (60 cm) of channel sediment and floodplain soil/sediment (which are predominantly wetlands), it would meet all of the sediment toxicity targets for mercury. This alternative would also meet the sediment toxicity targets for arsenic, lead, total PAHs, PCBs, hexachlorobenzene, and phenol.

Alternatives 3 and 4 would address all ARARs and PRGs. Alternative 2 would address all ARARs except for the application of NYSDEC's Part 375 unrestricted use soil cleanup objective of 0.18 mg/kg for mercury in portions of the floodplain with concentrations between 0.18 and 1.3 mg/kg.

Alternatives 2 through 4 address the PRGs for mercury and other contaminants through removal, to various extents. Alternative 3 is more protective than Alternative 2, since it addresses potentially contaminated surface soils/sediments throughout the entire remedial area (14.7 acres [6 hectares]) since this alternative is based on physical limitations to the extent of potential contamination. Alternative 2, which is based on one of the higher mercury PRGs (1.3 mg/kg) to define the areal extent of remediation, addresses a smaller portion of the remedial area (8.4 acres [3.4 hectares]). Alternative 4, which is based on the lowest of the mercury PRGs (0.15 mg/kg), also addresses the same remedial area as Alternative 3.

Alternative 3 is considered to be more protective than Alternative 2. Alternative 3 addresses all of the potential mercury PRGs at the point of exposure in the surface (top 2 ft [60 cm]) soils/sediments, while Alternative 2 does not fully address the two lowest mercury PRGs (0.15 and 0.5 mg/kg). Alternative 4, which is based on the lowest of the mercury PRGs, also addresses the same PRGs as Alternative 3 at the point of exposure.

As discussed in the "Toxicity-Based Sediment Effect Concentrations (SECs) Selected as PRGs for Mercury and Other Inorganics" text box (page 51), the mercury PRGs of 0.15 mg/kg and 1.3 mg/kg are based on the lowest effect level (LEL) and severe effect level (SEL), respectively, of the NYSDEC sediment screening values (NYSDEC, 1999), which are in turn based on Long and Morgan's (1990) ER-L and ER-M values. The ER-L (0.15 mg/kg) represents a concentration below which toxic effects are rarely expected, and the ER-M (1.3 mg/kg) represents a concentration

above which toxic effects are likely to occur. By meeting the LEL under Alternative 3, an added measure of protectiveness for the benthic community (*i.e.*, the base of the food chain) over the SEL (used for Alternative 2) is provided.

Alternative 2 is predicted to slightly exceed the post-remediation SWAC-based mercury target for floodplain soil/sediment in Reach BC and the post-remediation SWAC-based target for PCBs (wildlife bioaccumulation screening value) in Reaches BC and CD channel sediments, but would meet all other SWAC-based sediment targets for protection of bioaccumulation and direct contact (by humans). Alternatives 3 and 4 would meet all SWAC-based sediment targets for protection of bioaccumulation and direct contact (by humans).

All three alternatives remove a majority of the mercury mass in Reaches BC and CD. Alternative 3 removes about 535 pounds [242 kg] of mercury (80 percent of the total found in these reaches), which is more than Alternative 2 (450 pounds [200 kg], or 67 percent of the total), but less than Alternative 4 (670 pounds [300 kg] or 100 percent of the total above the lowest PRG). For Alternative 3, the residuals that would remain following removals (generally less than 1 mg/kg to about 5 mg/kg) would typically be one to two orders-of-magnitude lower than the maximum concentrations currently found at the Site (over 100 mg/kg). Furthermore, under Alternative 3, all residuals would be covered. The residuals for Alternative 2 would be higher than for Alternative 3.

In addition, when the estimated removal of mercury mass within the channel and floodplain of Reaches BC and CD of Ninemile Creek under Alternative 3 (535 pounds [242 kg]) is combined with the estimated removal of mercury mass within the channel and floodplain of lower Geddes Brook pursuant to the pending IRM (1,000 pounds [450 kg]), it is estimated that greater than 90 percent of the total mercury mass within OU1 would be removed.

In order to achieve these contaminant removals, Alternative 3 would remove about twice as much soil/sediment (59,000 cy [45,000 m^3]) as Alternative 2 (29,000 cy [22,000 m^3]), and about 20 percent less than Alternative 4 (73,000 cy [56,000 m^3]). All of these alternatives include disposal of these soils and sediments at Honeywell's LCP Bridge Street subsite under the landfill cap. Disposal at this site would eliminate the need for large volumes of heavy truck traffic to pass through nearby communities on public roads. Furthermore, the excavated soils and sediments would be used as fill that is needed for the closure of the containment system at Honeywell's LCP Bridge Street subsite, and would therefore eliminate the need for the same volume of heavy truck traffic on public roads bringing in other material as fill.

Both Alternatives 2 and 3, and potentially limited areas under Alternative 4, utilize an isolation cap and/or habitat layer to isolate any residual contamination left after removals. These layers can be designed to be reliable and protective of the low concentrations of contamination left as residuals. Alternative 4 would be slightly more reliable than Alternative 3, since about 20 percent more material would be sent to the more secure containment system at the LCP Bridge Street subsite.

All three alternatives would disrupt the benthic community of Ninemile Creek, as well as preventing access by the public during remedial construction. Alternative 2 would cause disruption for one year, Alternative 3 for two years, and Alternative 4 for three years. There is a potential risk of resuspension of contaminated sediments being washed downstream into Onondaga Lake during dredging/excavation. While it is expected that releases of this type would be controlled, this potential risk is most pronounced for Alternative 4 due to the large amount of sheet piling that would be required in the channel for the deeper removals to reach the PRG of 0.15 mg/kg mercury at depth. Alternative 3 avoids much of this potential risk via its inclusion of the permanently

relocated creek channel which would enable much of the adjacent work area removals to be conducted “in the dry.”

The relocation of a portion of the Ninemile Creek channel away from the wastebeds under Alternative 3 provides several advantages. This alternative facilitates remedy implementation, avoids the potential risk of resuspending contaminated sediments (most pronounced in Alternative 4), and allows the bottom of the new channel to be located in native materials that are expected to be uncontaminated (to be confirmed during design). Where the channel has been relocated in Reach CD into uncontaminated materials, the need for an isolation layer would be eliminated or minimized increasing the reliability and protectiveness of the remedy.

