Executive Summary

Overview

After decades of work and hundreds of millions of dollars spent, GE and EPA have addressed PCBs at both the former GE plant site in Pittsfield and adjacent areas and in the two miles of the Housatonic River near the former plant. More will be done in the next few years in several other areas, including Silver Lake and Unkamet Brook, but the amount of PCBs in the remediated areas has been dramatically reduced, which, in turn, has decreased the amount of PCBs carried downstream.

GE and EPA have now focused their attention on a third area, which has become known as the "Rest of River" – the stretch of the Housatonic River that begins where the River's East and West Branches meet in Pittsfield and extends south through western Massachusetts and Connecticut. Approximately 90% of the PCBs remaining in the Rest of River are in the 10-mile stretch between Pittsfield and Woods Pond Dam in Lenox, an area with a rich and vital ecosystem. Unlike the areas in and around the former GE plant site, most of this 10-mile stretch of the River has been untouched by development. It includes a unique, relatively unfragmented corridor of forests and wetlands that provide critical habitat for an extraordinary assemblage of plants and animals, including dozens of species listed by the Commonwealth of Massachusetts as threatened, endangered, or of special concern. In 2009, in recognition of its uniqueness, the Commonwealth designated the Upper Housatonic River as an Area of Critical Environmental Concern.

The question that is the subject of this Revised Corrective Measures Study (CMS) Report is: What to do about the PCBs remaining in the Rest of River? There are several possible approaches, and each one has advantages and disadvantages.

The basic problem is this: the Rest of River is a flourishing ecosystem. The more aggressively you work to remove PCBs from this ecosystem, the more you damage it in the name of "remediating" it. For example, to keep PCBs that have found their way into the banks of the River from reentering the River, you can "stabilize" the banks. This "stabilization" requires you to (1) eliminate the existing vertical and "undercut" banks that have been carved by nature and cannot be reproduced by man, and which are important habitat for birds and other animals that are currently using them; and (2) remove trees and other vegetation currently on the banks, which will permanently change their appearance and character and change the animals that can live in those areas.

Removing or capping sediments in the bottom of the River to address PCBs will have similar consequences. The more sediment you dredge, the more you displace fish and change the nature of the riverbed and its hospitability to aquatic life. Likewise, the more soil you remove from the floodplain, the more you change the nature of the floodplain and its hospitability to the plants and animals that currently live there (including the sensitive species living in the area's dozens of vernal pools and other areas). Building access roads and staging areas needed to carry out these large-scale engineering activities will cause further damage. At some point, the balance tips and you will find yourself, as the Boston Globe entitled a 2008 editorial about the Housatonic, “Destroying a river to clean it.” This is in nobody’s interest.

The answer to the question of what to do about the Rest of River can be found only through carefully weighing the potential advantages and disadvantages of each remedial approach. GE has done this in this Revised CMS Report. GE used EPA’s model to forecast future PCB levels in fish, water, and sediment. GE used assumptions based on EPA’s human health and ecological risk assessments to compare the various approaches. GE does not agree with EPA about all of these assumptions – in fact, GE strongly disagrees with the Agency about several of them – but in preparing the Revised CMS Report, GE used EPA’s assumptions. Using this information, the advantages and disadvantages of each potential remedial approach were determined.

The results of this process show that, when it comes to the Rest of River, less really is more. The least intrusive approaches to cleaning up river sediment and floodplain soil will meet EPA’s human health criteria, are protective of the environment, and are far more likely to achieve that goal without “destroying a river to clean it.”

There are several reasons that support this conclusion.

First, *all* of the approaches that GE studied involving any PCB removal will adequately protect human health according to standards developed by EPA.

Second, *none* of the approaches that have been suggested will decrease PCB levels in Housatonic River fish in Massachusetts to a point that, according to EPA’s assumptions, would allow people to eat those fish without restriction. No matter which alternative is adopted, the Rest of River will remain a “catch and release” fishery for the foreseeable future.

Third, although applying EPA’s assumptions does indicate some differences in how the various remedial alternatives will affect certain animal species, the incremental PCB reductions predicted for the more aggressive approaches are outweighed by the serious and certain ecological damage that would result from those approaches. It is important to remember that the amount of PCBs in the Rest of River is not going to increase. PCB levels are already dropping, and they will continue to drop no matter what is or isn’t done next. And we already know that even the highest historic levels of PCB contamination have *not* destroyed or degraded the ecology of the Rest of River; PCBs have been present for more than 70 years and yet the indigenous flora and fauna have flourished. These observations give us every reason to believe that the animal and plant populations of the Rest of River will *continue* to do just fine even if no further clean-up occurs.

On the other hand, there is no question that the more aggressive remediation alternatives under consideration will permanently damage the ecosystem. Riverbanks will be permanently deforested and reshaped; the riverbed will be altered; forests in the floodplains will be removed and will take generations to return to their current state (if they ever do); the vernal pools that dot the landscape will be destroyed; and the broad swath of largely contiguous forest will be fragmented by man-made access roads and staging areas. Habitats will be disrupted, populations will be displaced, and there is no way to know what will replace them.

Answering the question of what to do about the Rest of River, then, comes down to a comparison of what we do know and don't know. We know that the Rest of River is flourishing without any remediation at all. We know that the less intrusive removal alternatives will fully protect human health using EPA's assumptions. We don't know how much damage the Rest of River can bear from an attempt to remove more PCBs.

Therefore, GE believes that the least intrusive approach – "Monitored Natural Recovery" – is best here. However, taking into account EPA's human health and ecological risk assessments, and using numerous other assumptions and inputs specified by EPA even though GE strongly disagrees with them, the combination of sediment and floodplain remedial alternatives known as SED 10/FP 9 will provide the greatest benefit with the least ecological harm. Although it will require a substantial sediment removal project in the first five miles of the Rest of River and in Woods Pond, together with removal of floodplain soil, SED 10/FP 9 has been carefully designed to minimize the severe harm that will result from more invasive measures, and it will still meet all of EPA's human-health based goals (except for those relating to fish consumption, which can't be achieved by any remedial alternative). GE has also concluded that the excavated sediments and soils should be placed in a secure disposal facility built near the River but outside the floodplain, which will avoid the detriments of the other disposal and treatment options, especially with larger removal volumes.

ES.1 Background

***Upstream Source Control/Remediation*:** For over 30 years, the General Electric Company (GE) has been conducting source control and environmental cleanup activities at and near its former plant site in Pittsfield, Massachusetts, to address polychlorinated biphenyls (PCBs). For example, during this period, GE has conducted major source control activities at and near its former plant to prevent and control PCBs present in soils and underground oil plumes from entering the River.

During the last 11 years, GE and the U.S. Environmental Protection Agency (EPA) have performed cleanup activities under a comprehensive agreement embodied in a Consent Decree (CD) that became effective in 2000. Under the CD, GE and EPA remediated the two miles of the River that runs adjacent to and downstream of the former GE plant to the confluence of the East and West Branches of the River (the Confluence). Specifically, GE performed extensive sediment and bank soil remediation in the Upper ½-Mile Reach of the River (between the Newell Street and the Lyman Street Bridges in Pittsfield); and EPA then remediated the 1½-Mile Reach of the River (between the Lyman Street Bridge and the Confluence). GE's remedial efforts in upstream areas have also included remediation of soils in floodplain and former oxbow areas adjacent to the River, remediation of portions of the former GE plant site, and remediation of sediments and riverbank soils in the West Branch adjacent to Dorothy Amos Park in Pittsfield. In addition, over the next 2 to 3 years GE will conduct a sediment removal/capping project in Silver Lake (which discharges to the River) and remediation of Unkamet Brook (which flows into the River). Collectively, these completed and planned activities represent one of the largest remedial projects in EPA Region 1.

These activities have significantly reduced and will continue to reduce the amount of PCBs entering the Rest of River area. For example, water column data collected upstream of the Confluence indicate that the remediation in the 2-Mile Reach and adjacent upland areas reduced the concentration of PCBs in the Housatonic River water column by a factor of three to five (from pre- to post-remediation) under both base flow and storm conditions (see Section 6.1.3 of this Report). These reductions are expected to continue due to the ongoing and planned remediation actions upstream of the Confluence.

***Rest of River Studies Leading Up To the Revised CMS*:** As part of the settlement embodied in the CD, EPA issued a permit to GE under the federal Resource Conservation and Recovery Act (RCRA) (the Permit) relating to the Rest of River. That Permit and the CD specify the process for investigating the Rest of River, and for studying the need for and scope of additional remedial activities.[1] From 1997 through 2002, EPA conducted numerous sampling activities and investigations of the Rest of River area, building on the considerable investigations that had previously been conducted by GE and others. The resulting data were presented in GE's RCRA Facility Investigation (RFI) Report, finalized in September 2003, which documented the concentrations of PCBs in the surface water, sediments, floodplain soils, and biota of the Rest of River. That report focused in particular on the 10-mile stretch of the River and floodplain between the Confluence and Woods Pond Dam (known as the Primary Study Area or PSA), which contains approximately 90% of the PCBs in the Rest of River and also contains a unique and extraordinary ecosystem with numerous and diverse plant and animal species, including state-listed rare species.

