LEARN MORE AT: www.epa.gov/region1/ge

Statement of Basis for EPA's Proposed Remedial Action for the Housatonic River "Rest of River"

THE RIVER *The Housatonic River is contaminated with polychlorinated biphenyls (PCBs) released from the General Electric Company (GE) facility in Pittsfield, MA. The entire site consists of the 254-acre GE facility; the Housatonic River and its banks and floodplains from Pittsfield, MA, to Long Island Sound; and other contaminated areas. Under a federal Consent Decree, GE is required to address contamination throughout the site, including in the River.*

YOUR OPINION COUNTS: OPPORTUNITIES TO COMMENT

EPA is accepting public comment on this proposal from June 25, 2014 through August 8, 2014. EPA's Proposed Remedial Action is based on current information and the cleanup plan could change in response to public comment or new information. The following two public informational meetings will include a presentation describing the Proposed Remedial Action, followed by a question and answer session. EPA will begin a formal public comment period on June 25, 2014. Near the end of the public comment period, EPA will schedule a Public Hearing where the public will have an opportunity to make oral comments during this Hearing for EPA to consider. You may also submit written comments – see page 43 to find out how.

For further information about these meetings, call Kelsey O'Neil of EPA's Community Affairs office at 617-918-1003, or toll-free at 1-888-372-7341.

<u>Public Informational Meeting</u>
Wednesday, June 18, 2014 at 6:00 pm at Lenox Memorial Middle/High School, Lenox, MA
<u>Public Informational Meeting</u>
Tuesday, June 24, 2014 at 6:00 pm at Kent Town Hall, Kent, CT
<u>Public Hearing</u>
date/time/location to be determined

SUMMARY:

After careful study of the impacts of PCBs released to the Housatonic River from the GE-Pittsfield/Housatonic River site in Pittsfield, MA, and in consideration of the contaminant reduction accomplished by cleanup activities at other parts of the site, EPA proposes the following cleanup actions, known as corrective measures, or remedial action, for the "Rest of River" component of the GE-Pittsfield/Housatonic River site. EPA's Proposed Remedial Action was developed after consultation with Massachusetts Departments of Environmental Protection (MassDEP) and Fish and Game (MassDFG) and the Connecticut Department of Energy and Environmental Protection (CT DEEP).This Statement of Basis, in conjunction with the Draft Modification to the Reissued RCRA Permit, constitute EPA's "Proposed Plan" or "Proposed Cleanup Plan," setting forth EPA's Proposed Remedial Action for the Rest of River and Operation and Maintenance (O&M) as prescribed by Paragraph 22.n. of the Consent Decree (termed the "Proposed Remedial Action" or "Proposed Cleanup Plan" throughout this document) to address polychlorinated biphenyl (PCB) contamination in river sediment, banks and floodplain soil, and biota which poses an unacceptable risk to human health and the environment.

In addition to addressing risks in the areas slated for cleanup, the Proposed Remedial Action also includes provisions to reduce downstream transport of PCBs, relax or remove fish consumption advisories, and to avoid, minimize and/or mitigate adverse impacts to state-listed species and their habitats regulated under the Massachusetts Endangered Species Act (MESA), and

continued >

evaluated in the ERA for eight different groups of organisms that reside in the Housatonic River and its floodplain; three of these were aquatic (benthic invertebrates, amphibians, and fish) and five were wildlife (insect-eating birds, fish-eating birds, fish-eating mammals, other mammals, and Special Status Species (e.g., endangered or threatened). Whenever possible, three distinct lines of evidence were evaluated to best assess risk (site-specific field studies, site-specific toxicity studies, and adverse effects reported in the literature). Based on the weight of evidence in this evaluation, the following unacceptable ecological risks were identified in Massachusetts in Reaches 5 and 6 and are described as high or intermediate:

- PCBs in sediment and prey, as well as in the floodplain and vernal pools adjacent to those areas, posed high risk to amphibians and piscivorous (fish-eating) mammals. Risk was also high for some insectivorous birds, such as wood duck;
- Risk was intermediate to high for benthic invertebrates, organisms that live in and on river sediment and form the base of the food chain;
- Risk was high for exposure to prey for bald eagle and American bittern, two birds selected to represent the Threatened & Endangered (T&E) species, and intermediate for a T&E mammal species (small-footed myotis, a bat); and
- Risk was intermediate for piscivorous birds (osprey and belted kingfisher), and for omnivorous and carnivorous mammals (red fox and short-tailed shrew).

In addition, in limited areas downstream of Woods Pond to Rising Pond in Reaches 7 and 8, exposure to PCBs leads to potential risks to benthic invertebrates, amphibians, trout, piscivorous mammals, and bald eagles. In Connecticut, exposures to PCBs cause potential risks to wildlife that eat fish.

DESCRIPTION OF CLEANUP OBJECTIVES AND ALTERNATIVES CONSIDERED

The cleanup alternatives were developed to address the following cleanup objectives:

- Reduce the cancer risk and non-cancer risk for humans (defined as achieving concentrations that do not pose unacceptable risks using EPA's cancer risk range of one in one million to one in 10,000 (10^{-6} to 10^{-4}) and a non-cancer HI of 1) from exposure to PCBs in dietary items (primarily fish and duck), floodplain soil, and/or sediment in the Rest of River.
- Reduce the risk to ecological receptors from exposure to PCBs.
- Reduce the long-term downstream transport of PCBs in the Rest of River. This objective also includes the control of sources of releases to the river.

To meet these objectives, EPA has proposed Performance Standards, corrective measures, and identified ARARs for the Rest of River which are outlined in more detail in the Draft Permit. Cleanup alternatives were developed and evaluated by GE in the Corrective Measures Study (CMS). EPA has supplemented the analysis conducted by GE with additional supporting documentation. The cleanup options, or remedial alternatives, that were evaluated in detail and were considered for the Rest of River are summarized below.

Development of Cleanup Alternatives

Eleven alternatives were developed for addressing contamination in sediment and riverbanks. The 11 alternatives are termed SED 1 through SED 9, SED 9 MOD, and SED 10. These alternatives encompass a broad range of options from no action to the removal of over 2 million cubic yards of sediment and up to 35,000 cubic yards of riverbank soil. Ten alternatives (FP 1 through FP 4, FP 4 MOD, and FP 5 through FP 9) addressing PCB contamination in floodplain soil in the Rest of River were also developed. All of the floodplain alternatives involve removal of different volumes of contaminated floodplain soil and placement of backfill except FP 1, the no action alternative.

As part of the site study, a range of potential cleanup goals, known as Interim Media Protection Goals (IMPGs) were developed as one of the factors to use in the comparison of remedial alternatives. In addition to the IMPGs, it is important to note that certain specific numerical Performance Standards, which may differ from the IMPGs, are being proposed in the Draft Modification to the Reissued RCRA Permit to be met as part of the remedy. To develop a range of cleanup alternatives, different options for cleanup goals were used to address potential cancer risk to human health. The cleanup goal options for human health used by EPA to develop alternatives are within the range of what EPA considers to be protective. Human health cleanup goals are based upon reducing risk to within acceptable levels (to within EPA's 10^{-6} to 10^{-4} cancer risk range and/or non-cancer Hazard Index of one). Similarly, a range of IMPGs for ecological receptors were also developed.

The Performance Standards and corrective measures for EPA's Proposed Cleanup Plan are discussed generally in the section entitled "A Closer Look at EPA's Proposed Cleanup Plan" and outlined in specific terms in the Draft Permit.

More detail on these individual options to address sediment, riverbanks, and floodplain soil can be found in the Administrative Record.