Alternative 3, due to the methods of relocating a portion of Ninemile Creek, would be easier to implement than Alternative 4. Alternative 4 would involve a large amount of sheet pile and would be more difficult to implement in Reach BC due to the large (nine) number of bridges which would complicate sheet pile placement and possibly present additional stability concerns.

In addition to providing long-term effectiveness and permanence through its stability, the remedial action under all three action alternatives, including the channel realignment in Alternative 3, would be designed to meet requirements for protection of existing infrastructure and floodplain areas (*i.e.*, no adverse increase in water elevations or extent of flooding as compared to existing conditions).

Alternative 3 would remove about twice as much sediment and soil as Alternative 2, and approximately 20 percent less than Alternative 4. Thus, on the basis of the amount of contaminated sediment and soil removed and placed in a secure facility, Alternative 2 would result in much less reduction in mobility and toxicity than Alternatives 3 and 4, while Alternative 3 would result in a slightly lower reduction in mobility and toxicity than Alternative 4. However, the costs and difficulty of implementation are significantly greater for Alternative 4 than Alternative 3. The cost of Alternative 4 is 50 percent greater than Alternative 3.

Summary

NYSDEC and EPA prefer Alternative 3 because it provides the same overall protection of human health and the environment and compliance with ARARs as Alternative 4. Alternative 3 also presents less short-term risks and is more implementable than Alternative 4. While Alternative 3 relies on aquatic isolation capping in some areas of Ninemile Creek, the design, construction, monitoring, and maintenance of the isolation caps would ensure their reliability and long-term effectiveness. Also, some isolation capping could be needed in Reach BC under Alternative 4 as well, due to excavation restrictions that may be required for safety reasons in the vicinity of highway and railroad bridge piers/footings. Alternative 1 is rejected since none of the threats to human health and the environment would be abated. Alternative 2 is rejected because it is less protective, does not comply with all ARARs/TBCs, and affords less reduction of toxicity, mobility, and volume than Alternative 3. In addition to short-term risk and implementation issues, Alternative 4 is also significantly greater in cost than Alternative 3 ($30 million versus $20.2 million).

ACRONYMS AND ABBREVIATIONS

AMSL	Above Mean Sea Level
ARAR	Applicable or Relevant and Appropriate Requirement
BALCT	Benthic Aquatic Life Chronic Toxicity criteria
BERA	Baseline Ecological Risk Assessment
BSAF	Biota-Sediment Accumulation Factor
BSQV	Bioaccumulation-based Sediment Quality Value
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
COC	Chemical (or Contaminant) of Concern
CPOI	Chemical Parameter of Interest
CSF	Carcinogenic Slope Factor
CT	Central Tendency
CWA	Clean Water Act
cy	cubic yard
DO	Dissolved Oxygen
ECL	Environmental Conservation Law
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ER-L	Effects Range-Low
ER-M	Effects Range-Median
FS	Feasibility Study
ft	feet/foot
GAC	Granular Activated Carbon
gal/min	gallons per minute
GM	General Motors
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IFG	Inland Fisher Guide (GM Subsite)
IRM	Interim Remedial Measure
kg	kilogram
km	kilometer

LCP	Linden Chemicals and Plastics
LEL	Lowest Effect Level
LOAEL	Lowest Observed Adverse Effect Level
m	meter
Metro	Metropolitan Syracuse Sewage Treatment Plant
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mi	mile
MNR	Monitored Natural Recovery
NAPL	Non-Aqueous-Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/L	nanograms per liter
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
NYCRR	New York Code of Rules and Regulations
NYNHP	New York Natural Heritage Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
O&M	Operation and Maintenance
OU1/OU2	Operable Unit 1 / Operable Unit 2
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD/PCDF	Polychlorinated Dibenzo-p-Dioxin/Polychlorinated Dibenzofuran
PDI	Pre-Design Investigation
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
PSA	Preliminary Site Assessment
RAO	Remedial Action Objective
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SCA	Sediment Consolidation Area
SCO	Soil Cleanup Objective
SEC	Sediment Effect Concentration
SEL	Severe Effect Level
SMU	Sediment Management Unit (of Onondaga Lake)
SQS	Sediment Quality Standard
SOC	Stressor of Concern
SSLC	Species Screening Level Concentration
SVOC	Semivolatile Organic Compound
SWAC	Surface-Weighted Average Concentration
SYW	Syracuse West (from US Geological Survey quadrant sheet; used to identify New York State wetlands)

TBC	to-be-considered
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
µg/kg	micrograms per kilogram
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
ww	wet weight
YOY	Young-of-Year

GLOSSARY

Specialized terms used in this Proposed Plan are defined below.

Acute – Occurring over a short time. The duration of the acute toxicity tests performed for the Geddes Brook/Ninemile Creek RI/FS was 10 days.

Anoxic – Containing no dissolved oxygen. Commonly used to indicate an environment that cannot support life, except for some types of bacteria.

Applicable or Relevant and Appropriate Requirements (ARARs) – The federal and state environmental laws that a selected remedy will meet. These requirements may vary among sites and alternatives.

Baseline – Current conditions without remediation implemented (*i.e.*, "no action").

Bathymetry – The measurement of the depth of the floor of a water body from the water surface.

Benthic – Occurring at the bottom of a body of water (*e.g.*, a lake bottom).

Benthic Macroinvertebrates – Small but visible animals (*e.g.*, insects, worms, clams, and snails) that live in or on the sediments at the bottom of a lake or stream.

Berm – A horizontal ledge cut between the foot and top of an embankment to stabilize the slope and intercept sliding earth.

Bioaccumulation – The general term describing a process by which chemicals are taken up by an organism either directly from exposure to a contaminated medium or by consumption of food containing the chemical.

Biota – Animal and plant life.

Bioturbation – The process whereby bottom dwelling and burrowing organisms mix up sediment and destroy primary layering.