Next, EPA performed a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Rest of River. GE was then required to develop and submit proposed Interim Media Protection Goals (IMPGs), which are preliminary remediation goals, applicable to various environmental media (e.g., floodplain soil, sediment, fish), that are considered by EPA to be protective of human health and ecological receptors based upon EPA's findings in the HHRA and ERA. GE did so while expressing its strong disagreements with EPA's HHRA and ERA and the effect of the disputed issues on the development of the

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[1] Copies of the reports discussed below are available on EPA's website for the Housatonic River, http://www.epa.gov/region1/ge/index.html.

IMPGs. The IMPGs based on EPA's HHRA and ERA were approved by EPA after GE revised them to incorporate numerous directions from EPA. Under the Permit, attainment of the IMPGs is one of the factors to be considered in evaluating remedial alternatives and is to be balanced along with a number of other factors specified in the Permit (as described below).

During this same period, EPA developed a mathematical model to simulate the fate, transport, and bioaccumulation of PCBs between the Confluence and Rising Pond Dam (the most downstream impoundment on the River in Massachusetts). This model estimates PCB concentrations in the water, sediments, and fish in that portion of the Rest of River for a period of 52 years into the future (or 30 years after completion of remediation, if longer), both in the absence of any additional remediation and in response to various sediment remedial alternatives. It has been used to assess the effects of the sediment remedial alternatives evaluated in this Report on future PCB levels in water, sediments, and fish in the Massachusetts portion of the River.[2]

In February 2007, as required by the Permit and after discussions with EPA, GE submitted a Proposal to EPA for conducting the Corrective Measures Study (CMS) – an evaluation of potential remedial alternatives. The CMS Proposal, along with a number of addenda, identified and screened potential remediation technologies for the Rest of River, developed a set of specific remedial alternatives for detailed evaluation, and described the proposed methodology to be used for that evaluation. Those remedial alternatives covered a broad range of potential approaches – from no action to extensive removal of sediments and floodplain soils. EPA approved the CMS Proposal and addenda, subject to a number of conditions.

GE submitted a CMS Report to EPA in March 2008. The public and the Commonwealth expressed significant concerns about that report. For example, the Commonwealth advised EPA of its view that the CMS Report was inadequate and needed to be revised to consider other options that did not cause the ecological damage inherent in the remedial alternatives presented in the CMS Report. EPA then provided extensive comments on the report in September 2008, requiring that GE provide substantial additional information and perform further analyses. GE began these analyses and discussed with EPA and the Commonwealth the development of a new remedial alternative (consisting of both sediment and floodplain remediation) that would reduce the adverse ecological impacts from remedial construction activities. EPA agreed that the new alternative should be included in the revised CMS evaluations, and requested that another set of remedial alternatives (one for

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[2] EPA did not design its model to forecast PCB concentrations past Rising Pond Dam. Therefore, at EPA's request, GE developed a simplistic procedure for extrapolating the results of the model downstream into Connecticut. The estimates from that extrapolation procedure are used in this report, but are highly uncertain.

sediments and one for the floodplain), which EPA had developed and described, also be evaluated.

In March 2009, GE submitted a detailed interim response to EPA's September 2008 comments. In addition, in August 2009, GE submitted a work plan for the evaluation of the additional remedial alternatives mentioned above. That work plan proposed to evaluate the new and the previous remedial alternatives in a Revised CMS Report. EPA conditionally approved that work plan on January 15, 2010. GE disputed certain of the conditions mandated by EPA staff to EPA management, but EPA management upheld its staff's decisions in a decision issued on June 10, 2010.

In the meantime, in February 2010, GE submitted an in-depth evaluation of the impacts of the remedial alternatives and the potential for avoiding or minimizing those impacts and restoring affected habitats in six "example areas" identified by EPA in the PSA.

***GE's Reservations of Rights*:** During the course of the process described above, GE has disagreed with EPA on many key issues, as stated in numerous reports and submittals. First, GE has a fundamental disagreement with EPA regarding the effects of PCBs on human health and the environment. The toxicity values that EPA uses to assess what it regards as the cancer and non-cancer risks of PCBs to humans are based on laboratory studies of animals. However, based on the scientific evidence from human exposure studies, PCBs have not been shown to cause cancer in humans or to cause adverse non-cancer effects in humans at environmental levels.[3] Further, the evidence does not indicate that PCBs have adversely affected the Rest of River ecosystem; indeed, field surveys by both EPA and GE contractors have demonstrated abundant, diverse, and thriving fish and wildlife populations and communities in the Rest of River area despite over 70 years of exposure to PCBs. In addition, GE disagrees with many of the specific assumptions, input values, interpretations, and conclusions in EPA's HHRA and ERA, which overstate the risks of PCBs to humans and ecological receptors. GE also disagrees with numerous directives that EPA has issued to GE both for revising the IMPGs and for conducting the CMS. GE has preserved its position on all of these issues.

As discussed above, upstream remediation and source control activities, along with natural recovery processes, have significantly reduced the PCBs in the Rest of River, and those improvements are continuing.[4] As documented in this report, further remediation would unavoidably and severely damage the ecosystem of the River and floodplain, including riverbanks, mature forests, vernal pools and other wetlands, and the plants and animals that

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[3] In addition, a number of recent studies on human and animal cells have shown that human cells are many times less sensitive to the effects of PCBs than the cells of the laboratory test animals used in the studies on which EPA's toxicity values are based. See Section 1.2 of this report.

[4] For example, the most recent adult fish sampling data from the River, which were collected in 2008, show a substantial reduction in PCB concentrations in the fish in the PSA from those measured in 1998 and 2002.

inhabit or use the River and floodplain. In these circumstances, GE has concluded that, apart from monitoring the ongoing source control and natural recovery processes, it would be inappropriate to conduct additional remedial actions in the Rest of River area.

Nevertheless, while preserving its position, GE has, as required by the CD and the Permit, conducted the evaluations in this Revised CMS taking into account EPA's HHRA and ERA and using the assumptions, procedures, and other inputs that EPA directed GE to use. Many of these EPA assumptions and directives with which GE disagrees have fundamentally shaped the analyses presented herein and the resulting conclusion as to which set of remedial alternatives best meets the Permit criteria. Given GE's objections and its appeal rights under the CD and the Permit, this Revised CMS Report should not be regarded as a proposal by GE to implement those alternatives.

ES.2 Scope of Revised CMS Report

This Revised CMS Report presents the results of a detailed evaluation of a range of remedial alternatives, approved by EPA for evaluation, for sediments (including riverbanks), floodplain soils, and treatment and/or disposition of removed materials. In addition, this report presents a detailed comparative evaluation of several combinations of sediment and floodplain remedial alternatives, ranging from MNR to very extensive remedial measures.

***Reaches Addressed*:** For purposes of these evaluations, GE has used the Rest of River reaches and subreaches designated by EPA. These are shown on Figure ES-1 and are as follows:

- Reach 5 – from the Confluence to Woods Pond, which is further divided into three subreaches – 5A (Confluence to Pittsfield wastewater treatment plant [WWTP]); 5B (Pittsfield WWTP to Roaring Brook); and 5C (Roaring Brook to start of Woods Pond) – and which also contains a large number of backwater areas adjacent to the River;
- Reach 6 – Woods Pond;
- Reach 7 – Woods Pond Dam to Rising Pond (the next large impoundment);
- Reach 8 – Rising Pond;
- Reach 9 – Rising Pond Dam to the Connecticut border; and
- Reaches 10-17 – Connecticut border to Long Island Sound.

***Sediment/Riverbank Alternatives*:** For sediments and erodible riverbanks, GE has evaluated a total of 10 individual remedial alternatives (designated SED 1 through SED 10). With the exception of SED 1 (no action) and SED 2 (MNR only), these alternatives use various combinations of remediation technologies, including: (a) sediment removal (via mechanical or hydraulic methods) followed in most cases by capping or placement of backfill; (b) placement of a clean cap over existing sediments; (c) thin-layer capping (placement of a thin layer of clean material over existing sediments to provide a reduction in PCB concentrations in the biologically active zone, thereby accelerating the natural recovery process); (d) stabilization of riverbanks, with removal of bank soil where appropriate, to minimize erosion of bank soils into the River; and (e) MNR (reliance on naturally occurring processes to contain or otherwise reduce the bioavailability of PCBs in sediment, with monitoring to assess the rate of recovery). The 10 individual sediment remedial alternatives evaluated in the Revised CMS are summarized, and key statistics regarding each (e.g., removal volume, capping area, estimated implementation duration) are presented, in Tables ES-1 and ES-2, respectively.