Combined Sediment and Floodplain Soil Alternatives

The remedy for the Rest of River will necessarily involve both sediment and floodplain components. In order to more easily explain and compare the alternatives, the individual sediment and floodplain alternatives have been combined into nine comprehensive alternatives for all contaminated material (floodplain soil/sediment). The Combination Alternatives (or Combinations), listed below, were designed to span the full range of remedial actions in terms of removal volumes, methods, and affected areas:

Combination Alternative 1: SED1/FP 1
(the "no action" alternative)
Combination Alternative 2: SED 2/FP 1
Combination Alternative 3: SED 3/FP 3
Combination Alternative 4: SED 5/FP 4
Combination Alternative 5: SED 6/FP 4
Combination Alternative 6: SED 8/FP 7
Combination Alternative 7: SED 9/FP 8
Combination Alternative 8: SED 10/FP 9
Combination Alternative 9: SED 9 MOD/FP 4 MOD
(EPA's Proposed Remedial Action)

A matrix showing each combination alternative broken down by river reach and floodplain is shown in Table 1. Table 2 outlines estimated volumes, timeframe, and acres addressed for each of the combinations. Please note that the terms "Combination Alternative 1" through "Combination Alternative 9" are used to simplify the discussion and analysis for the reader of this document. In other technical documents that are part of the Administrative Record, the various individual sediment and floodplain alternatives are typically referred to using their corresponding "SED" and "FP" designations.

The evaluation of cleanup alternatives for Rest of River was based on eleven sediment alternatives, ten floodplain alternatives, and five treatment/disposition alternatives. In the proposed RCRA Permit modification and in GE's Revised CMS submittal, alternatives have been analyzed through the use of combination alternatives for sediment and floodplain. These combined alternatives recognize the interrelated nature of the sediment and floodplain cleanup, infrastructure, and thus the interrelated nature of decision-making for the proposed remedy. As such, the combination alternatives are designed to make review of the many possible combinations of different approaches more manageable for the public. Nonetheless, EPA is soliciting public input on each component of the Proposed Cleanup Plan, and reviewers may comment on individual sediment or floodplain components, or on different potential combinations of sediment and floodplain remediation that are not part of the nine Combinations discussed below. Note, for all of the alternatives presented below the values for the areas affected by remediation, amount of sediment or soil to be removed, durations, and costs are estimates for comparison purposes only.

__Combination Alternative 1__

Combination Alternative 1 is a combination of Sediment Alternative SED 1 and Floodplain Alternative FP 1. This alternative involves no action in either the river or the floodplain. Combination Alternative 1 does not involve the excavation or capping of any contaminated soil and sediment. Since there is no active remedy construction, this alternative does not take any time to implement. Contamination remains in the River above safe levels for human health and ecological receptors and is expected to remain that way for over 250 years and there are no measures to prevent exposure. There is no cost associated with this alternative.

__Combination Alternative 2__

Combination Alternative 2 is a combination of Sediment Alternative SED 2 and Floodplain Alternative FP 1. This alternative involves monitored natural recovery (MNR) in all River reaches (Reaches 5 through 16) and no action in the floodplain. Combination Alternative 2 does not involve the excavation or capping of any contaminated soil and sediment. Since there is no active remedy construction, this alternative does not take any time to implement (not including the duration of monitoring). Contamination remains in the River and floodplain above risk-based levels (IMPGs) for human health and ecological receptors and is expected to remain that way for over 250 years. Human exposure in the interim is addressed by Institutional Controls. The cost for this alternative is estimated at $5 million[1] .

__Combination Alternative 3__

Combination Alternative 3 is a combination of Sediment Alternative SED 3 and Floodplain Alternative FP 3. This alternative involves removal of approximately 2 feet of river bed sediment followed by capping in Reach 5A; bank soil removal and stabilization of Reach 5A and 5B river banks; a combination of thin layer capping (often referred to as enhanced MNR or EMNR) and MNR in Reach 5C; thin layer capping/EMNR in Reach 6 (Woods Pond); and, MNR in all other River reaches (Reach 5B, Backwaters, and Reaches 7 through 16).

For the floodplain, Combination Alternative 3 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-4} cancer risk or non-cancer HI = 1 (whichever is lower) plus additional cleanup to a depth of 3 feet in certain frequently used areas to achieve a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower). This alternative also includes additional floodplain

Table 1
Combination Alternatives Matrix

Combination Alternative	Reach 5A	Reach 5B	Reach 5 Erodible Banks	Reach 5C	Reach 5 Backwaters	Reach 6 Woods Pond	Reach 7 Impoundments	Reach 7 Channel	Reach 8 Rising Pond	Reaches 9-16	Floodplain
1 (SED1/FP1)	No Action	No Action	No Action	No Action	No Action	No Action	No Action	No Action	No Action	No Action	No Action
2 (SED 2/ FP 1)	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	No Action
3 (SED 3/FP 3)	2 ft removal with capping	MNR	Removal/ stabilization	Combination of TLC and MNR	MNR	TLC	MNR	MNR	MNR	MNR	Remove/replace top 12 inches to 10-4 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-5; Additional floodplain excavation to achieve the less strict ecological risk-based IMPGs; Remove/replace vernal pool soils > 5.6 mg/kg
4 (SED 5/FP 4)	2 ft removal with capping	2 ft removal with capping	Removal/ stabilization	Combination of 2 ft removal with capping (in shallow areas) and capping (in deeper areas)	Combination of TLC and MNR	Combination of 1.5 ft removal with capping in shallow areas and capping in deep area	MNR	MNR	TLC	MNR	Remove/replace top 12 inches to 10-5 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-5; Additional floodplain excavation to achieve the less strict ecological risk-based IMPGs; Remove/replace vernal pool soils > 5.6 mg/kg
5 (SED 6/ FP4)	2 ft removal with capping	2 ft removal with capping	Removal/ stabilization	2 ft removal with capping	Removal of sediments in >50 mg/kg in top 1 ft (with capping/ backfill); TLC for remainder >1 mg/kg	Combination of 1.5 ft removal with capping in shallow areas and capping in deep area	TLC	MNR	Combination of TLC in shallow areas and capping in deep areas	MNR	Remove/replace top 12 inches to 10-5 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-5; Additional floodplain excavation to achieve the less strict ecological risk-based IMPGs; Remove/replace vernal pool soils > 5.6 mg/kg
6 (SED 8/ FP 7)	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal/ stabilization	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	MNR	Removal to 1 mg/kg depth horizon with backfill	MNR	Remove/replace top 12 inches to 10-6 ICR but not <2 ppm; In frequently used areas remove/replace top 3 feet to 10-6; Additional floodplain excavation to achieve the more strict ecological risk-based IMPGs; Remove/replace vernal pool soils > 3.3 mg/kg
7 (SED 9/ FP 8)	2 ft removal with capping	2 ft removal with capping	Removal/ stabilization	2 ft removal with capping in upper reach and 1.5 ft removal with capping in lower reach	Combination of sediment removal with capping and capping without removal	3.5 ft removal and capping in shallow areas and 1 ft removal and capping in deep areas	Removal depths of 1 to 1.5 ft with capping	MNR	Removal depths from 1 to 1.5 ft with capping	MNR	Remove/replace top 12 inches to 10-5 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-5; Remove/replace vernal pool soils > 3.3 mg/kg; Remove/replace any additional soils in top 12 inches > 50 mg/kg
8 (SED 10/ FP 9)	2 ft removal capping in selected areas	MNR	Removal/stabilization in selected areas	MNR	MNR	Removal of 2.5 ft in areas > 13 mg/kg in top 6 inches	MNR	MNR	MNR	MNR	Remove/replace top 12 inches to 10-4 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-4
9 (SED 9/ FP 4 MOD)	2.5 ft removal and capping	Removal and backfill of areas > 50 mg/kg and EMNR in remainder of reach	Removal/ stabilization of erodible river banks in Reach 5A and banks in reach 5B w/PCBs > 50mg/kg	2 ft removal with capping	Combination of 1 ft removal and capping in areas > 1 mg/kg, excluding certain high priority habitat	Combination of removal with capping ranging from 4 to 7 ft of removal based on water depth	Coordinate w/ dam removal; Removal depths of 1 to 1.5 ft with capping; or cleanup to 1 mg/kg	MNR	Removal depths of 1 to 1.5 ft with capping or cleanup to 1 mg/kg	MNR	Remove/replace top 12 inches to 10-5 ICR or HI = 1; Except in in high priority habitat areas, then remove/replace top 12 inches to 10-4 ICR or HI = 1; In frequently used areas remove/replace top 3 feet to 10-5; Remove/replace vernal pool soils > 3.3 mg/kg