Byproduct – Material, other than the principal product, generated as a consequence of an industrial process or as a breakdown product in a living system.

Calcite – A mineral composed of calcium and carbonate.

Cancer Slope Factor (CSF) – A plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The CSF is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular concentration of a specific potential carcinogen.

Carcinogenic – The property of a substance to cause or aggravate cancer.

Chronic – Involving a stimulus that is lingering or continues for a long time; often signifies periods from several weeks to years, depending on the reproductive life cycle of the species. Chronic exposures typically induce a biological response of relatively slow progress and long duration.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – Commonly known as Superfund, CERCLA was enacted by Congress on December 11, 1980 and subsequently amended. This law provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Confluence – A stream formed by two or more streams flowing together; also the point at which these streams meet.

Consent Decree – A legal document, approved by a judge, that, in the case of a CERCLA investigation, formalizes an agreement between EPA (or, in the case of Geddes Brook/Ninemile Creek and Onondaga Lake, New York State) and one or more potentially responsible parties outlining the terms by which the investigation will take place. A Consent Decree is subject to a public comment period prior to its approval by a judge and is enforceable as a final judgment by a court.

Contaminant – Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, sediment, soil, or biota. In the case of Geddes Brook/Ninemile Creek, contaminants are typically chemical substances.

Conventional Parameters – Conventional parameters are those measurements that are meant to give a general physical and chemical characterization of the environment, and include methods which utilize gravimetric, spectrophotometric, ion chromatographic, or electrometric analysis.

Culvert – A covered channel or a large-diameter pipe that takes a watercourse below ground level.

Dewater – To remove water from solid material (*e.g.*, sediments) by a solid-liquid separation technique.

Diffusion – The movement of dissolved constituents from areas of high concentration to areas of low concentration.

Discharge – Flow of surface water in a stream or the outflow of groundwater from a flowing well, ditch, or spring. Can also apply to release of liquid effluent from a facility or to chemical emissions into the air.

Dissolved Oxygen (DO) – The oxygen freely available in water, vital to fish and other aquatic life and for the prevention of odors. DO levels are considered an important indicator of a water body's ability to support desirable aquatic life.

Ecological Risk Assessment – The application of a formal framework, analytical process, or model to estimate the effects of human actions on a natural resource and to interpret the significance of those effects in light of the uncertainties identified in each component of the assessment process. Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characterization.

Ecosystem – The biotic community and abiotic (non-living) environment within a specified location and time, including the chemical, physical, and biological relationships among the biotic and abiotic components.

Exposure – Contact by humans or wildlife with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term (acute exposure), of intermediate duration, or long-term (chronic exposure).

Exposure Pathway – The course (path) a contaminant takes from the source to the exposed individual.

Feasibility Study (FS) – A study to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well. The FS typically evaluates a series of remedial alternatives and recommends the selection of a cost-effective alternative.

Floodplain – Areas above the mean water level that are occasionally inundated from the stream. The floodplain of Geddes Brook/Ninemile Creek includes areas that are wetlands and uplands (non-wetlands).

Flume – A natural or manmade channel that diverts water.

Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation.

Hazard Index (HI) – The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways.

Hazard Quotient (HQ) – The ratio of an exposure level to a substance to a toxicity value selected for the risk assessment for that substance.

Hazardous Substance – Generally, any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive.

Heterogeneous – A mixture of dissimilar or nonuniform constituents.

Human Health Risk – The likelihood that a given exposure or series of exposures may have damaged or will damage the health of individuals.

Ice Scour – Water-bottom erosion caused by ice, resulting in removal of sediments and the formation of deep holes and channels.

Ionic Waste – Solid and liquid materials contaminated with calcium, calcium carbonate, chloride, and sodium ions, that have been historically discharged to Geddes Brook, Ninemile Creek, and Onondaga Lake. Ionic waste was produced as a result of Honeywell's soda-ash manufacturing process and was disposed of by various means (*e.g.*, pumped to the Honeywell wastebeds in the form of a slurry).

Macrophyte – Plants, usually aquatic, large enough to be seen without magnification. They may be rooted or free floating.

Marl – A mixture of clay with lime (calcium carbonate).

Media (singular: medium) – Specific environments (*e.g.*, water, sediment, fish) that are the subject of regulatory concern and activities.

Mitigation – Measures taken to reduce adverse impacts on the environment.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action.

Mutagenic – The property of a substance or mixture of substances to cause genetic changes.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – The federal regulation governing CERCLA cleanups and the determination of the sites to be corrected under both the Superfund program and the program to prevent or control spills into surface waters or elsewhere. 40 CFR Part 300, et seq.

National Priorities List (NPL) – The NPL is EPA's list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the U.S. and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation and remediation.

Non-Aqueous-Phase Liquid (NAPL) – Contaminants that remain undiluted as the original bulk liquid in the subsurface; *e.g.,* spilled oil. Dense NAPL, or DNAPL, includes chlorinated hydrocarbon solvents or petroleum fractions with a specific gravity greater than 1.0 that can sink through the water column until they reach a confining layer.

Operable Unit (OU) – Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.

Operation and Maintenance (O&M) – Activities conducted after a Superfund site action is completed to ensure that the action is effective. O&M actions can include those taken after construction to ensure that facilities constructed to treat wastewater will be properly operated and maintained to meet discharge limits.

Organic Compounds – Carbon compounds, such as solvents, oils, and pesticides. Most are not readily dissolved in water. Some organic compounds can cause cancer.

Pathway – The physical course a chemical or pollutant takes from its source to the exposed organism.

Persistence – Refers, in general, to the length of time a compound remains in the environment, once introduced. A compound may persist for less than a second or indefinitely.

pH – An expression of the intensity of the basic or acidic condition of a liquid; may range from 0 to 14, where 0 is the most acidic, 7 is neutral, and 14 is the most basic. Natural waters usually have a pH between 6.5 and 8.5.

Porewater – Porewater is the water filling the spaces between grains of sediment.

Pre-Design Investigation (PDI) – A preliminary gathering of data to support design plans for the selected remedy.