Table ES-1. Summary of Remediation Alternatives for Sediments and Riverbanks

Alternative	Description
SED 1	No action.
SED 2	Monitored natural recovery (MNR).
SED 3	Sediment removal in Reach 5A; thin-layer capping in portion of Reach 5C and in Woods Pond.
SED 4	Sediment removal in Reach 5A; combination of sediment removal, engineered capping, and/or thin-layer capping in Reaches 5B and 5C and Woods Pond; thin-layer capping in portions of the Reach 5 backwaters.
SED 5	Sediment removal in Reaches 5A and 5B; combination of sediment removal, engineered capping, and/or thin-layer capping in Reach 5C, the Reach 5 backwaters, and Woods Pond; thin-layer capping in Rising Pond.
SED 6	Sediment removal in Reaches 5A, 5B, and 5C; combination of sediment removal, engineered capping, and/or thin-layer capping in the Reach 5 backwaters, Woods Pond, and Rising Pond; thin-layer capping in Reach 7 impoundments.
SED 7	Sediment removal in Reaches 5A, 5B, and 5C; combination of sediment removal, engineered capping, and/or thin-layer capping in the Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond.
SED 8	Removal of all sediments with PCBs above 1 mg/kg from the main stem and backwaters of entire River between Confluence and Woods Pond Dam, from Reach 7 impoundments, and from Rising Pond.
SED 9	Sediment removal in entire Reach 5 channel, Woods Pond, Reach 7 impoundments, and Rising Pond; combination of sediment removal and engineered capping in Reach 5 backwaters with PCBs > 1 mg/kg.
SED 10	Sediment removal in portions of Reach 5A based on application of criteria designed to avoid or minimize adverse ecological effects; sediment removal from top 2.5 feet in portions of Woods Pond based on PCB concentrations.

Notes:

1. Under SED 3 through SED 10, all portions of the River where active remediation is not specified would be subject to MNR.
2. Where sediment removal is specified, the excavations would be capped or, in some instances (under SED 7 and SED 8), backfilled to the pre-existing grade, except that: (a) under SED 9, shallower portions of Woods Pond would have a thinner cap than the depth of removal; and (b) under SED 10, the excavated portions of Woods Pond would not be capped or backfilled.
3. All alternatives other than SED 1, SED 2, and SED 10 also include stabilization of all riverbanks in Reaches 5A and 5B, with removal of bank soil as appropriate. SED 10 includes bank stabilization/soil removal on select riverbanks in Reaches 5A and 5B.
4. All alternatives also include continued maintenance of fish consumption advisories.

Table ES-2. Overview of Volumes, Areas, and Duration for Sediment Alternatives

	SED 1/2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8	SED 9	SED 10
Sediment removal volume (cubic yards [cy])	0	134,000	262,000	377,000	521,000	770,000	2,252,000	886,000	235,000
Bank soil removal volume (cy)	0	35,000	35,000	35,000	35,000	35,000	35,000	35,000	6,700
Capping after removal (acres)	0	42	91	126	178	150	0	333	20
Backfill after removal (acres)	0	0	0	0	0	69	351	0	0
Capping without removal (acres)	0	0	37	60	45	45	0	3	0
Thin-layer capping (acres)	0	97	119	102	112	72	0	0	0
Time to implement (years)	0	10	15	18	21	26	52	14	5

Note: MNR would be a component of all alternatives except SED 1.

***Floodplain Soil Alternatives*:** For floodplain soil, GE has evaluated a total of nine individual remedial alternatives (designated FP 1 through FP 9). Except for the no action alternative (FP 1), these alternatives all involve the removal of soil, followed by replacement of that soil with clean backfill and revegetation of the remediated area. These alternatives are of three types: (1) alternatives that achieve average PCB concentrations that meet particular EPA-approved IMPGs for a given area (FP 2, FP 3, FP 4, FP 7, and FP 9);[5] (2) alternatives based on removal of soils within a given depth that exceed a specified PCB concentration (FP 5 and FP 6); and (3) a combination of the those approaches (FP 8). The nine individual floodplain soil alternatives are described, and the total removal volume and removal area for each are listed, in Tables ES-3 and ES-4, respectively.[6]

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[5] The IMPGs generally consist of ranges of numbers. For example, those intended to be protective of human health include values that correspond to various cancer risk levels (as determined by EPA) within EPA's acceptable cancer risk range – from a 10^{-4} cancer risk (a 1 in 10,000 chance of excess cancer) to a 10^{-6} cancer risk (a 1 in a million chance of excess cancer) – as well as values based on assumed non-cancer impacts (as determined by EPA). Most of the ecological IMPGs consist of ranges of concentrations (based on thresholds in EPA's ERA) from an upper to a lower bound. The above-listed floodplain alternatives were designed to meet certain selected sets of those IMPGs.

[6] It is assumed that each of these alternatives would be combined and coordinated with a sediment remediation alternative and could be implemented within the duration of the associated sediment alternative.

Table ES-3. Summary of Remediation Alternatives for Floodplain Soils

Alternative	Description
FP 1	No action.
FP 2	Soil removal/backfilling to achieve the health-based IMPGs based on 10^{-4} cancer risk or on non-cancer (whichever is lower).
FP 3	Same as FP 2 except: (a) in certain frequently used areas, soil removal/backfilling to achieve the health-based IMPGs based on 10^{-5} cancer risk or on non-cancer (whichever is lower); and (b) supplemental remediation to achieve upper-bound IMPGs for ecological receptors.
FP 4	Soil removal/backfilling to achieve the health-based IMPGs based on 10^{-5} cancer risk or on non-cancer (whichever is lower). Supplemental remediation to achieve upper-bound IMPGs for ecological receptors.
FP 5	Removal of soils that contain PCB concentrations of 50 mg/kg or greater, with backfilling.
FP 6	Removal of soils that contain PCB concentrations of 25 mg/kg or greater, with backfilling.
FP 7	Soil removal/backfilling to achieve the health-based IMPGs based on 10^{-6} cancer risk, but no lower than 2 mg/kg for direct human contact (level specified in Consent Decree as the standard for residential use). Supplemental remediation to achieve lower-bound IMPGs for ecological receptors.
FP 8	Soil removal/backfilling to achieve the health-based IMPGs based on 10^{-5} cancer risk or on non-cancer (whichever is lower). Supplemental remediation in vernal pools to achieve lower-bound IMPG for amphibians. Additional removal of all remaining soils that contain PCB concentrations of 50 mg/kg or greater, with backfilling.
FP 9	Same as FP 2 with additional soil removal/backfilling to achieve the health-based RME IMPGs based on 10^{-4} cancer risk or on non-cancer (whichever is lower) in top 3 feet in certain heavily used subareas.

Notes:

1. The health-based IMPGs refer to the IMPGs that were based on EPA's "Reasonable Maximum Exposure" assumptions in its Human Health Risk Assessment.
2. For all alternatives, the remediation described applies to the top foot of soil, except that FP 3 through FP 9 also involve additional remediation in certain heavily used subareas as necessary to achieve specified criteria in the top 3 feet of soil.

Table ES-4. Overview of Volumes and Areas for Floodplain Alternatives

	FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7	FP 8	FP 9
Removal volume (cy)	0	22,000	74,000	121,000	104,000	320,000	631,000	177,000	26,000
Removal area (acres)	0	13	44	72	63	197	387	108	14

***Combinations of Sediment and Floodplain Alternatives*:** Since the selected remedy for the Rest of River will involve both a sediment/riverbank remediation component and a floodplain remediation component, the comparative evaluation of alternatives in this Revised CMS Report has been conducted for certain combinations of sediment and floodplain (SED/FP) alternatives, as approved by EPA. Those combinations (which span the full range of remedial alternatives in terms of removal volumes and affected areas) are as follows:

- SED 2 and FP 1;
- SED 3 and FP 3;
- SED 5 and FP 4;
- SED 6 and FP 4;
- SED 8 and FP 7;
- SED 9 and FP 8; and
- SED 10 and FP 9.