Note: Sediment removal depths specified in this table are approximate and are for volume/cost estimation and for comparison purposes only. Actual removal depths would be determined in accordance with the Modification of the Reissued RCRA Permit.

MNR – Monitored Natural Recovery
EMNR – Enhanced Monitored Natural Recovery
ICR – Incremental Cancer Risk
IMPGs – Interim Media Protection Goals
TLC – Thin-Layer Capping

Table 2
Comparison of Combination Alternatives

Combination:	1	2	3	4	5	6	7	8	9
	SED 1/ FP 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	SED 9 MOD/ FP 4 MOD[1]
Sediment Removal Volume (cubic yards (cy))	0	0	134,000	377,000	521,000	2,252,000	886,000	235,000	890,000
Bank Soil Removal Volume (cy)	0	0	35,000	35,000	35,000	35,000	35,000	6,700	25,000
Sediment Capping after Removal (acres)	0	0	42	126	178	0	333	20	298
Sediment Backfill after Removal (acres)	0	0	0	0	0	351	0	0	0
Sediment Capping without Removal (acres)	0	0	0	60	45	0	3	0	0
Thin Layer Capping (acres)	0	0	97	102	112	0	0	0	0
Floodplain Soil Removal Volume (cy)	0	0	74,000	121,000	121,000	615,000	177,000	26,000	75,000
Floodplain Acres Excavated (acres)	0	0	44	72	72	377	108	14	45
Total Soil/Sediment Volume Removal (cy)	0	0	243,000	533,000	677,000	2,902,000	1,098,000	267,700	990,000
Estimated PCB Mass Removed (pounds)	0	0	21,700	33,300	37,300	94,100	53,100	13,900	46,970
Estimated Time to Implement (years)	0	0	10	18	21	52	14	5	13

Notes: Monitored Natural Recovery (MNR) is a component of all Combinations except Combination Alternative 1.

Volumes and areas specified in this table are approximate and are for volume/cost estimation and for comparison purposes only. Actual volumes and areas will be determined in accordance with the Modification of the Reissued RCRA Permit.

[1] Combination 9 sediment removal and capping estimates based upon capping of four Reach 7 impoundments, which is one possible outcome of the cleanup approach proposed for these impoundments.

excavation to achieve the less stringent ecological risk-based numerical values (IMPGs).

Combination Alternative 3 involves the excavation of approximately 134,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 74,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 44 acres of floodplain area and also includes the capping of 42 acres of river bed after excavation, and 97 acres of thin-layer capping of sediment. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 10 years to implement. The cost for this alternative is estimated at $177 million, excluding costs for transportation or disposal of excavated soil or sediment.

<u>Combination Alternative 4</u>

Combination Alternative 4 is a combination of Sediment Alternative SED 5 and Floodplain Alternative FP 4. This alternative involves removal of approximately 2 feet of river bed sediment followed by capping in Reaches 5A and 5B; bank soil removal and stabilization of Reach 5A and 5B river banks; a combination of 2 foot removal followed by capping (in shallower areas) and capping (in deeper areas) in Reach 5C; a combination of thin layer capping/EMNR and MNR in the Backwaters; a combination of 1.5 foot removal with capping in shallow areas and capping (without sediment removal) in deeper areas of Reach 6 (Woods Pond); thin layer capping/EMNR in Reach 8 (Rising Pond) and MNR in all other River reaches (Reach 7 and Reaches 9 through 16).

For the floodplain, Combination Alternative 4 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower). This alternative also includes additional floodplain excavation to achieve the less stringent ecological risk-based numerical values.

Combination Alternative 4 involves the excavation of approximately 377,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 121,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 72 acres of floodplain area and also includes the capping of 126 acres of river bed after excavation, 60 additional acres of river bed capping in areas not slated for excavation, and 102 acres of thin-layer capping of sediment. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 18 years to implement. The cost for this alternative is estimated at $319 million, excluding costs for transportation or disposal of excavated soil or sediment

<u>Combination Alternative 5</u>

Combination Alternative 5 is a combination of Sediment Alternative SED 6 and Floodplain Alternative FP 4. This alternative involves removal of approximately 2 feet of river bed sediment followed by capping in Reaches 5A, 5B, and 5C; bank soil removal and stabilization of Reach 5A and 5B river banks; one foot removal followed by capping in areas of Backwaters exceeding 50 mg/kg PCBs; 1.5 foot removal with capping in shallow areas and capping (without sediment removal) in deeper areas of Reach 6 (Woods Pond); thin layer capping/EMNR in the Reach 7 impoundments; a combination of thin layer capping/EMNR in shallow areas and capping in deep areas of Rising Pond (Reach 8); and, MNR in all other River reaches (Reach 7 channel and Reaches 9 through 16).

For the floodplain, Combination Alternative 5 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower). This alternative also includes floodplain excavation to achieve the less stringent ecological risk-based numerical values.

Combination Alternative 5 involves the excavation of approximately 521,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 121,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 72 acres of floodplain area and also includes the capping of 178 acres of river bed after excavation, 45 additional acres of river bed capping in areas not slated for excavation, and 112 acres of thin-layer capping of sediment. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 21 years to implement. The cost for this alternative is estimated at $397 million, excluding costs for transportation or disposal of excavated soil or sediment.

<u>Combination Alternative 6</u>

Combination Alternative 6 is a combination of Sediment Alternative SED 8 and Floodplain Alternative FP 7. This alternative involves removal of river bed sediment in Reaches 5A, 5B, and 5C, Backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond to meet a PCB concentration of 1 mg/kg followed by backfill; bank soil removal and stabilization of Reach 5A and 5B river banks; and, MNR in all other River reaches (Reach 7 channel and Reaches 9 through 16).

For the floodplain, Combination Alternative 6 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on a 10^{-6} cancer risk or non-cancer HI = 1 (whichever is lower). This alternative also includes floodplain excavation to achieve the more stringent ecological risk-based numerical values.

---

[1]All cost estimates referenced in this document are in total 2010 dollars, for present worth values, see Table 6.

Combination Alternative 6 involves the excavation of approximately 2,252,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 121,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 387 acres of floodplain area and also includes the backfill of 351 acres of river bed after excavation. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 52 years to implement. The cost for this alternative is estimated at $917 million, excluding costs for transportation or disposal of excavated soil or sediment.