Preliminary Remediation Goal (PRG) – Established for the Geddes Brook/Ninemile Creek RI/FS to provide additional information and goals with which remedial alternatives can be developed and selected. PRGs are used to achieve remedial action objectives.

Present-Worth Analysis/Present-Worth Cost – A method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared. When calculating present-worth costs for Superfund sites, capital and operation and maintenance costs are included.

Proposed Plan – Part of the Superfund remedial response process. The preferred remedy for a site is presented to the public in the Proposed Plan. The Proposed Plan briefly summarizes the alternatives studied in the detailed analysis phase of the Remedial Investigation/Feasibility Study, highlighting the key factors that led to identifying the preferred remedy. The Proposed Plan, as well as the Remedial Investigation/Feasibility Study and the other information that forms the basis for the lead agency's response selection, is made available for public comment in the Administrative Record file. The opportunity for a public meeting is provided at this stage.

Receptor – Entity exposed to a stressor.

Record of Decision (ROD) – Following receipt of public comments and any final agency comments, the lead agency (in the case of Geddes Brook/Ninemile Creek and Onondaga Lake, NYSDEC) selects and documents the remedy selection decision in a ROD. The ROD documents the remedial action plan for a site.

Remedial Action Objective (RAO) – RAOs were developed for the Geddes Brook/Ninemile Creek site to provide the overall goals of the remedial process and provide the basis for comparing the degree to which various alternatives protect human health and the environment.

Remedial Design – A phase of remedial action that follows the remedial investigation/feasibility study and Record of Decision and includes development of engineering drawings and specifications for a site cleanup.

Remedial Investigation (RI) – An in-depth study designed to gather data needed to determine the nature and extent of contamination and risks to humans and the environment at a Superfund site. The RI is usually done prior to the feasibility study (FS). Together they are usually referred to as the "RI/FS."

Remediation – Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site.

Residuals – Contaminants that are left in place following remediation.

Responsiveness Summary – A summary of oral and/or written public comments received during a comment period on key documents, and a response to those comments. A Responsiveness

Summary will be issued with the Record of Decision to address comments received on this Proposed Plan.

Resuspension – The process of lifting sediment particles from the bottom of a lake into the overlying water. Resuspension can be caused by forces such as water turbulence from waves and currents, bottom-feeding fish (*e.g.*, carp), and methane gas ebullition. The particles may settle back to the bottom or be carried away by currents.

Riprap – A foundation in water made of irregularly placed stones or boulders for river/stream work.

Sediment – Unconsolidated particulate material found at the bottom of lakes, rivers, streams and other water bodies at bed elevations equal to or lower than the mean high water level. Sediment is the primary contaminated medium at the Geddes Brook/Ninemile Creek site. Sediments are within the channels of the streams as well as the wetlands portion of the floodplain which are generally only about 6 to 12 inches above average stream water level.

Sediment Effects Concentrations (SECs) – Sediment quality guidelines used to predict sediment toxicity.

Sediment Management Units (SMUs) – The eight areas of Onondaga Lake that were established to assist in the evaluation to better manage remediation of contaminated sediments. SMUs 1 through 7 are located in the littoral zone of the lake and SMU 8 is the entire profundal zone of the lake.

Slurry – A free-flowing, pumpable suspension of fine solid material into a liquid.

Solidification and Stabilization – Removal of wastewater from waste, water from dredged sediments, or changing waste or dredged sediments chemically to make it less permeable and susceptible to transport by water.

Soluble – Capable of being dissolved.

Stressor – A physical, chemical, or biological entity that can induce adverse effects on an ecosystem or human health.

Substrate – The surface or medium that serves as a base for something.

Superfund – The common name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The Superfund Amendments and Reauthorization Act (SARA) amended CERCLA on October 17, 1986.

Surface Water – Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs.

Sustainability – Relates to survival, growth, and reproduction. The sustainability of plant and animal communities and populations was used in the Geddes Brook/Ninemile Creek baseline ecological risk assessment as the basis for assessment endpoints.

Teratogenic – The property of a substance to interfere with the normal development of a fetus or embryo.

Threshold – The dose or exposure level below which a significant adverse effect is not expected.

Treatment – Any method, technique, or process designed to remove solids and/or pollutants from solid waste, waste streams, effluents, and air emissions.

Trophic – Pertaining to a position in a food web, food chain, or food pyramid.

Upwelling – The upward movement of groundwater through sediments.

Wastebed – The disposal areas for Solvay wastes resulting from the treatment of sodium chloride with ammonia and carbon dioxide to make sodium bicarbonate and calcium chloride.

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FIGURES

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TABLES

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USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for the Geddes Brook/Ninemile Creek site is important to NYSDEC and EPA. Comments provided by the public are valuable in helping us select a final cleanup remedy for the Site.

You may use the space below to write your comments, then fold and mail to the address provided at the beginning of this Proposed Plan. Comments must be postmarked by January 2, 2009. Those with electronic communications capabilities may submit their comments to NYSDEC and EPA via the Internet at the following e-mail address: DERweb@gw.dec.state.ny.us. Please note "Geddes Brook/Ninemile Creek Proposed Plan" in subject box.

Name _____
Address _____
City _____
State _____
Zip _____

Table 6. Concentrations of Select Contaminants in Geddes Brook/Ninemile Creek Fish

Contaminants (only contaminants considered risk drivers are shown)	Units (wet weight)	Target Tissue Concentration Range (mg/kg) [2]		Fish Concentrations (mg/kg) Data from 1990, 1998, 2000, and 2002		
				Arithmetic Mean	95% UCL[4]	Max Detection
Human Health Exposure - Fish Fillets		**RME**				
Mercury (as methylmercury)[5]	mg/kg	0.6		0.55	0.73	2.5
Total PCBs [6]	mg/kg	0.011 to 1.1		0.17	0.45	1.9
PCDD/PCDEs - TEQ as 2,3,7,8-TCDD [7]	mg/kg	1.0E-07 to 1.0E-05		2.3E-06	5.9E-06	1.8E-05
Ecological Exposure - Small Fish (3 to 18 cm) Whole Fish [1, 3]		**NOAEL**	**LOAEL**			
Mercury (as methylmercury)	mg/kg	0.009	0.187	0.28	0.85	0.85
Ecological Exposure - Large Fish (18 to 60 cm) Whole Fish [1, 3]		**NOAEL**	**LOAEL**			
Mercury (as methylmercury)	mg/kg	0.014	0.345	0.56	1.9	1.9

Sources:
-- Human health exposure data (fish fillets) were taken from Table 3.1 of Appendix B of the Geddes Brook/Ninemile Creek Human Health Risk Assessment (HHRA) report.
-- Ecological exposure data (whole fish) were taken from Table 1-2 of the Geddes Brook/Ninemile Creek FS report.