The following table provides an overview of each of these combinations:

Table ES-5. Overview of Combinations of Sediment and Floodplain Alternatives

Remedial Components[1]	SED 2/ FP 1	SED 3/ FP 3	SED 5/ FP 4	SED 6/ FP 4	SED 8/ FP 7	SED 9/ FP 8	SED 10/ FP 9
Removal Volume (cubic yards)							
Sediment	---	134,000	377,000	521,000	2,252,000	886,000	235,000
Riverbank Soil	---	35,000	35,000	35,000	35,000	35,000	6,700
Floodplain Soil	---	74,000	121,000	121,000	615,000	177,000	26,000
Total	---	243,000	533,000	677,000	2,902,000	1,098,000	267,700
Area Subject to Sediment/Soil Removal (acres)[2]							
Sediment	---	42	126	178	351	333	62
Floodplain	---	44	72	72	377	108	14
Total	---	86	198	250	728	441	76
Riverbank Subject to Stabilization/Bank Soil Removal (linear miles, considering both banks)							
Riverbank	--	14	14	14	14	14	1.6
Capping Without Removal or Thin-Layer Capping (acres)							
Capping	---	---	60	45	---	3	---
Thin-Layer Capping	---	97	102	112	---	---	---
Total Surface Area Impacted (acres) and Construction Duration (years)							
Area Impacted by Remediation	---	183	360	407	728	444	76
Area Impacted by Access Roads/ Staging Areas[3]	---	94	97	106	97	80	36
Construction Duration	---	10	18	21	52	14	5

1. MNR would also be a component of all combinations.
2. All areas subject to removal would be capped or backfilled following removal except for 42 acres of Woods Pond under SED 10/FP 9, where sediment would be removed without capping or backfilling.
3. Includes impacted areas outside the floodplain.

Treatment/Disposition Alternatives**:** GE has evaluated a total of five alternatives for the treatment and/or disposition of removed sediments and soils. These alternatives include three disposal alternatives and two alternatives that would involve treatment followed by disposal, as follows:

- TD 1 – Off-site Disposal: Sediments and soils would be transported for disposal in permitted off-site landfills.
- TD 2 – Confined Disposal Facility (CDF): Sediments that are hydraulically dredged from certain river reaches would be pumped into on-site CDF(s) that would be built within a local waterbody.[7]
- TD 3 – Upland Disposal Facility: Sediments and soils would be placed in an Upland Disposal Facility constructed in an area near the River (but outside the 500-year floodplain), with an engineered cover, impermeable liners, and monitoring systems.
- TD 4 – Chemical Extraction: Sediments and soils would be treated using a chemical extraction process, in which an extraction fluid is mixed with those materials to remove some of the PCBs from the solids into the fluid. For purposes of the Revised CMS, it has been assumed that the treated solids would be disposed of off-site and that the fluid would be subject to wastewater treatment.[8]
- TD 5 – Thermal Desorption: Sediments and soils would be treated using a thermal desorption process, in which most of the PCBs are removed from those materials through application of heat to volatilize the PCBs and the volatilized PCBs are then condensed into a liquid, which would be sent off-site for incineration. This alternative has been evaluated under two assumptions: (a) that a portion of the thermally treated solids would be reused on-site as backfill in the floodplain (after mixing with organic material to promote plant growth and sampling to ensure that the concentrations are sufficiently low to allow reuse) and that the remainder of the treated materials would be sent off-site for disposal; and (b) that all treated sediments and soils would be sent off-site for disposal.

Evaluation Criteria**:** In accordance with the Permit, each of the alternatives and alternative combinations discussed above has been evaluated under three “General Standards” and six “Selection Decision Factors” specified in the Permit. These criteria are as follows:

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[7] Under this alternative, sediments that are not hydraulically dredged, as well as floodplain and bank soils, would have to be handled by another treatment/disposition method.

[8] At EPA’s request, a bench-scale treatability study was conducted of this technology, using a process developed by BioGenesis Enterprises, Inc. A report of that study and an analysis of it are included in this Revised CMS Report.

General Standards:

- Overall Protection of Human Health and the Environment;
- Control of Sources of Releases; and
- Compliance with Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) (or the basis for a waiver of an ARAR under the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]).

Selection Decision Factors:

- Long-Term Reliability and Effectiveness (including magnitude of residual risk, adequacy and reliability of alternative, and potential long-term adverse impacts on human health or the environment);
- Attainment of IMPGs;
- Reduction of Toxicity, Mobility, or Volume of Wastes;
- Short-Term Effectiveness (including impacts to the environment, nearby communities, and workers during implementation);
- Implementability; and
- Cost.

Under the Permit, GE is required to conclude its evaluations with a recommendation as to which alternatives or combination of alternatives, in GE's opinion, is "best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another."

ES.3 Evaluation

Overview**:** GE has conducted a thorough evaluation of each of the remedial alternatives described above under each of the nine Permit criteria, given the constraints imposed by the Permit and the EPA directives for the Revised CMS Report. Sections 1 through 5 of this Report describe in detail the approaches and procedures used in these evaluations. The evaluations of the individual sediment and floodplain alternatives are presented in Sections 6 and 7, respectively.[9] A comparative evaluation of the combinations of sediment and floodplain alternatives is presented in Section 8. The evaluation of the treatment/disposition

[9] As noted above, the evaluations of the sediment alternatives have used EPA's model to estimate future PCB concentrations in sediment, surface water, and fish resulting from the implementation of those alternatives. They have also used the extrapolations of the model results into Connecticut, although those extrapolations are highly speculative. EPA's model has also been used to evaluate the long-term reliability and effectiveness of caps, thin-layer caps, and backfill used in the various remedial alternatives, since the model includes simulations of the forces of erosion under high flow events, including an extreme storm event on the scale of a 50- to 100-year flood.

alternatives, including a comparative evaluation of those alternatives, is presented in Section 9. Cost estimates for combinations of sediment and floodplain alternatives with pertinent treatment/disposition alternatives are presented in Section 10.

ES.3.1 Evaluation of Sediment and Floodplain Alternatives

This summary of GE's evaluation of the sediment and floodplain remedial alternatives focuses on the evaluation of the combinations of those alternatives listed in Table ES-5 above. Based on its evaluation, GE has concluded that, given the constraints imposed by EPA's directives, the combination of SED 10 and FP 9 is "best suited" to meet the General Standards in the Permit, in consideration and balancing of the Selection Decision Factors. That combination would involve the following elements:

- Removal (followed by capping) of 66,000 cubic yards (cy) of sediment over 20 acres in selected areas of the River in Reach 5A;
- Stabilization of the riverbanks in selected areas in Reaches 5A and 5B (totaling approximately 1.6 linear miles), including removal of approximately 6,700 cy of bank soil;
- Removal of 169,000 cy of sediments over 42 acres in Woods Pond (in areas with the highest PCB concentrations in the upper sediments
- MNR in the remaining portions of the River in the Rest of River area; and
- Removal of 26,000 cy of floodplain soil (followed by backfilling) from approximately 14 acres of the floodplain.

The reasons for this conclusion are summarized below.

ES.3.1.1 Attainment of General Standards

<u>Overall Protection of Human Health</u>: The evaluation of protection of human health in this Revised CMS Report has considered initially the extent to which the sediment and floodplain alternatives would achieve the IMPGs based on EPA's HHRA. For direct human contact with sediments and floodplain soils, all of the combinations of sediment and floodplain alternatives identified above would achieve IMPGs within or below EPA's cancer risk range in all sediment and floodplain exposure areas established by EPA. In addition, all of those combinations would achieve the IMPGs based on non-cancer impacts in all such exposure areas, except that SED 2/FP 1 (MNR only) would not achieve those IMPGs for the most highly exposed individuals in 24 of the 120 floodplain exposure areas. Thus, even accepting EPA's HHRA, all of the combinations of alternatives would provide protection of human health from direct contact with sediments and soils, with the exception of purported non-cancer effects in a few floodplain areas under SED 2/FP 1. For human consumption of agricultural products from the floodplain, all of the sediment-floodplain alternative combinations would achieve IMPGs within or below EPA's cancer risk range, as well as the non-cancer IMPGs, in all farm areas evaluated for such consumption and thus would provide human health protection.

For human consumption of fish from the River, the post-remediation concentrations predicted by EPA's model under all combinations of alternatives would not, in Massachusetts, achieve both the cancer- and non-cancer-based IMPGs based on unrestricted consumption of fish within the model projection period (which ranges from 52 to 81 years). As a result, no matter the extent of remediation, fish consumption advisories would have to remain in place indefinitely to provide human health protection from the asserted risks reported in EPA's HHRA for human consumption of fish. In Connecticut, where fish PCB levels are already much lower, extrapolation of EPA's model results downstream (although highly uncertain) indicates that all of the alternative combinations would achieve very low PCB levels in fish by the end of the model period – i.e., 0.1 mg/kg or lower (except 0.16 mg/kg in one impoundment under SED 2/FP 1) – which may allow the Connecticut Department of Health to remove the fish consumption advisories for PCBs. In the meantime, fish consumption advisories would remain in place in Connecticut for human health protection.[10]

In considering overall protection of human health, it should also be noted that the larger combinations of sediment and floodplain alternatives would result in a greater risk of fatalities and injuries, both to on-site workers as a result of workplace accidents and to the public as a result of traffic accidents. For example, total injury estimates due to both workplace and traffic accidents indicate that SED 10/FP 9 would involve 3.7 such injuries, but that the larger combinations would involve approximately 7.5 to 41 such injuries, depending on the size of the project.