<u>Combination Alternative 7</u>

Combination Alternative 7 is a combination of Sediment Alternative SED 9 and Floodplain Alternative FP 8. This alternative involves removal of approximately 2 feet of river bed sediment followed by capping in Reaches 5A, 5B, and 5C; bank soil removal and stabilization of Reach 5A and 5B river banks; a combination of one foot removal followed by capping or capping without removal in areas of the Backwaters exceeding 1 mg/kg PCBs; one to 3.5 foot removal followed by capping in Reach 6 (Woods Pond); one to 1.5 foot removal followed by capping in the Reach 7 impoundments and Rising Pond (Reach 8); and, MNR in all other River reaches (Reach 7 channel and Reaches 9 through 16). This alternative differs from the other sediment removal alternatives in that: (1) all sediment removal and capping work, including in Reaches 5A and 5B, would be performed in the "wet" by equipment operating in the river (either on the river bottom or on barges), and (2) removal of the sediment in Backwaters and Reaches 6, 7, and 8 would be performed concurrently with removal activities in the Reach 5 channel. However, capping in those reaches would be delayed, where necessary, until after all the removal/capping activities in Reach 5 have been completed.

For the floodplain, Combination Alternative 7 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower) and additional removal of soils exceeding 50 mg/kg PCBs. This alternative also includes floodplain and vernal pool excavation to achieve the more stringent ecological risk-based numerical values.

Combination Alternative 7 involves the excavation of approximately 886,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 177,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 108 acres of floodplain area and also includes the capping of 333 acres of river bed after excavation, and 3 additional acres of river bed capping in areas not slated for excavation. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 14 years to implement. The cost for this alternative is estimated at $394 million, excluding costs for transportation or disposal of excavated soil or sediment.

<u>Combination Alternative 8</u>

Combination Alternative 8 is a combination of Sediment Alternative SED 10 and Floodplain Alternative FP 9. This alternative involves removal of approximately 2 feet of river bed sediment followed by capping in select areas of Reach 5A and MNR in the remainder of Reach 5A; bank soil removal and stabilization of Reach 5A and 5B river banks; a combination of 2.5 foot removal in areas with PCB concentrations greater than 13 mg/kg in the top 6 inches, without subsequent capping or backfilling, and MNR in other areas of Woods Pond; and MNR in all other River reaches (Reach 5B, Reach 5C, Backwaters, and Reaches 7 through 16).

For the floodplain, Combination Alternative 8 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-4} cancer risk or non-cancer HI = 1 (whichever is lower) plus additional cleanup to a depth of 3 feet in certain frequently used areas to achieve a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower).

Combination Alternative 8 involves the excavation of approximately 236,000 cubic yards of sediment, 35,000 cubic yards of bank soil and 26,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 14 acres of floodplain area and also includes the capping of 20 acres of river bed after excavation. Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. This alternative is estimated to take 5 years to implement. The cost for this alternative is estimated at $94 million, excluding costs for transportation or disposal of excavated soil or sediment.

<u>Combination Alternative 9</u>

<u>EPA's Preferred Alternative (Proposed Remedial Action)</u>

Combination Alternative 9 is a combination of Sediment Alternative SED 9 MOD and Floodplain Alternative FP 4 MOD. This alternative involves removal of river bed sediment followed by capping in Reaches 5A and 5C; bank soil removal and stabilization of PCB-contaminated erodible Reach 5A river banks; excavation of Reach 5B river bed and bank areas exceeding 50 mg/kg PCBs with EMNR (using activated carbon or other sediment amendment) for remaining areas of Reach 5B sediment; a combination of one foot removal followed by capping of the Backwaters exceeding 1 mg/kg PCBs, excluding certain high priority habitat areas; one to seven foot removal followed by capping in Reach 6 (Woods Pond); excavation and/or capping to address Reach 7 impoundments and Rising Pond (Reach 8), as discussed above; and, MNR in all other River reaches (Reach 7 channel and Reaches 9 through 16).

EPA's May 2012 status report entitled "Potential Remediation Approaches to the GE-Pittsfield/Housatonic River Site 'Rest of River' PCB Contamination" (the Status Report) highlighted the objectives of addressing the unacceptable risks posed by PCBs and of minimizing the amount of bank excavation to preserve the dynamic character and related biodiversity and habitats of the river. To that end, the Status Report proposed a remedial approach that, based on data collected prior to the issuance of the permit, would result in an amount of bank excavation in Reach 5A of 3.5 miles, and an amount of bank excavation in Reach 5B of 0.2 miles. Under any alternative, the actual remediation amounts would be determined during remedial design. If the new data to be collected identified the need for greater bank excavation, then the foregoing amounts of bank excavation would change based on new data. Under Combination Alternative 9, the corrective measures for the river banks would be designed and implemented to achieve Performance Standards while minimizing impacts on river dynamics and other ecological processes, and on the abundance of state-listed and other wildlife species and the diversity of their habitats that are supported by the existing river ecosystem.

This alternative is similar to Combination Alternative 7 and differs from the other sediment removal alternatives in that: (1) all sediment removal and capping work, including in Reaches 5A and 5B, would be performed in the "wet" by equipment operating in the river (either on the river bottom or on barges); and (2) removal of the sediment in the Backwaters and Reaches 6, 7, and 8 would be performed concurrently with removal activities in the Reach 5 channel. However, capping in those reaches would be delayed, where necessary, until after all the removal/capping activities in Reach 5 have been completed. It is important to note that the sediment removal depths outlined above, for the most part, were derived based upon certain assumptions on the estimated cap thicknesses in the various reaches of the river. As outlined in the section entitled "Engineered Cap Design" above, specific cap designs and thicknesses will be determined based upon additional evaluations in the future. Thus, the volume and cost estimates for this alternative outlined below could be reduced should a thinner cap be deemed appropriate.

For the floodplain, Combination Alternative 9 involves the removal of one foot of contaminated soil with subsequent backfilling to meet a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower) while providing for avoidance, minimization, or mitigation of impacts in priority habitat areas for state-listed species of concern by establishing a secondary remediation target to meet a human-health based cleanup target based on 10^{-4} cancer risk or non-cancer HI = 1 (whichever is lower) in high priority habitat areas. This alternative also includes additional cleanup to a depth of 3 feet in certain frequently used areas to achieve a human-health based cleanup target based on 10^{-5} cancer risk or non-cancer HI = 1 (whichever is lower). This alternative also includes vernal pool excavation to achieve the more stringent ecological risk-based cleanup target for amphibians.

This alternative also provides for a phased, adaptive management approach to all remediation activities. For vernal pool remediation, this also includes the pilot testing of non-excavation cleanup methods described previously.

Combination Alternative 9 involves the excavation of approximately 890,000 cubic yards of sediment, 25,000 cubic yards of bank soil and 75,000 cubic yards of floodplain soil. This alternative involves the excavation of approximately 45 acres of floodplain area and also includes the capping of approximately 298 acres of river bed after excavation to reduce the amount of PCBs transported downstream. Pilot studies, Institutional Controls, long-term operation, monitoring, and maintenance are also components of this alternative. Additionally, this alternative includes provisions for GE to maintain responsibility for the incremental costs incurred due to the potential impacts of PCBs on authorized activities within the Massachusetts and Connecticut portions of the river. This alternative is estimated to take 13 years to implement. The cost for this alternative is estimated at $326 million, excluding costs for transportation or disposal of excavated soil or sediment.