-- Target tissue concentrations were taken from Appendix 1 of the Geddes Brook/Ninemile Creek ES report and from Attachment A-2 of Appendix A of the Supplemental ES report. Eish tissue PRGs can be found in the text boxes on pages 54 and 55 of the Proposed Plan.

Notes:
1. Mercury concentrations were adjusted from fillet to whole body concentrations by multiplying by a factor of 0.7, as developed in the Onondaga Lake Baseline Ecological Risk Assessment.
2. RME = reasonable maximum exposure; NOAEL = no-observed-adverse-effect-level; LOAEL = lowest-observed-adverse-effect-level.
3. NOAELs and LOAELs for small (3 to 18 cm) fish are based on the belted kingfisher and mink. NOAELs and LOAELs for large (18 to 60 cm) fish are based on the great blue heron and river otter.
4. The maximum detected concentration was used as the 95% UCL if it was lower than the calculated UCL.
5. The human health target tissue concentration for mercury (0.6 mg/kg) is based on young child RME (non-cancer effects). The RME target concentration for adults is slightly higher (0.9 mg/kg). See the PRGs in fish tissue text box onpage 54 of the Proposed Plan.

6. The human health target tissue concentrations for total PCBs based on RME carcinogenic risks at risk targets of 1E-05 and 1E-04 for adults are 0.11 mg/kg and 1.1 mg/kg, respectively. The RME targets based on non-cancer effects of 0.12 to 0.19 mg/kg fall within the range based on the carcinogenic risk target of 1E-05. A target concentration based on the 1E-06 risk level (0.011 mg/kg) is much lower than mean background concentrations in US waters and may not be achievable. See the PRGs in fish tissue text box on page 54 of the Proposed Plan.

7. The human health target tissue concentrations for PCDD/PCDFs based on RME carcinogenic risks at risk targets of 1E-05 and 1E-04 for adults are 1E-06 mg/kg and 1E-05 mg/kg, respectively. Non-carcinogenic targets could not be developed for PCDD/PCDFs. A target concentration based on the 1E-06 risk level (1E-07 mg/kg) is much lower than mean background concentrations in US waters and may not be achievable. See the PRGs in fish tissue text box on page 54 of the Proposed Plan.

Table 1. Contaminants of Potential Concern for the Geddes Brook/Ninemile Creek HHRA

Contaminant	Fish Fillets	Channel Sediments	Floodplain Soils/Sediments	Surface Water
Metals/Inorganics				
Aluminum		•	•	
Antimony		•	•	•
Arsenic (inorganic)	•	•	•	
Cadmium	•			•
Chromium		•	•	•
Copper	•			
Cyanide		•	•	
Iron	•	•	•	
Lead		•	•	•
Manganese		•	•	•
Methylmercury	•	•	•	•
Mercury (inorganic)	NA [1]	•	•	•
Nickel	•			
Selenium	•	•		
Thallium		•	•	•
Vanadium	•			
Zinc	•			
Volatile Organic Compounds				
No VOC COPCs identified in any Geddes Brook/Ninemile Creek medium				
Semivolatile Organic Compounds				
3-Nitroaniline			•	
N-nitroso-di-n-propylamine			•	
Hexachlorobenzene	•	•	•	
Polycyclic Aromatic Hydrocarbons				
Benz(a)anthracene		•	•	
Benzo(a)pyrene		•	•	
Benzo(b)fluoranthene		•	•	
Benzo(g,h,i)perylene			•	
Benzo(k)fluoranthene			•	
Dibenz(a,h)anthracene		•	•	
Indeno(1,2,3-cd)pyrene		•	•	
Phenanthrene		•	•	
Pesticides				
4,4-DDD	•			
4,4'-DDE	•			
4,4'-DDT	•			
Dieldrin	•	•		
Heptachlor Epoxide	•	•		
Polychlorinated Biphenyls				
Aroclor 1248	•		•	
Aroclor 1254	•	•	•	
Aroclor 1260	•	•	•	
Aroclor 1268		•	•	
Total PCBs (sum)	•	•	•	
Dioxins/Furans				
2,3,7,8-TCDD TEQ	•	•	•	•

Notes: • - Specified contaminant identified as a contaminant of potential concern (COPC).
NA - This analyte or parameter group not analyzed in specified exposure area.
Contaminants not listed were not identified as COPCs in any site medium.
[1] - All mercury in fish addressed as methylmercury.

Table 2. Contaminants and Stressors of Concern Selected for Geddes Brook/Ninemile Creek Media in the BERA

Contaminant	Surface Water	Channel Sediments	Floodplain Soils/Sediments	Plants	Fish
Metals/Inorganics					
Arsenic		•	•	•	•
Barium	•				
Cadmium			•		
Chromium			•	•	
Copper		•	•		
Iron			•		
Lead	•	•	•	•	
Manganese	•	•	•		
Mercury/Methylmercury	•	•	•	•	•
Nickel		•	•		
Selenium			•	•	•
Thallium			•	•	
Vanadium			•	•	
Zinc		•	•	•	•
Volatile Organic Compounds					
Dichlorobenzenes (Sum)		•			
Carbon disulfide		•			
Methylene chloride		•			
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate		•			
Hexachlorobenzene		•	•		
2-Methylphenol		•			
Phenol		•	•		
Polycyclic aromatic hydrocarbons (total)		•	•		
Pesticides/Polychlorinated Biphenyls					
Chlordane isomers		•	•		
DDT and metabolites		•	•		•
Dieldrin			•		
Endrin			•		
Endosulfans (sum)		•			
Heptachlor and heptachlor epoxide		•	•		
Polychlorinated biphenyls (total)		•	•		•
Dioxins/Furans					
PCDD/PCDFs (TEQ)			•		•
Other Substances/Stressors					
Calcite		•			
Chloride	•				
Sodium	•				
Total dissolved solids	•				

Notes: • – Contaminants and stressors of concern assessed in the BERA for the specific media listed.