Overall Protection of the Environment: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

Application of the ecological IMPGs to the combinations of sediment and floodplain alternatives under evaluation indicates that SED 2/FP 1, SED 10/FP 9, SED 3/FP 3, and SED 5/FP 4 would achieve the IMPGs for some ecological receptor groups in all areas and would achieve the IMPGs for other receptor groups in some areas. For example, SED 10/FP 9 would achieve the IMPGs for warmwater fish and threatened and endangered species, as well as levels within the range of the IMPGs for omnivorous/carnivorous mammals, in all averaging areas; and it would achieve levels within the range of the IMPGs for benthic invertebrates in 84% of the averaging areas, for amphibians in 21% of the

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[10] Both Massachusetts and Connecticut also have state-wide fish consumption advisories based on mercury, unrelated to releases from the former GE plant. These advisories would not be affected by any reductions in PCB concentrations.

averaging areas, and for insectivorous birds in 58% of the areas.[11] The remaining combinations – SED 6/FP 4, SED 8/FP 7, and SED 9/FP 8 – would achieve the ecological IMPGs or levels within the ranges of those IMPGs for all receptor groups in all averaging areas.

However, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. The fact that there are exceedances of the IMPGs for certain receptors in certain areas does not translate into adverse impacts that would prevent the maintenance of healthy local populations of those receptors, let alone negatively impact the overall wildlife community in the Rest of River area. This is true, first, because of the highly conservative nature of the individual averaging areas to which the IMPGs are applied (as required by EPA) and the fact that the local populations of these receptors extend beyond those areas.[12] Furthermore, field surveys conducted by both EPA and GE, as well as other existing ecological information, have documented the presence of numerous and diverse plant and animal species (including state-listed rare species) that continue to reproduce and inhabit the River and floodplain in the PSA despite the fact that PCBs have been present in the area for over 70 years. Thus, even accepting the IMPGs based on EPA's ERA, the impact of the IMPG exceedances on the maintenance of healthy local populations of these receptors is at best uncertain.

Moreover, as noted above, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks. In particular, "it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat" (EPA, 2005d, p. 6-6). Thus, it is critical that any uncertain risks that may be indicated by IMPG exceedances be weighed against the certain adverse impacts on the habitat of further remedial efforts to achieve the ecological IMPGs. As discussed in detail in this report, implementation of any of the combinations of sediment and floodplain alternatives under evaluation except SED 2/FP 1 and SED 10/FP 9 would cause substantial and widespread short-term and long-term adverse impacts on the ecosystem of the PSA and the plants and animals that use it regardless of the implementation of restoration measures. These adverse impacts include:

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[11] That combination would not achieve the IMPGs for coldwater fish, piscivorous birds, or piscivorous mammals in any area.

[12] For example, the local populations of wood frogs, wood ducks, and shrews (which EPA has selected to represent amphibians, insectivorous birds, and omnivorous/carnivorous mammals) extend throughout the PSA; and the local population of mink (as representative of piscivorous mammals) extends beyond the boundaries of the PSA, including to tributaries of the River and to other riverine areas in the vicinity.

- *River Impacts*: The removal and/or capping of sediments in the River would remove or bury the existing aquatic vegetation and benthic invertebrates in those areas, displace the fish, and change the surface of the riverbed from its current condition (sand, sand and gravel, or silt) to a substrate composed of a stone cap or backfill material. This would alter the riverbed habitat until the natural deposition of sediments from upstream changes the surface back to a condition approximating its current condition, which could take many years, especially if the upstream areas are similarly impacted. While it is expected that, over time, vegetation, invertebrates, and fish would recolonize these areas, the length of time for that to occur and the abundance of organisms and mix of species in the recolonized community are uncertain, the return of specialized or rare species is doubtful, and colonization by invasive species is highly probable.

- *Riverbank Impacts*: All of these combinations of alternatives would involve the implementation of bank stabilization measures on both sides of the River along the 7 miles in Reaches 5A and 5B (14 linear miles of riverbanks) to control erosion. While these measures would include use of bioengineering techniques where appropriate, they would cause long-term and permanent adverse impacts on the riverbank habitat. By design, these measures would result in the permanent elimination of vertical and undercut banks, which provide critical habitat for several species of birds and other animals. They would also require the removal of the mature trees and other vegetation from the banks, as well as a long-term management plan to prevent the reforestation of the stabilized banks (due to the potentially destabilizing effect of large trees on those banks). This would result in a permanent change in the vegetative character of the banks from their current wooded condition to a more open condition with dense shrub growth, with a corresponding reduction in the quality of the habitat for birds, dragonflies, reptiles, and mammals that currently use the mature trees on the banks. Further, the implementation of stabilization measures would produce a long-term reduction in animal slides and burrows on the banks and in access routes for the movement of smaller and less mobile animals to and from the River. As a result of these changes, there would be a long-term reduction in species richness and diversity on the riverbanks, and the stabilized riverbanks would never return to their current condition.

- *Floodplain Forest Impacts*: The floodplain soil removal activities and the necessary access roads and staging areas in the floodplain (to support both sediment and floodplain remediation) would have long-term negative impacts on the floodplain forests, which include a variety of forested wetland habitats. These activities would involve the removal of all trees, shrubs, and other vegetation in the affected areas and (for soil removal) replacement of existing native soil with commercial backfill having different characteristics. In the areas of mature floodplain forests that would be impacted by these activities (ranging from 38 to 178 acres under these combinations of sediment and floodplain alternatives), this would result in a long-term loss of those forested habitats. It would take at least 50 to 100 years for a replanted forest community to reach a mature condition comparable to current conditions, and that progression could take even longer and would be unreliable in large cleared areas due to cumulative stresses from floods, changes in microclimate, changes in hydrology, and colonization by invasive species. During that period, there would be a loss of the forest wildlife species (including rare species) that currently utilize these mature forested wetland habitats, and the return of at least some of those species would be doubtful.

- *Other Wetland Impacts*: In other impacted floodplain wetland areas (ranging from 21 to 75 acres under these combinations), the soil removal activities and construction of access roads and staging areas would cause changes in the soil conditions, vegetation, and hydrology of the wetlands. These impacts would last until soil and hydrological conditions similar to pre-remediation conditions return through flooding and other natural processes – which is unpredictable. During this period, the wildlife that use these wetlands would be lost. In fact, even after the return of such conditions, the biological communities that are re-established may not match the pre-remediation communities. For example, there would be a high potential for proliferation of invasive plants, and the return of sensitive species, including state-listed wildlife species, would be doubtful.

- *Vernal Pool Impacts*: Each of these combinations of sediment and floodplain remedial alternatives would involve excavation and replacement of soils in all or portions of most (88% or more) of the vernal pools in the PSA floodplain. These activities would cause an immediate loss, in all or parts of these pools, of the amphibian and other species that depend on vernal pools for breeding. They would also cause both short-term and long-term alterations in the hydrology, vegetation, and soil conditions of these vernal pools. The ability to re-establish these characteristics of vernal pools, especially their hydrology, is limited and highly susceptible to failure. Moreover, these combinations of alternatives would involve considerable disturbances of the habitats surrounding the vernal pools, which (in the immediately adjacent areas) are critical for maintaining water quality and providing shade and litter for the pools and (in areas up to 750 feet from the pools) provide a variety of protective cover, temperature and moisture regulation, and overwintering habitat functions for the vernal pool amphibians. Even small impacts to these habitats have the potential to disrupt important aspects of those areas' non-breeding functions for the vernal pool amphibians. In addition, the disturbances within and around the vernal pools would create a high potential for predators (e.g., green frogs, bullfrogs) to invade individual vernal pools, which would further undermine the re-establishment of the vernal pool functions. Due to these impacts, it is highly likely that the full complement of characteristics that contribute to vernal pool functions would not be re-established in at least many of the affected vernal pools. As a result, there would be a long-term or permanent loss of sensitive vernal pool species in the PSA.

- *River/Floodplain Corridor Impacts*: These combinations of sediment and floodplain remedial alternatives would result in fragmentation of the contiguous, largely undisturbed forested riparian/floodplain corridor in the PSA. Such habitat fragmentation would displace some species and disrupt the dispersal and migratory movements of species that rely on the existing forested riparian corridor to facilitate access and movement.