Treatment/Disposition Alternatives

Five alternatives were developed for treatment and/or disposition (TD) of removed sediment, riverbank soil, and floodplain soil from the Rest of River. These alternatives are as follows:

- TD 1: Off-Site Disposal in Existing Licensed Landfill(s) (EPA's Preferred Alternative)
- TD 2: Local Disposal in Confined Disposal Facility (CDF)
- TD 3: Local Disposal in an On-Site Upland Disposal Facility
- TD 4: Chemical Extraction
- TD 5: Thermal Desorption

Alternative TD 1, disposal in an existing off-site licensed landfill or landfills, would involve the transportation of removed sediment and floodplain soil to commercial solid waste and/or TSCA-licensed landfill(s) for disposal. In the CMS, GE evaluated transport of contaminated material by trucks. In its comments, EPA required that GE provide an evaluation of rail transport in the Revised CMS. GE provided a qualitative evaluation and concluded that rail transport would be technically feasible; therefore transportation could be conducted either by trucks or by rail. However GE did not provide cost information. EPA further evaluated the feasibility of rail and developed a cost estimate. This modification is also referred to in this document as TD 1 RR. The estimated cost for this alternative ranges from $55 to $832 million for disposal via truck and $52 to $787 million for disposal via rail, depending on which Combination Alternative it is paired with. For the preferred sediment/floodplain alternative, the estimated cost of disposal via truck is $308 million and via rail is $287 million.

Massachusetts' requirements regarding the disposal of contaminated soil and sediment have not been included as ARARs for Alternative TD 1 since ARARs apply only to on-site activities and the Proposed Remedial Action requires that all contaminated soil and sediment be disposed of off-site at existing licensed facilities approved to receive such soil and sediment.

Alternative TD 2, disposition in a local in-water Confined Disposal Facility/Facilities (CDF), would involve the placement of dredged sediments in a CDF or CDFs located within the river or backwater area. A CDF is an engineered structure consisting of dikes or other structures that extend above an adjacent water surface and enclose a disposal area for containment of dredged sediments. Disposal of material that exceeds the capacity of the CDFs would be disposed of in existing off-site licensed landfills. The potential locations evaluated as part of this alternative are shown in Figure 8. The estimated cost for this alternative ranges from $100 to $510 million, depending on which Combination Alternative it is paired with; with EPA's preferred Combination, this alternative is estimated to cost $317 million.

Alternative TD 3, disposition in a local on-site Upland Disposal Facility or Facilities, would involve the permanent disposition of removed sediment/soil at an Upland Disposal Facility constructed in close proximity to the River, but outside the 500-year floodplain. The removed sediment and soil would be loaded into trucks at the staging areas, covered, and transported over on-site and local roadways to a nearby Upland Disposal Facility. Three potential locations for an Upland Disposal Facility were identified and evaluated by GE in the CMS. These sites are located near Woods Pond, Forest Street in Lee, and Rising Pond (referred to, respectively, as the Woods Pond, Forest Street, and Rising Pond Sites). The potential locations evaluated as part of this alternative are shown in Figure 8. The estimated cost for this alternative ranges from $36 to $201 million, depending on which Combination Alternative it is paired with; with EPA's preferred Combination, this alternative is estimated to cost $100 million.

Alternative TD 4, chemical extraction of PCBs from removed sediment/soil, involves treatment of the removed sediments and soils by a technology known as chemical extraction. In general terms, chemical extraction is the process of mixing an extraction fluid/solvent with removed sediment and soil, so that PCBs in the sediment or soil are preferentially transferred into the extraction fluid. The resulting PCB-contaminated fluid is then treated or disposed of off-site along with treated sediments. The estimated cost for this alternative ranges from $89 to $999 million, depending on which Combination Alternative it is paired with; with EPA's preferred Combination, this alternative is estimated to cost $399 million.

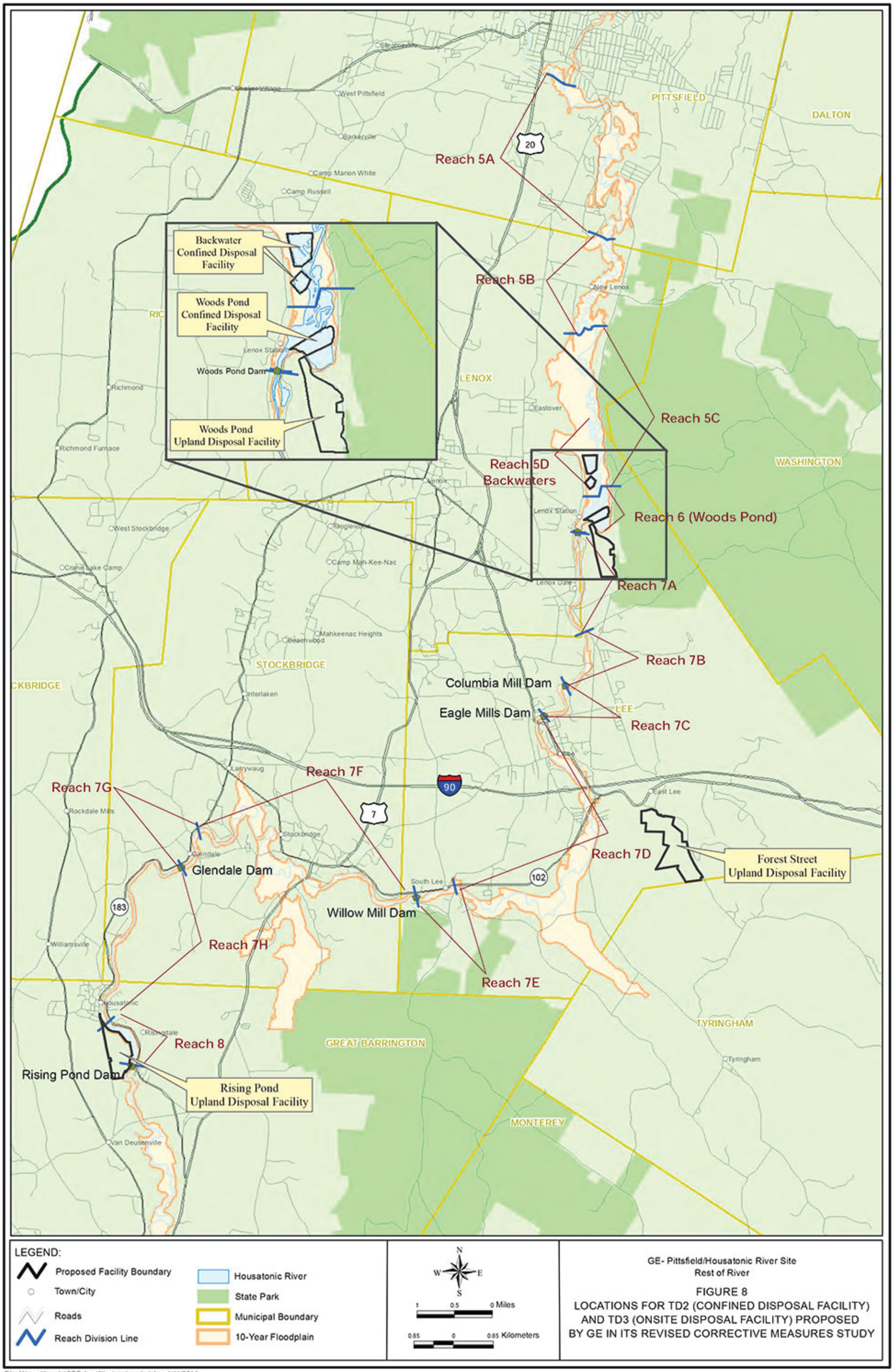
Alternative TD 5, thermal desorption of PCBs from removed sediment/soil, would involve treatment of the removed sediments and soils by a technology known as thermal desorption. Thermal desorption removes contaminants by raising the temperature of the contaminated material to transfer the contaminants from the sediment or soil to a gas stream. The gas stream is then treated to remove particulates and the organic contaminants. The material that remains is then sent to an appropriate treatment/disposal facility. Treated sediments or soils may then be disposed of in an appropriate disposal facility or potentially reused, depending on its chemical concentrations and physical characteristics. The estimated cost for this alternative ranges from $103 million to $1.53 billion, depending on which Combination Alternative it is paired with and how much material is reused; with EPA's preferred Combination Alternative, this alternative is estimated to cost between $515 and $540 million.