Table 3. Summary of Channel Sediment Data for Select Parameters from Geddes Brook and Ninemile Creek (1998, 2001)

	Upper Ninemile Creek		Lower Ninemile Creek		Upper Geddes Brook		Lower Geddes Brook	
Parameter	**Maximum Detection**	**Average Detection**	**Maximum Detection**	**Average Detection**	**Maximum Detection**	**Average Detection**	**Maximum Detection**	**Average Detection**
0 to 15 cm								
Arsenic (mg/kg)	5.80	5.20	23.7	6.12	3.30	2.55	6.60	4.44
Benzo(a)pyrene (µg/kg)	180	118	1,100	328	2,100	1,550	2,900	720
Hexachlorobenzene (µg/kg)	ND	ND	2,450	193	3.10	3.10	795	253
Lead (mg/kg)	23.5	18.0	194	39.7	30.3	30.3	114	36.4
Mercury (mg/kg)	0.15	0.10	21.1	3.08	0.36	0.20	15.7	2.62
Methylmercury (µg/kg)	1.89	1.24	6.26	2.48	2.01	1.60	4.83	2.91
Total PAHs (µg/kg)	2,040	1,379	13,981	3,645	24,469	18,009	42,130	8,717
Total PCBs (µg/kg)	ND	ND	1,350	166	ND	ND	150	111
Phenol (µg/kg)	ND	ND	220	142	ND	ND	250	195
15 to 45 cm								
Arsenic (mg/kg)	4.20	4.20	33.2	7.09	3.40	3.40	14.6	6.26
Benzo(a)pyrene (µg/kg)	ND	ND	2,800	460	360	360	480	283
Hexachlorobenzene (µg/kg)	ND	ND	7,100	807	ND	ND	5,500	925
Lead (mg/kg)	9.90	9.90	532	50	35.2	35.2	200	41.4
Mercury (mg/kg)	0.03	0.03	68.6	6.58	0.32	0.27	5.30	1.57
Methylmercury (µg/kg)	0.17	0.17	9.01	2.82	0.59	0.59	4.60	1.37
Total PAHs (µg/kg)	ND	ND	33,915	4,420	4,083	4,083	6,030	2,929
Total PCBs (µg/kg)	ND	ND	1,200	210	52.0	52.0	400	250
Phenol (µg/kg)	ND	ND	1,700	499	ND	ND	120	92.5
45 to 75 cm								
Arsenic (mg/kg)	NA	NA	101	10.1	2.70	2.70	8.30	5.76
Benzo(a)pyrene (µg/kg)	NA	NA	1,600	374	150	150	1,400	557
Hexachlorobenzene (µg/kg)	NA	NA	26,000	2,168	ND	ND	17,500	5,322
Lead (mg/kg)	NA	NA	388	45.8	25.1	25.1	371	127
Mercury (mg/kg)	NA	NA	118	5.33	0.37	0.30	79.0	16.7
Methylmercury (µg/kg)	NA	NA	20.1	4.80	0.27	0.27	8.82	3.04
Total PAHs (µg/kg)	NA	NA	23,685	4,071	1,787	1,787	12,620	5,575
Total PCBs (µg/kg)	NA	NA	2,100	258	37	37	4,500	1,580
Phenol (µg/kg)	NA	NA	940	505	ND	ND	ND	ND
75 to 105 cm								
Arsenic (mg/kg)	NA	NA	101	14.6	3.60	3.60	22.7	10.2
Benzo(a)pyrene (µg/kg)	NA	NA	1,200	251	82	82	3,900	1,123
Hexachlorobenzene (µg/kg)	NA	NA	1,050	372	ND	ND	107,500	27,386
Lead (mg/kg)	NA	NA	374	50.9	14.8	14.8	144	57.6
Mercury (mg/kg)	NA	NA	28.3	3.09	0.42	0.26	3.76	2.79
Methylmercury (µg/kg)	NA	NA	14.9	2.94	0.35	0.35	3.51	2.34
Total PAHs (µg/kg)	NA	NA	17,661	3,296	943	943	55,180	15,785
Total PCBs (µg/kg)	NA	NA	2,500	441	27.5	27.5	133	133
Phenol (µg/kg)	NA	NA	700	401	ND	ND	ND	ND
Below 105 cm								
Arsenic (mg/kg)	NA	NA	37.6	7.69	NA	NA	10.3	9.35
Benzo(a)pyrene (µg/kg)	NA	NA	1,100	418	NA	NA	2,800	1,600
Hexachlorobenzene (µg/kg)	NA	NA	435	228	NA	NA	140,000	73,125
Lead (mg/kg)	NA	NA	321	44.1	NA	NA	115	86.7
Mercury (mg/kg)	NA	NA	30.2	1.57	NA	NA	10.4	8.85
Methylmercury (µg/kg)	NA	NA	4.36	1.10	NA	NA	3.14	3.09
Total PAHs (µg/kg)	NA	NA	15,654	4,867	NA	NA	41,860	23,621
Total PCBs (µg/kg)	NA	NA	475	167	NA	NA	ND	ND
Phenol (µg/kg)	NA	NA	780	285	NA	NA	ND	ND

Notes:
1. NA=Not analyzed
2. ND=Not detected
3. The sediment samples outside of the site limits, as defined in this Proposed Plan, are not included in these statistics. These include NM1, NM2, TN-17 and TN-18, which are located upstream of Amboy Dam in upper Ninemile Creek, and GB1, which is located in upper Geddes Brook. These data can be found in the RI report, and the statistics reported for upper Ninemile Creek and upper Geddes Brook in Appendix I of the RI include the data from these stations.