Under all of the combinations of alternatives except SED 2/FP 1 and SED 10/FP 9, these impacts would occur over extensive areas of the Rest of River, as shown by the impacted area acreages in Table ES-5 above. Overall, these impacts would cause severe harm to the animals that the IMPGs were designed to protect. As a result, these combinations of alternatives would have a net negative ecological impact on the Rest of River and thus would not meet the standard of providing overall protection of the environment.

Implementation of SED 2/FP 1 would not produce any of these adverse impacts. However, based on EPA's conclusions in its ERA (which GE strongly disagrees with but has been directed to follow), that combination of alternatives may not be fully protective of the environment due to the number and extent of exceedances of the ecological IMPGs (although the impact of these exceedances on the maintenance of healthy local populations of the wildlife receptors is still uncertain).

While SED 10/FP 9 would have some of the above-described short-term and long-term adverse ecological effects in certain areas, it would minimize those impacts relative to the other combinations of sediment and floodplain removal alternatives and would not produce widespread long-term impacts on the overall environment of the PSA. Based on balancing the certain adverse impacts of remedial activities with the, at most, uncertain risks of PCBs remaining in the ecosystem, SED 10/FP 9 would provide overall protection of the environment, since it would (a) reduce the PCB exposure levels of ecological receptors and provide additional protection from the perceived PCB effects reported in EPA's ERA, while at the same time (b) causing the least amount of environmental damage of any of the combinations involving removal.

Control of Sources of Releases: The extent to which the combinations of sediment and floodplain alternatives would control sources of PCB releases focuses on the sediment components of those combinations, because the floodplain is not a significant source of PCB releases to the River, as it is generally flat, well vegetated, and depositional in nature. Completed and ongoing source control and remediation measures upstream of the Confluence, along with natural recovery processes, have resulted and will continue to result in significant reductions in the mass of PCBs entering the Rest of River. As noted above, water column data indicate that the upstream source control and remediation actions reduced the PCB concentrations in the water entering the Rest of River by a factor of three to five. EPA's model estimates that, in 52 years, the upstream remediation and natural recovery processes (reflected in the simulation of SED 2) would result in further reductions of 37% and 41% (relative to current levels) in the mass of PCBs passing Woods Pond and Rising Pond Dams, respectively, and a reduction of 50% in the mass of PCBs transported from the River to the floodplain in Reaches 5 and 6. The sediment components of the other combinations of alternatives would control additional sources within the Rest of River by permanently removing and/or capping PCB-containing sediments, resulting in an additional reduction in PCB transport in the River and to the floodplain. The model results indicate that, under SED 10, the mass of PCBs passing both Woods Pond and Rising Pond Dams would decrease by 62% relative to current levels, while the PCB mass transported to the Reach 5/6 floodplain would decrease by 68%. Under SED 3, the modeled total decrease in these three PCB loads (i.e., mass transport) would be 94%, 87%, and 97%, respectively. For alternatives greater than SED 3, the modeled reductions in all three loads level off, and are generally greater than 95%, achieving little additional reduction in the PCB transport passing Woods Pond and Rising Pond Dams and to the Reach 5/6 floodplain despite the remediation of substantially more surface area and the consequent increase in adverse ecological impacts.

Moreover, EPA's model predicts no significant differences among all these alternatives in the extent to which, following their implementation, a large flood event could cause buried sediments to be exposed.

Compliance with ARARs: The detailed analyses presented in later sections of this report show the following with respect to the compliance of the combinations of sediment and floodplain alternatives with requirements that have been identified as potential ARARs:

- Based on forecasts from EPA's model, SED 2/FP 1 and SED 10/FP 9 would not achieve the federal and state water quality criterion for freshwater aquatic life (0.014 μg/L) in Massachusetts (but would in Connecticut). The other combinations of alternatives would achieve that criterion according to the same model. However, where it is not met, this criterion should be waived under CERCLA on the ground that the actions necessary to achieve it would result in greater risk to the environment than alternatives that do not achieve that criterion, as discussed above under protection of the environment.

- Based on EPA's model forecasts, none of the sediment-floodplain combinations would achieve the very low federal and Massachusetts water quality criterion based on human consumption of organisms (0.000064 μg/L) in any of the Massachusetts reaches or in one or more of the four Connecticut impoundments. For that reason, that criterion should be waived under CERCLA as technically impracticable to meet.

- SED 2/FP 1 would achieve all the relevant location-specific and action-specific ARARs (since SED 2 would meet the ARARs relating to MNR and there are no ARARs for FP 1). The other combinations of sediment and floodplain alternatives could be designed and implemented to achieve certain of the potential location-specific and action-specific ARARs, but there are a number of federal and state regulatory requirements that would not be met (including those relating to the protection of the Upper Housatonic ACEC). To the extent that these requirements constitute ARARs, they would need to be waived by EPA as technically impracticable to meet (or on some other ground) under CERCLA. However, the requirements that would not be met, and thus would require waivers, are fewer under SED 10/FP 9 than under the other combinations.[13]

ES.3.1.2 Consideration and Balancing of Selection Decision Factors

A balancing of the Selection Decision Factors favors SED 10/FP 9. For example:[14]

Long-Term Reliability and Effectiveness: In terms of the magnitude of residual risk, all of the combinations of sediment and floodplain remedial alternatives would result in substantial reductions in PCB concentrations in sediments, surface water, and fish in the Rest of River. For example, based on forecasts using EPA's model, completed and ongoing upstream source control and remediation measures, along with natural recovery processes, as reflected in the simulation of SED 2/FP 1, would result in reductions of 40% to 60% in fish fillet concentrations relative to current conditions (depending on the river reach).[15] The other combinations are estimated by the model to result in greater total reductions in fish fillet concentrations – 50% to 80% for SED 10/FP 9, 75% to nearly 100% for SED 3/FP 3, and mostly greater than 90% to nearly 100% for the remaining combinations. However, the additional reductions achieved by SED 3/FP 3 and the larger alternatives would require the removal of substantially more aquatic habitat, with a corresponding increase in the adverse ecological impacts described above. For example, SED 3/FP 3 would adversely impact more than twice the aquatic habitat as SED 10/FP 9 and the remaining alternative combinations would adversely impact approximately 5 to 6 times more aquatic habitat than SED 10/FP 9.

Similarly, while the combinations involving floodplain soil removal would reduce the floodplain PCB concentrations over progressively larger areas – from SED 10/FP 9 to SED 3/FP 3 to SED 5/FP 4 and SED 6/FP 4 to SED 9/FP 8 and finally to SED 8/FP 7 - they

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[13] In addition, under all of the combinations of alternatives except SED 2/FP 1, it is possible that, in the unlikely event that excavated sediments or soils should be found to constitute hazardous waste under RCRA or comparable state regulations (which is not anticipated), the temporary staging areas for the handling of those materials may not meet certain requirements for the storage of hazardous waste. In that unlikely event, such requirements should be waived as technically impracticable. This possibility applies equally to all of these combinations of alternatives.

[14] This section focuses on long-term reliability and effectiveness, short-term effectiveness, implementability, and cost. Attainment of IMPGs was discussed previously under Overall Protection of Human Health and the Environment. With respect to the reduction of toxicity, mobility, or volume of wastes, none of the combinations of alternatives would include any treatment processes that would reduce the toxicity of PCBs in the sediments or soils; reduction of mobility of PCBs in the River can be assessed in terms of the extent to which the alternatives would reduce the transport of PCBs past Woods Pond and Rising Pond Dams and into the PSA floodplain, as discussed above under Control of Sources of Releases; and the removal volumes are shown in Table ES-5 above.

[15] It should be noted that the most recent (2008) adult fish sampling data from Reach 5B/5C and Woods Pond show lower PCB concentrations in those fish than the initial concentrations in EPA's model. This suggests that, over time, SED 2/FP 1 may achieve even lower concentrations than predicted by EPA's model. This would need to be confirmed by future fish sampling.

would also have increasingly greater negative impacts on the diverse ecological habitats within the floodplain and the plants and animals that use them.

As discussed above, all of the combinations of sediment and floodplain removal alternatives except SED 10/FP 9 would cause substantial and widespread long-term, and in some cases permanent, adverse impacts on the ecosystem of the PSA. These impacts include alteration of the aquatic habitat for an uncertain length of time, a permanent change in the riverbank habitat in Reaches 5A and 5B (including loss of mature overhanging trees and vertical and undercut banks), a long-term loss of floodplain forests and other wetlands in the PSA, a long-term or permanent loss of many of the vernal pools in the PSA, and fragmentation of the contiguous, largely undisturbed forested riparian/floodplain corridor in the PSA. These impacts would result in a corresponding loss of the many and diverse wildlife species, including state-listed rare species, that rely on those habitats. While SED 10/FP 9 would have some of these impacts in some areas, it would minimize those impacts and would not produce widespread long-term impacts on the overall ecosystem of the PSA.