HOW DOES EPA CHOOSE A FINAL CLEANUP PLAN?

Before making its recommendation, EPA coordinated with the Commonwealth of Massachusetts and the State of Connecticut regarding potential cleanup approaches. EPA worked closely with the States on the development of the Performance Standards, corrective measures and identification of ARARs prior to the issuance of this plan to the public.

EPA also held extensive discussions with GE, and solicited input from the community through workshops and public meetings. The timeline of these events is summarized elsewhere in this document and information exchanged in these discussions is also contained in the Administrative Record. The States, GE, and the public also have the opportunity to comment on the Proposed Remedial Action during the public comment period.

EPA used nine criteria that were established in the Permit to compare alternatives, and propose and select a final cleanup plan. Of the nine criteria, Overall Protection of Human Health



GE- Pittsfield/Housatonic River Site
Rest of River

FIGURE 8
LOCATIONS FOR TD2 (CONFINED DISPOSAL FACILITY) AND TD3 (ONSITE DISPOSAL FACILITY) PROPOSED BY GE IN ITS REVISED CORRECTIVE MEASURES STUDY

File: Y:\gepitt\mxds\CDF_landfills_inset.mxd ricksc 4/11/2014 and the Environment, Compliance with Applicable or Relevant and Appropriate Federal and State Requirements (known as "ARARs"), and Control of Sources of Releases are the three General Standards for Corrective Measures. In addition, EPA considered six other Selection Decision Factors; those factors are as follows: Long-Term Reliability and Effectiveness, Attainment of Interim Media Protection Goals; Reduction of Toxicity, Mobility or Volume; Short- Term Effectiveness; Implementability; and Cost. Following are definitions of the nine criteria from the Permit.

General Standards for Corrective Measures

1. Overall Protection of Human Health and the Environment: How each alternative or combination of alternatives would provide human health and environmental protection, taking into account EPA's Human Health and Ecological Risk Assessments.
2. Control of Sources of Releases: How each alternative or combination of alternatives would reduce or minimize possible further releases, including (but not limited to) the extent to which each alternative would mitigate the effects of a flood that could cause contaminated sediments to become available for human or ecological exposure.
3. Compliance with Applicable or Relevant and Appropriate Federal and State Requirements (ARARs): How each alternative or combination of alternatives would meet such requirements or, when such a requirement would not be met, the basis for a waiver under CERCLA and the National Contingency Plan ("NCP"), per the Consent Decree.

Selection Decision Factors

4. Long-Term Reliability and Effectiveness:
   a. Magnitude of residual risk, including (but not limited to) the extent to which each alternative would mitigate long-term potential exposure to residual contamination, and the extent to which and time over which each alternative would reduce the level of exposure to contaminants;

   b. Adequacy and reliability of each alternative or combination of alternatives, including (i) operation, monitoring, and maintenance requirements; (ii) availability of labor and materials needed for operation, monitoring, and maintenance; (iii) whether the technologies have been used under analogous conditions; and (iv) whether the combination of technologies (if any) have been used together effectively; and

   c. Any potential long-term adverse impacts of each alternative or combination of alternatives on human health or the environment, including (but not limited to) potential exposure routes and potentially affected populations, any impacts of dewatering and disposal facilities on human health or the environment, any impacts on wetlands or other environmentally sensitive areas, and any measures that may be employed to mitigate such impacts.

5. Attainment of Interim Media Protection Goals (IMPGs): The ability of each alternative or combination of alternatives to achieve the Interim Media Protection Goals, including (if applicable) the time period in which each alternative would result in the attainment of the IMPGs and an evaluation of whether and the extent to which each alternative would accelerate such attainment compared to natural processes. Note that these IMPGs were used in the comparison of remedial alternatives and are not necessarily the same as the Performance Standards or Cleanup Standards proposed in the Draft Modification to the Reissued RCRA Permit required to be met as part of the remedy.

6. Reduction of Toxicity, Mobility, or Volume of Wastes:
   a. If applicable, treatment process used and materials treated;

   b. If applicable, amount of hazardous materials destroyed or treated;

   c. If applicable, degree of expected reductions in toxicity, mobility, or volume;

   d. If applicable, degree to which treatment is irreversible; and

   e. If applicable, type and quantity of residuals remaining after treatment.

7. Short-Term Effectiveness: Impacts to nearby communities, workers, or the environment during implementation of each alternative, including (but not limited to) risks associated with excavation, transportation, dewatering, disposal, or containment of sediments, soils, or other materials containing hazardous constituents.

8. Implementability:
   a. Ability to construct and operate the technology, taking into account any relevant site characteristics;

   b. Reliability of the technology;

   c. Regulatory and zoning restrictions;

   d. Ease of undertaking additional corrective measures if necessary;

   e. Ability to monitor effectiveness of remedy;

f. Coordination with other agencies;

g. Availability of suitable on-site or off-site treatment, storage and disposal facilities and specialists; and,

h. Availability of prospective technologies.

9. Cost:
   a. Capital costs;
   b. Operating and maintenance costs; and,
   c. Present worth costs.

Personnel from the Massachusetts Department of Environmental Protection, the Massachusetts Department of Fish and Game, and the Connecticut Department of Energy and Environmental Protection have been consulted extensively as EPA was preparing this cleanup proposal. Formal state and community input on the Proposed Cleanup Plan received during the public comment period will be considered prior to EPA issuing a final cleanup plan.

COMPARATIVE ANALYSIS OF COMBINED SEDIMENT/FLOODPLAIN ALTERNATIVES

This section presents a summary of a comparative evaluation of the nine combination alternatives for river sediment and floodplain soil using the Permit criteria. A more detailed evaluation of the criteria is in the Administrative Record.

Overall Protection of Human Health and the Environment

This criterion was evaluated taking into account the HHRA and ERA. Combination Alternative 1 provides no protection of human health and the environment. Combination Alternatives 2 and 8 do not adequately meet IMPGs for humans or ecological receptors and are, therefore not protective of human health and the environment in the long term.

In addition, Combination Alternatives 1, 2, and 8 would not meet the federal and state water quality criterion for freshwater aquatic life and therefore would not be protective of the environment. None of the alternatives analyzed would achieve the federal and state water quality criterion for human consumption of organisms in any of the Massachusetts reaches while Combinations 1, 2, 3, and 8 would not achieve this criterion in any Connecticut impoundments. Combinations 4, 5, 6, 7, and 9 would restore water quality consistent with this criterion in significant segments of the river in Connecticut, based on estimates of meeting this criterion in the future in 50% or more of the Connecticut impoundments. See “Compliance with Federal and State ARARs” for further discussion regarding water quality criteria.