Table 4. Summary of Floodplain Soil/Sediment Data for Select Parameters from Geddes Brook and Ninemile Creek (1998, 2000, 2001, 2002, and 2007)

	Lower Ninemile Creek			Islands in Lower Ninemile Creek			Lower Geddes Brook			Geddes Brook IRM Sampling		
Parameter	Depth Interval (cm)	Maximum Detection	Average Detection	Depth Interval (cm)	Maximum Detection	Average Detection	Depth Interval (cm)	Maximum Detection	Average Detection	Depth Interval (cm)	Maximum Detection	Average Detection
Arsenic (mg/kg)	0 to 15	23.0	5.76	0 to 15	6.40	5.63	0 to 15	7.70	5.85	0 to 15	NA	NA
Benzo(a)pyrene (µg/kg)	0 to 15	14,000	654	0 to 15	320	248	0 to 15	8,000	1,067	0 to 15	780	340
Hexachlorobenzene (µg/kg)	0 to 15	890	91	0 to 15	745	423	0 to 15	1,650	263	0 to 15	880	328
Lead (mg/kg)	0 to 15	466	44.3	0 to 15	42.2	34.4	0 to 15	192	52.5	0 to 15	NA	NA
Mercury (mg/kg)	0 to 15	58.7	2.29	0 to 15	1.90	0.71	0 to 15	14.1	4.33	0 to 15	15.7	3.98
Methylmercury (µg/kg)	0 to 15	27.5	5.83	0 to 15	NA	NA	0 to 15	5.31	4.03	0 to 15	NA	NA
Total PAHs (µg/kg)	0 to 15	173,980	7,756	0 to 15	3,990	3,036	0 to 15	138,363	14,707	0 to 15	8,410	3,738
Total PCBs (µg/kg)	0 to 15	600	70.7	0 to 15	80.0	49.6	0 to 15	450	137	0 to 15	NA	NA
Phenol (µg/kg)	0 to 15	120	91.4	0 to 15	ND	ND	0 to 15	ND	ND	0 to 15	NA	NA
Arsenic (mg/kg)	15 to 30	31.0	5.91	15 to 45	6.00	5.68	15 to 30	8.90	5.82	15 to 30	NA	NA
Benzo(a)pyrene (µg/kg)	15 to 30	20,000	736	15 to 45	400	250	15 to 30	460	282	15 to 30	430	220
Hexachlorobenzene (µg/kg)	15 to 30	1,050	130	15 to 45	165	93	15 to 30	1,360	344	15 to 30	840	394
Lead (mg/kg)	15 to 30	317	36	15 to 45	39.8	35.1	15 to 30	173	50.7	15 to 30	NA	NA
Mercury (mg/kg)	15 to 30	59.5	3.79	15 to 45	4.70	0.99	15 to 30	33.7	11.7	15 to 30	39.1	6.14
Methylmercury (µg/kg)	15 to 30	NA	NA	15 to 45	NA	NA	15 to 30	NA	NA	15 to 30	NA	NA
Total PAHs (µg/kg)	15 to 30	283,060	8,693	15 to 45	4,590	2,976	15 to 30	4,992	2,947	15 to 30	4,720	2,370
Total PCBs (µg/kg)	15 to 30	1,050	143	15 to 45	140	59.1	15 to 30	800	462	15 to 30	NA	NA
Phenol (µg/kg)	15 to 30	66	55	15 to 45	ND	ND	15 to 30	ND	ND	15 to 30	NA	NA
Arsenic (mg/kg)	30 to 60	NA	NA	45 to 75	9.40	6.40	30 to 60	NA	NA	30 to 60	NA	NA
Benzo(a)pyrene (µg/kg)	30 to 60	1,700	298	45 to 75	270	270	30 to 60	NA	NA	30 to 60	4,000	690
Hexachlorobenzene (µg/kg)	30 to 60	6,400	1,006	45 to 75	20	20	30 to 60	NA	NA	30 to 60	8,100	2,840
Lead (mg/kg)	30 to 60	NA	NA	45 to 75	45.9	27.3	30 to 60	NA	NA	30 to 60	NA	NA
Mercury (mg/kg)	30 to 60	76.9	4.16	45 to 75	0.85	0.32	30 to 60	NA	NA	30 to 60	269	14.2
Methylmercury (µg/kg)	30 to 60	NA	NA	45 to 75	NA	NA	30 to 60	NA	NA	30 to 60	NA	NA
Total PAHs (µg/kg)	30 to 60	18,714	3,208	45 to 75	3,092	3,092	30 to 60	NA	NA	30 to 60	40,700	6,363
Total PCBs (µg/kg)	30 to 60	NA	NA	45 to 75	15	15	30 to 60	NA	NA	30 to 60	NA	NA
Phenol (µg/kg)	30 to 60	NA	NA	45 to 75	ND	ND	30 to 60	NA	NA	30 to 60	NA	NA
Arsenic (mg/kg)	60 to 90	NA	NA	75 to 105	5.40	3.95	60 to 90	NA	NA	60 to 90	NA	NA
Benzo(a)pyrene (µg/kg)	60 to 90	1,500	285	75 to 105	200	200	60 to 90	NA	NA	60 to 90	1,800	696
Hexachlorobenzene (µg/kg)	60 to 90	870	256	75 to 105	2	2	60 to 90	NA	NA	60 to 90	93	93
Lead (mg/kg)	60 to 90	NA	NA	75 to 105	34.3	20.1	60 to 90	NA	NA	60 to 90	NA	NA
Mercury (mg/kg)	60 to 90	43.1	2.71	75 to 105	0.28	0.12	60 to 90	NA	NA	60 to 90	156	7.18
Methylmercury (µg/kg)	60 to 90	NA	NA	75 to 105	NA	NA	60 to 90	NA	NA	60 to 90	NA	NA
Total PAHs (µg/kg)	60 to 90	16,404	2,857	75 to 105	2,832	2,832	60 to 90	NA	NA	60 to 90	17,950	7,012
Total PCBs (µg/kg)	60 to 90	NA	NA	75 to 105	ND	ND	60 to 90	NA	NA	60 to 90	NA	NA
Phenol (µg/kg)	60 to 90	NA	NA	75 to 105	ND	ND	60 to 90	NA	NA	60 to 90	NA	NA

Notes:
1. NA=Not analyzed
2. ND=Not detected
3. The floodplain data for Ninemile Creek upstream of the confluence with Geddes Brook and for Geddes Brook upstream of the West Flume were not included in these statistics because these floodplain areas are not within the site limits. These soil data can be found in the RI report, and statistics for upper Ninemile Creek and upper Geddes Brook are reported in Appendix I of the RI. The data from 2007 are reported in Appendix B of the Supplemental FS (Parsons, 2008a). The summary of the 2007 data provided by Parsons was revised by Earth Tech for NYSDEC.