Short-Term Effectiveness: The prognosis is much the same for short-term adverse impacts. Apart from SED 2/FP 1, SED 10/FP 9 would cause the fewest such impacts. Since that combination would affect less surface area and have a shorter duration than any of the other alternative combinations involving removal, it would cause less habitat destruction, less disruption of recreational use of the River and floodplain, and a shorter period of disruption to local communities from construction noise and truck traffic.[16] Similarly, when compared to the other combinations of sediment and floodplain removal alternatives, SED 10/FP would result in the fewest emissions of greenhouse gases (GHG) – e.g., approximately 18% less than SED 3/FP 3, 2.5 times less than SED 5/FP 4, 5 times less than SED 9/FP 8, and 13 times less than SED 8/FP 7. It would also result in the fewest overall truck trips for transport of excavated and replacement materials, with the lowest attendant risk of traffic accidents, and would have the lowest estimated number of injuries to on-site workers.

Implementability: All of the combinations of sediment and floodplain removal alternatives under evaluation would use available and established construction techniques (except for an unproven removal/capping approach suggested by EPA to meet its directives for Reach 5A under SED 9). However, based on available information regarding remedies at other sites, no dredging/removal projects have been identified of the magnitude of several of the combinations of sediment and floodplain alternatives being considered here (i.e., SED 3/FP 3, SED 5/FP 4, SED 6/FP 4, SED 8/FP 7, and SED 9/FP 8) in a setting comparable to the Rest of River. As a result, implementation of those combinations would involve complications and uncertainties that have not been encountered at other sites and that

[16] In addition, except for SED 3/FP 3 (which would involve the smallest amount of sediment removal), SED 10/FP 9 would result in the lowest potential for resuspension of PCB-containing sediments during sediment removal.

would not be faced (or would be less significant) for a smaller-scale combination of alternatives, such as SED 10/FP 9.

Cost: Estimated costs are presented in Section ES-4 below for combinations of the combined SED/FP alternatives with the treatment/disposition alternatives. As shown there, this factor also favors SED 10/FP 9 among the combinations of sediment-floodplain alternatives that involve removal.

ES.3.2 Evaluation of Treatment/Disposition Alternatives

Applying the Permit criteria, GE has concluded that TD 3, disposition in an on-site Upland Disposal Facility, constitutes the best of the treatment/disposition alternatives for the reasons discussed below.[17] Since TD 2 (disposition in local in-water CDF(s)) does not appear to be viable and would not meet the General Standard of overall environmental protection,[18] this analysis focuses on the other treatment/disposition alternatives.

ES.3.2.1 Attainment of General Standards

Overall Protection of Human Health and the Environment: TD 1 and TD 3 would provide overall protection of human health and the environment through permanent disposal and isolation of removed sediments and soils in a permitted off-site landfill (TD 1) or in an Upland Disposal Facility, which would be constructed with impermeable liners and a cover and would be subject to long-term monitoring and maintenance to ensure its effectiveness (TD 3). TD 4 (chemical extraction) would provide protection by reducing the PCB concentrations in the sediments and soils, followed by appropriate disposal of the treated material. Based on bench-scale study results, it appears that the chemical extraction process could not reduce PCB concentrations in the treated material to levels that would allow on-site reuse. Thus, the treated solid material would be transported off-site for disposal, and the large volumes of wastewater would also be treated prior to discharge, with off-site disposal of the water treatment sludge. TD 5 (thermal desorption) would provide protection by reducing the PCB concentrations in the treated sediments and soils. However, that alternative would produce the greatest amount of greenhouse gas emissions of any of the treatment/disposition alternatives (as discussed further below). Moreover, if a portion of the thermally treated soils is reused as backfill in the floodplain, that reuse would result in long-term adverse environmental impacts in the floodplain forest and other wetland areas due to

[17] As discussed in the body of this report, three potential locations have been identified for such a facility, all of which are located relatively near the River but outside the 500-year floodplain.

[18] The reasons for this conclusion are that in-water CDF(s) (assumed to be constructed in the deep portion of Woods Pond and/or a backwater area): (a) could be used only for certain hydraulically dredged sediments under certain sediment alternatives and would not provide for disposition of the remaining sediments or of floodplain or riverbank soils; (b) would not meet numerous ARARs; and (c) would result in a permanent loss of aquatic habitat in a large portion of Woods Pond and/or the backwater where the CDF(s) would be constructed, as well as a likely loss of flood storage capacity in those areas, thus failing to provide overall protection of the environment.

the differences in soil characteristics between that material (even after mixing with organic material) and the existing natural soil in those wetland areas. Hence, TD 5 with such reuse would not provide overall protection of the environment.

Control of Sources of Releases: All of these treatment/disposition alternatives would meet the standard for control of sources of future releases of PCBs. TD 1 and TD 3 would effectively and permanently isolate the PCB-containing sediments and soils from being released into the environment through placement of those materials into off-site permitted landfills or into a properly designed and monitored Upland Disposal Facility, located outside the floodplain, any of which would be designed to prevent such releases. TD 4 and TD 5 would control future releases through treatment of the sediments and soils, followed by appropriate off-site disposition of the treated material, although these alternatives do present the potential for some leaks or spills during treatment activities.

Compliance with Federal and State ARARs: There are no identified ARARs for TD 1, since that alternative would involve off-site transport and disposal. For TD 3, the Upland Disposal Facility could be designed and operated to meet the pertinent ARARs (provided that EPA makes any necessary risk-based approval determination under its Toxic Substances Control Act [TSCA] regulations), with the possible exception of certain habitat-related requirements (depending on the location and size of the facility) and certain siting restrictions that could potentially apply in the unlikely event that the materials involved were found to be subject to the state hazardous waste regulations. TD 4 and TD 5 could be designed and implemented to meet most of the potential ARARs (again assuming that EPA makes any necessary risk-based determination under its TSCA regulations); but there are some regulatory requirements that could not be met (and some that might not be met) at the location identified for a treatment facility or in the unlikely event that the materials to be treated were found to be subject to the state hazardous waste regulations. To the extent that any regulatory requirements that could not be met constitute ARARs, EPA would need to waive them under CERCLA as technically impracticable to meet.

ES.3.2.2 Consideration and Balancing of Selection Decision Factors

An overall balancing of the Selection Decision Factors favors TD 3.[19] A full discussion of the application of each of those factors (other than IMPG attainment, which is not relevant here) to the treatment/disposition alternatives is provided in the text of this report. The main reasons are summarized below.

Overall Reliability: On-site disposal in a properly designed facility has been used reliably at numerous sites, and would have the highest degree of long-term effectiveness and reliability,

[19] The extent to which TD 3 is better suited to meet the Permit criteria than TD 1 increases with the volume of excavated materials to be disposed of and the duration of the implementation period, and is less pronounced with the volumes and durations at and near the lower end of the range.

particularly for larger volumes of material. Use of off-site disposal facilities (TD 1) is also common for permanent disposal, but as the volume of materials requiring disposal and the length of time required to do so increase, the more uncertainty would exist regarding the future availability of sufficient off-site landfill capacity over the long term.

The use of chemical extraction (TD 4) has not been demonstrated at full scale on sediments and soils comparable to those in the Rest of River, and there are uncertainties regarding the extent to which that process can reduce PCB concentrations in such materials. Results from the site-specific bench-scale study indicate that PCB concentrations cannot be reduced to levels that would allow reuse. Moreover, based on those results, there are uncertainties regarding the extent to which the treated materials could be disposed of off-site as non-TSCA-regulated materials.

Thermal desorption (TD 5) has rarely been used to treat PCB-containing sediments, due in part to the time and cost of removing moisture from the sediments prior to treatment. Mechanical problems can result from treatment of high-organic, high-moisture-content, fine-grained materials, which can clump and clog equipment or otherwise be physically difficult to treat. Further, while thermal desorption has been used at several sites to treat PCB-containing soils, the volumes of materials treated in those cases were substantially smaller and the duration of the treatment operation was substantially shorter than the volumes and duration that could be involved at the Rest of River. Moreover, when on-site reuse of thermally treated materials has occurred, the materials have typically been placed in a small area and covered with clean backfill. In short, the reliability of this process for treatment of a large volume of materials like the Rest of River sediments and soils is unknown, as is the ability to use the thermally treated solids (even after mixing with organic material) as backfill in the floodplain without being covered by other material.