Combination Alternatives 6, 7, and 9 would provide the highest level of protection to human health and the environment because the largest volume of sediment and floodplain soil would be addressed (by a combination of removal and capping in place, or amended with activated carbon to reduce the bioavailability of PCBs) and downstream transport would be reduced to the greatest extent. Combination Alternatives 3, 4 and 5 would also provide protection. However, more contaminated sediment would remain in place in the river under these alternatives under thin layer caps or subject to MNR. As a result, there is a greater chance additional releases of contaminants could occur in the future under these Alternatives. While thin layer capping has been used successfully at other sites across the nation, site-specific conditions (e.g., higher PCB concentrations and higher flows) have raised concerns about its suitability for the Housatonic River. In addition, Combinations 1, 2, 3, 4, 5, and 8 leave more contaminated floodplain soil in place thereby decreasing the overall protectiveness of these Alternatives. Unless measures are undertaken to preserve the dynamic, meandering character of the river and avoid, minimize and mitigate impacts to state-listed species habitat, Combination Alternatives that require extensive excavation in these ecological resources, including state-listed habitats (such as Combination 6) may result in less overall protection of the environment. By employing a more targeted remediation approach, Combination 9 provides the best balance between addressing human health risks and ecological risks and negative impacts of remedial work on the river’s ecosystem, including its array of state-listed species habitats. Those Combination Alternatives that have minimal or no impact to state-listed species (Combinations 1, 2, or 8) have much less cleanup than Combination 9 and thus provide reduced overall protection for risks to human health and the environment.

Combination Alternatives 2 through 9 rely to varying degrees on Institutional Controls throughout the river in both Massachusetts and Connecticut to be protective of human health in the long term. Those alternatives that rely more extensively on these controls (Combinations 2 and 8) over longer timeframes and larger areas have more uncertainty that they will protect human health in the long term, and such controls provide no protection for ecological risks. Those alternatives (Combinations 6, 7, and 9) that rely on these controls over shorter timeframes or smaller areas have higher overall protection of human health.

Control of Sources of Releases

A computer model was used to predict the reductions in the mass of PCBs passing Woods Pond and Rising Pond Dams, respectively, and the reductions in the mass of PCBs transported from the river to the floodplain versus today’s conditions in Reaches 5 and 6[2]. These results are summarized in Table 3 for each Combination. Table 3 also shows trapping efficiency for solids in Woods Pond for each Combination.

As additional sources are controlled by permanently removing and/or capping PCB-contaminated sediment and reducing the contribution of PCBs from the contaminated eroding banks, significant additional reductions in PCB mass transport in the river and transport to the floodplain occurs. As a result, Combination Alternatives 1, 2 and 8 do the least to control releases. While Combination Alternatives 6 and 7 do the most to control releases, Combination Alternatives 3, 4, 5 and 9 also provide significant control of releases.

Combinations 7, 8, and 9 nearly double the solids trapping efficiency of Woods Pond when compared to the other Combinations. PCBs are attached to solids that move through the river system. Therefore, the increase in trapping of solids in Woods Pond is a mechanism to reduce downstream migration of PCBs. It is estimated that 25% of the mass of PCBs in the river sediment are within Woods Pond. Combinations 7 and 9, and to a lesser extent, Combination 8, also control sources of releases by removing a significant mass of PCBs from behind the Woods Pond dam. In the event of a serious breach or failure of the dam, the release of PCBs downstream would be less for these alternatives (7 through 9) than for Combinations 1 through 6 that rely primarily on capping or MNR.

The different combinations are expected to have different responses in the occurrence of an extreme flood event. Combinations 1 and 2 will have no different response than what would be expected to occur under current conditions as there is no active remediation. In this case, PCB-contaminated sediment and soil from eroding banks are expected to be released and mobilized downstream. Combination 8 is expected to result in similar, but slightly less downstream transport as it has only a small area in Reach 5A which is addressed with an engineering approach, and residual PCBs in Woods Pond are not capped. Combination 3 will result in slightly less transport than the previous alternatives, however the use of a thin-layer cap in Reach 5C and Woods Pond, and MNR in Reach 5B, the Backwaters and Reach 7 impoundments is not expected to adequately control sources of releases in an extreme event. Combinations 4 and 5 are expected to provide adequate protection in an extreme event in Reaches 5 and 6 but the use of thin-layer capping and backfill in the downstream reaches provides a high level of uncertainty in performance during such an event. Combination 6 followed by Combination 7 are expected to provide the highest level of protection of all the combinations during an extreme event as they provide the greatest amount of remediation with corresponding engineering controls. Combination 9 is expected to provide adequate protection in an extreme storm event in all reaches, with the exception of Reach 5B which is subject to MNR and therefore bed sediment and bank soil may erode and be transported downstream. However, the areas of the highest PCB concentrations in Reach 5B will be removed.

Compliance With Federal and State ARARs

A summary of some of the more significant chemical-, location-, and action-specific ARARs is included below.

Chemical-Specific ARARs

Chemical-specific ARARs include federal and state water quality criteria for PCBs. These criteria are the freshwater chronic aquatic life criterion of 0.014 micrograms per liter (ug/L) and the human health criterion (based on consumption of water and/or organisms) of 0.000064 ug/L (or 0.064 parts per trillion).

Combination Alternatives 1, 2, and 8 would not achieve the federal and state water quality criteria for freshwater aquatic life in Massachusetts (but would in Connecticut). Combination Alternatives 3-7 and 9 would achieve these criteria in all reaches of the river.

None of the alternatives would achieve the federal and state water quality criteria for human consumption of water and organisms in the any of the Massachusetts reaches. Combinations 1, 2, 3, and 8 would not achieve this criterion in any Connecticut impoundments. Based on modeling, Combination Alternatives 4, 6, 7, and 9 would restore water quality consistent with this criterion in 50% or more of the Connecticut impoundments. Because the water quality criteria for human consumption of organisms (0.000064 ug/L) is not expected to be met in the River in Massachusetts under any of the alternatives evaluated, EPA is proposing to waive this criterion under both Federal and State ARARs as technically impracticable in Reaches 5 through 9. As a modified Performance Standard for this waived criterion, the project will be required to meet the Biota Performance Standard and the Downstream Transport Performance Standard in the Permit.

Current modeling shows Combination Alternatives 7 and 9 will achieve the 0.000064 ug/L criterion in at least 3 of the 4 Connecticut impoundments. However, the results from the Connecticut model are very uncertain due to the empirical, semi-quantitative nature of the analyses. As such, it is not possible to predict with certainty attainment or nonattainment of the human health criterion based on human consumption

[2] The initial (i.e., current) annual PCB mass values used in the model are 20 kg/yr passing Woods Pond Dam, 19 kg/yr passing Rising Pond Dam, and 12 kg/yr transported from the river to the floodplain in Reaches 5 and 6.

Table 3

Percent Reduction in Annual PCB Mass Passing Woods Pond and Rising Pond Dams and Transported to the Reach 5/6 Floodplain and Solids Trapping Efficiency for Woods Pond for Combinations of Alternatives (relative to current conditions)

Combination:	1	2	3	4	5	6	7	8	9
Location	SED 1/ FP 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	SED 9 MOD/ FP 4 MOD
Percent Reduction in Annual PCB Mass									
Woods Pond Dam	37%	37%	94%	97%	97%	98%	97%	62%	89%
Rising Pond Dam	41%	41%	87%	93%	95%	96%	96%	62%	89%
Reach 5/6 Floodplain	50%	50%	97%	98%	98%	99%	98%	68%	92%
Solids Trapping Efficiency for Woods Pond									
Solids Trapping Efficiency of Woods Pond	15%	15%	13%	15%	15%	15%	26%	24%	30%

of water and organisms of 0.000064 ug/L in Connecticut (Reaches 10 through 16). Thus, no waiver is being proposed for Connecticut at this time.

Location-Specific and Action-Specific ARARs

All Combination Alternatives meet action-specific ARARs.