Table 4 cont.

	2007 Geddes Brook			2007 Ninemile Creek OU-1		
Parameter	**Depth Interval (cm)**	**Maximum Detection**	**Average Detection**	**Depth Interval (cm)**	**Maximum Detection**	**Average Detection**
Arsenic (mg/kg)	0 to 30	13.1	9.81	0 to 30	12.3	6.94
Benzo(a)pyrene (µg/kg)	0 to 30	NA	NA	0 to 30	NA	NA
Hexachlorobenzene (µg/kg)	0 to 30	NA	NA	0 to 30	0.10	0.07
Lead (mg/kg)	0 to 30	NA	NA	0 to 30	NA	NA
Mercury (mg/kg)	0 to 30	36.0	5.72	0 to 30	12.0	2.07
Methylmercury (µg/kg)	0 to 30	NA	NA	0 to 30	NA	NA
Total PAHs (µg/kg)	0 to 30	NA	NA	0 to 30	20.3	5.02
Total PCBs (µg/kg)	0 to 30	NA	NA	0 to 30	NA	NA
Phenol (µg/kg)	0 to 30	NA	NA	0 to 30	NA	NA
Arsenic (mg/kg)	----	----	----	----	----	----
Benzo(a)pyrene (µg/kg)	----	----	----	----	----	----
Hexachlorobenzene (µg/kg)	----	----	----	----	----	----
Lead (mg/kg)	----	----	----	----	----	----
Mercury (mg/kg)	----	----	----	----	----	----
Methylmercury (µg/kg)	----	----	----	----	----	----
Total PAHs (µg/kg)	----	----	----	----	----	----
Total PCBs (µg/kg)	----	----	----	----	----	----
Phenol (µg/kg)	----	----	----	----	----	----
Arsenic (mg/kg)	30 to 60	17.4	6.99	30 to 60	11.1	5.91
Benzo(a)pyrene (µg/kg)	30 to 60	NA	NA	30 to 60	NA	NA
Hexachlorobenzene (µg/kg)	30 to 60	NA	NA	30 to 60	0.05	0.04
Lead (mg/kg)	30 to 60	NA	NA	30 to 60	NA	NA
Mercury (mg/kg)	30 to 60	14.7	3.94	30 to 60	3.60	0.69
Methylmercury (µg/kg)	30 to 60	NA	NA	30 to 60	NA	NA
Total PAHs (µg/kg)	30 to 60	NA	NA	30 to 60	8.25	2.83
Total PCBs (µg/kg)	30 to 60	NA	NA	30 to 60	NA	NA
Phenol (µg/kg)	30 to 60	NA	NA	30 to 60	NA	NA
Arsenic (mg/kg)	60 to 90	7.30	3.58	60 to 90	5.40	3.17
Benzo(a)pyrene (µg/kg)	60 to 90	NA	NA	60 to 90	NA	NA
Hexachlorobenzene (µg/kg)	60 to 90	NA	NA	60 to 90	0.01	0.01
Lead (mg/kg)	60 to 90	NA	NA	60 to 90	NA	NA
Mercury (mg/kg)	60 to 90	11.0	1.48	60 to 90	0.72	0.19
Methylmercury (µg/kg)	60 to 90	NA	NA	60 to 90	NA	NA
Total PAHs (µg/kg)	60 to 90	NA	NA	60 to 90	0.89	0.50
Total PCBs (µg/kg)	60 to 90	NA	NA	60 to 90	NA	NA
Phenol (µg/kg)	60 to 90	NA	NA	60 to 90	NA	NA

Table 5. Summary of Surface Water Data for Select Parameters from Geddes Brook and Ninemile Creek (1998)

	Upper Ninemile Creek		Lower Ninemile Creek		Upper Geddes Brook		Lower Geddes Brook	
Parameter	Maximum Detection	Average Detection	Maximum Detection	Average Detection	Maximum Detection	Average Detection	Maximum Detection	Average Detection
Dissolved Arsenic (µg/L-dis)	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Lead (µg/L-dis)	ND	ND	ND	ND	ND	ND	1.2	1.2
Lead (µg/L)	1.8	1.8	1.7	1.7	ND	ND	1.8	1.8
Dissolved Methylmercury (ng/L-dis)	4.2E-02	4.1E-02	3.2E-02	2.1E-02	4.0E-02	2.9E-02	6.1E-02	3.7E-02
Dissolved Total Mercury (ng/L-dis)	ND	ND	ND	ND	ND	ND	1.4	1.4
Total Mercury (ng/L)	2.3	1.8	27	9.2	2.1	2.1	27	22
Hexachlorobenzene (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
Phenol (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
Total PCBs (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
1. ND=Not detected
2. Data collected during the GB/NMC RI from the West Flume (Station GB4) and the "Unnamed Creek" (Station GB5), both of which discharge to lower Geddes Brook, are not included in this data summary since these streams are outside of the scope of this remedy.
3. The water samples outside of the site limits, as defined in this Proposed Plan, are not included in these statistics. These include NM1 and NM2 upstream of Amboy Dam in upper Ninemile Creek, and GB1 in upper Geddes Brook. These data can be found in the R1 report, and the statistics reported for upper Ninemile Creek and upper Geddes Brook in Appendix I of the R1 include the data from these stations.