<u>Long- and Short-Term Adverse Impacts</u>: All of these TD alternatives would have some negative impacts on the environment and local communities. In terms of local ecological impacts, TD 1 would have no such impacts, TD 4 and TD 5 would result in a temporary loss of habitat at the location of the treatment facility for the period of treatment and some time thereafter, and TD 3 would result in a permanent loss of the existing habitat in the specific area of the disposal facility. The significance of this loss of habitat would depend on the existing habitat type at the facility location and on the size of the facility. For example, for TD 3, the existing habitat at the locations identified for a disposal facility ranges from disturbed land that is or was used as a sand and gravel quarry (where any habitat effects would be minimal) to mature upland forest (where habitat effects would be more significant, but still limited to the area of the facility). For TD 4 and TD 5, the existing habitat at the location identified for a treatment facility consists of open grassland with scattered shrub growth.

All of these alternatives would generate increased GHG emissions during their implementation. For the range of removal volumes, TD 3 would produce the fewest such emissions, TD 1 and TD 4 would produce considerably greater GHG emissions, and TD 5 would produce by far the greatest amount of GHG emissions of any of the TD alternatives –

with the differences among these alternatives increasing as the volumes of material to be disposed of or treated increase. In addition, the thermal desorption process under TD 5 could lead to the volatilization and emission of certain metals (e.g., mercury) and the emission of dioxins/furans which can be formed during the process.

All of these alternatives would also cause an increase in truck traffic for the transport of excavated materials from the staging areas to the disposal or treatment facility(ies) (and, for TD 4 and TD 5, from the treatment facility to off-site disposal facilities) and for the delivery of construction materials and equipment to the disposal or treatment facility (for TD 3 through TD 5). This increase in truck traffic would create short-term impacts, including increased noise and an increased risk of accidents, not only for local communities but also for communities along the transportation routes. For example, an estimate of traffic accident risks from the off-site truck traffic associated with these alternatives indicates that, for the range of volumes, TD 1 and TD 4 would cause the most injuries related to such transport, followed closely by TD 5, with far fewer transport-related injuries for TD 3.

ES.4 Combined Cost Estimates

Estimated costs for combinations of the seven sediment-floodplain alternative combinations under evaluation with the five treatment/disposition alternatives are presented in Table ES-6 below.

Table ES-6. Total Cost Estimates for Combinations of SED/FP Alternative Combinations with TD Alternatives[1]

Alternative	TD 1	TD 2[2]	TD 3[3]	TD 4	TD 5[4]
SED 2/FP 1	$ 5 M	NA	$5 M	$5 M	$5 M
SED 3/FP 3	$251 M	NA	$204 - 228 M	$274 M	$337 - 366 M
SED 5/FP 4	$483 M	NA	$362 - 402 M	$509 M	$679 - 709 M
SED 6/FP 4	$612 M	$487 M	$444 - 493 M	$619 M	$860 - 891 M
SED 8/FP 7	$1,740 M	$1,337 M	$1,160 M	$1,826 M	$2,866 - 3,026 M
SED 9/FP 8	$729 M	$558 M	$435 - 512 M	$662 M	$1,132 - 1,175 M
SED 10/FP 9	$183 M	NA	$121 - 146 M	$181 M	$283 - 290 M

1. Cost are given in 2010 dollars; $ M = million dollars
2. Where applicable, estimated costs assume placement in CDFs of certain hydraulically dredged sediments and off-site disposal for remaining excavated materials.
3. Range depends on location of Upland Disposal Facility. For sediment-floodplain alternatives in which the removal volume exceeds the capacity of the Upland Disposal Facility at a given location, cost estimates were made only for the location(s) where that entire volume of material could be disposed of.
4. Low end of range assumes reuse in floodplain of half of treated floodplain soils and off-site disposal of remaining treated materials; high end of range assumes off-site disposal of all treated material.

As can be seen from the above table, the most cost-effective combination of alternatives, apart from those involving SED 2/FP 1, is the combination of SED 10, FP 9, and TD 3, all of which would meet the General Standards in the Permit. Under the National Contingency Plan, where more than one alternative would achieve the threshold criteria, the most cost-effective alternative must be selected (see 40 CFR § 300.430(f)(1)(ii)(D)).

ES.5 Overall Conclusion

Taking into account EPA's HHRA and ERA and using EPA's directives for the CMS, as required under the Permit, GE has concluded that a combination of alternatives SED 10, FP 9, and TD 3 is best suited to meet the General Standards of the Permit, including protection of human health and the environment, in consideration of the Selection Decision Factors, including balancing of those factors against one another. Taken as a whole, this would be a major remedial project – a 5-year project involving the excavation and disposal of over 265,000 cubic yards of sediment and soil, at an estimated combined cost of $121 to $146 million (depending on the location of the local disposal facility). As noted above, this conclusion is subject to GE's reservations of rights, including its appeal rights, and thus does not constitute a proposal to implement these alternatives.

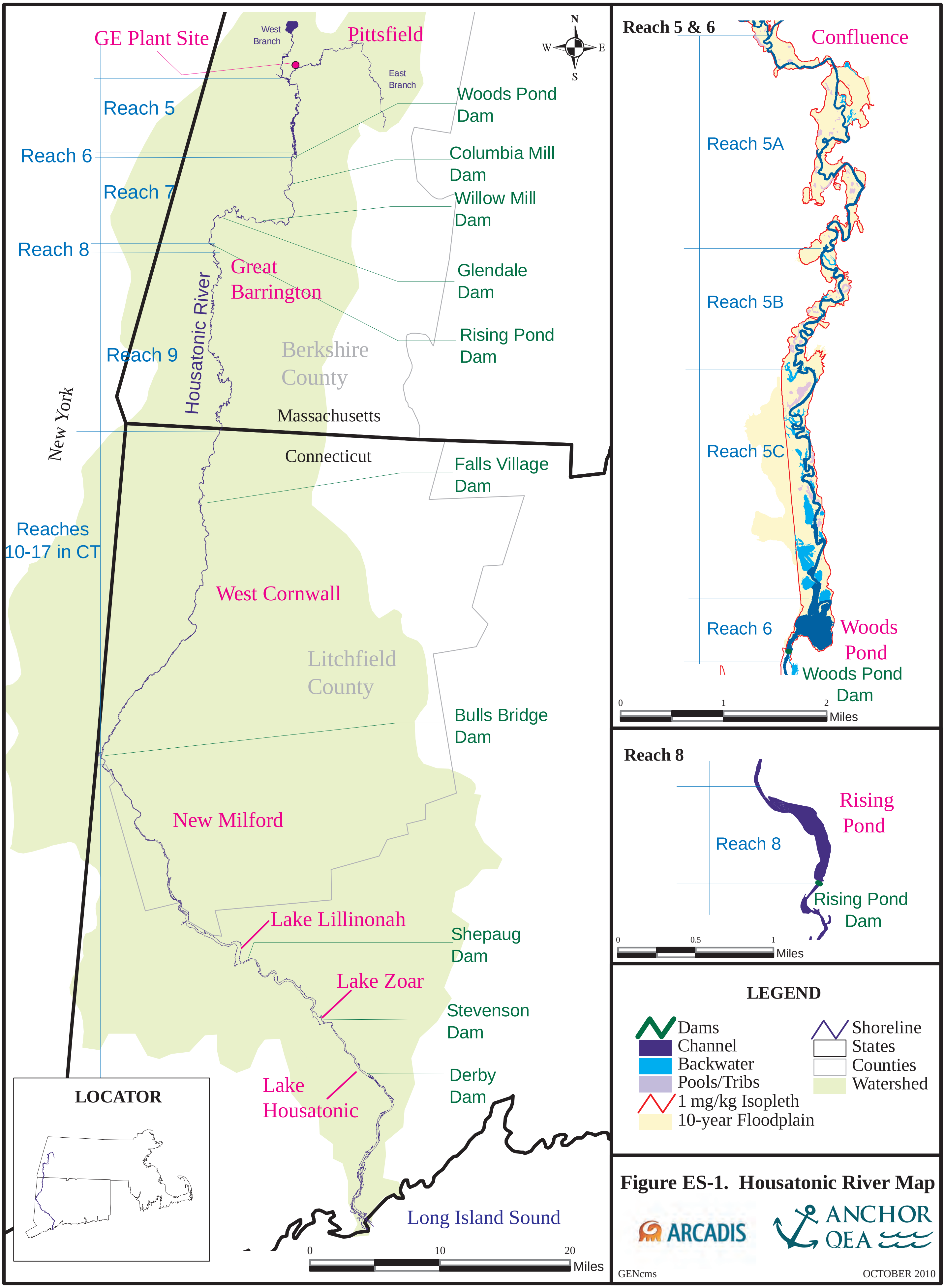

Figure ES-1. Housatonic River Map

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