Combination Alternatives 3 - 9 would involve temporary destruction of wetlands and a discharge of dredged or fill material into waters of the state and/or U.S. Of the alternatives providing adequate risk reduction (Combinations 6, 7, and 9), Combination Alternative 9, is the least damaging practicable alternative under the Clean Water Act and State and other federal wetlands requirements. See additional information under Wetland and Floodplain Impacts elsewhere in this document. The Massachusetts Endangered Species Act (MESA), M.G.L. c. 131A, is applicable to all active alternatives (Combination Alternatives 3-9). MESA and its regulations at 321 CMR 10.00 were promulgated to conserve and protect state-listed species and their habitats. Unacceptable levels of PCBs are present in such habitat areas in the Rest of River. During the implementation of the Proposed Remedial Action, the removal of PCBs from the Rest of River is anticipated to provide a benefit to state-listed species inhabiting the area due to the reduction in adverse effects to ecological receptors from the PCBs. In overseeing the response actions, EPA, in coordination with the Division of Fisheries and Wildlife in the Massachusetts Department of Fish and Game, which administers MESA, will require that implementation of the corrective measures avoid, minimize and mitigate impacts to state-listed species and their habitats, as required by MESA. In particular, the proposed corrective measures for backwaters, floodplain soils and vernal pools each include a set of protocols to help evaluate how best to avoid, minimize and mitigate impacts as part of floodplain soil/vernal pool remediation.

Long-Term Reliability and Effectiveness

Combination Alternatives 1 and 2 would provide no or little long-term reliability and effectiveness as no actions or few actions would be taken to mitigate long-term exposure to contamination or reduce the level of exposure to contaminants. All other Combination Alternatives provide varying degrees of long-term reliability and effectiveness through active cleanup and Institutional Controls to mitigate longterm exposure to contamination and reduce the level of exposure to contaminants. Of these cleanup alternatives, those Combination Alternatives that remove the most contaminated soil and sediment (Combination Alternative 6, followed by Combination Alternatives 7 and 9) provide the best long-term reliability and effectiveness because the magnitude of the residual risk that remains is much lower than those alternatives that leave significantly more contaminated material in place (Combination Alternatives 3, 4, and 8, and to a certain extent, Combination 5).

However, Combination Alternatives that fundamentally impact the dynamic, meandering character of the river or require extensive excavation in habitats supporting state-listed species (such as Combinations 6 and 7) may result in reduced long-term effectiveness because of potential long-term adverse effect on the environment. As a result, Combination 9, which includes more excavation than most alternatives, but also provides the most measures and procedures to preserve and protect the river's sensitive ecosystem, including its array of state-listed species habitats, provides the best balance in terms of reducing residual risk and minimizing long-term ecological impacts. All active alternatives would require restoration and compliance with relevant ARARs to mitigate the impacts of the remediation. Restoration is expected to be effective and reliable, returning habitats to their pre-remediation state for all active alternatives on a timeframe appropriate for the type of habitat being restored (e.g. a floodplain forest will take longer than an emergent wetland). Where a considerable amount of soil or sediment remains unaddressed or under a thin-layer cap (Alternatives 1, 2, 3, 4, 5, and 8), there would be a greater potential for contaminated material to move downstream. As a result, the long-term reliability and effectiveness of these alternatives is based significantly on long-term maintenance, monitoring and Institutional Controls. Institutional Controls in this situation (for large areas and long time frames) are difficult to monitor and enforce and are not appropriate in managing ecological risks. As a result, those alternatives that rely more heavily on these controls and on monitoring and maintenance (Combinations 1, 2, 3, 4, 5, and 8) may not be adequate and would be less reliable in the long-term compared to other, more active alternatives (such as Combinations 6, 7, and 9). Combinations 6, 7, and 9 are also more reliable in the long-term based on their removal of a large mass of PCBs from behind Woods Pond dam.

Finally, because all active alternatives (Combinations 3-9) rely on essentially the same components, there is no significant difference between these alternatives in terms of availability of labor and materials needed for operation, monitoring, and maintenance. In addition, the components in all active alternatives have been used effectively together under comparable conditions.

With regard to timeframes to reduce exposure to contaminants, see the discussion under "Attainment of IMPGs" below.

Attainment of IMPGs

As part of the Corrective Measures Study process, human health Interim Media Protection Goals (IMPGs) were developed to address cancer risk and non-cancer risk for the following three major routes of exposure:

- Direct contact with sediment and floodplain soil.
- Consumption of fish and waterfowl.
- Consumption of agricultural products.

Current land use in the floodplain no longer includes any agricultural exposures; these IMPGs would be considered if future uses were to change to agriculture.

Two sets of ecological IMPGs were also developed: more stringent "lower-bound" IMPGs and less stringent "upper-bound" IMPGs.

An evaluation of whether, and to what extent, each alternative would achieve IMPGs or whether an alternative would accelerate attainment of the cleanup levels when compared to natural processes, or in this case Combinations 1 and 2, was conducted.

For human health direct contact risk, Combinations 3-9 meet many more IMPGs in more floodplain and sediment areas than do Combinations 1 and 2.

For human fish consumption, most IMPGs would continue to be exceeded for greater than 250 years under Combinations 1, 2, 3, and 8 in Massachusetts. All other alternatives meet some of the IMPGs far sooner than these Combinations in many reaches, including downstream in CT, within a relatively short time after completion of work in a particular river reach. A full evaluation of each alternative's performance regarding fish consumption based IMPGs can be found in the Administrative Record, see Figure 9 for a representative example. Table 4 shows the modeled average fish fillet PCB concentrations at the end of the 52-year modeling period, and Table 5 provides estimated reductions (by percentage) for the Combination Alternatives.

For ecological receptors, some of the upper- or lower-bound IMPGs are attained in the some of the exposure areas for Combinations 1, 2, 3, and 8. By definition, Combinations 4 and 5 are designed to meet the upper-bound ecological IMPGs (with some lower-bound IMPGs being achieved for some receptors) and Combinations 6 and 7 are designed to meet the lower-bound (more stringent) ecological IMPGs. While each alternative represents a different balance between risk reduction and habitat protection, EPA has determined that Combination 9 provides the best balance between meeting the ecological IMPGs while minimizing and mitigating the impact of the remedy on the river's ecosystem and its array of state-listed species and habitats.

Reduction of Toxicity, Mobility, or Volume of Wastes

Treatment is not part of any of the major components (removal and capping) of the active Combination Alternatives, except to the extent that use of activated carbon or other sediment amendment is used to reduce toxicity in soils or sediment.

The degree to which the Combination Alternatives would reduce the toxicity, mobility, or volume (TMV) of PCBs is discussed below.

Reduction of Toxicity: None of the Combination Alternatives with the exception of Combination 9 includes any treatment processes that would reduce the toxicity of PCBs in the sediment or soil. Combination 9 requires the addition of an amendment such as activated carbon in certain components of the remedy, including vernal pools, Reach 5B sediment, and Backwaters. The addition of such an amendment is expected to reduce toxicity. Since none of the other Combinations provide for this treatment, Combination 9 surpasses all other alternatives in the amount of materials treated and the degree of reductions in toxicity due to treatment.

Reduction of Mobility: Combination Alternatives 1 and 2 do not reduce the mobility of PCBs in the river. Combination Alternatives 3-9 reduce mobility through removal, capping, backfilling, thin-layer capping, and/or bank stabilization activities. Of those active remedies, Combination Alternative 6 provides the greatest reductions in mobility followed by alternatives 7 and 9. Alternatives 3 and 8 provide the least reduction in mobility of contaminants, while Alternatives 4 and 5 provide more reduction than Alternatives 3 and 8, but less than Alternatives 6, 7, and 9.

Reduction of Volume: Combination Alternatives 1 and 2 do not reduce the volume of PCBs in the river and floodplain. Combination Alternatives 3-9 reduce the volume of PCB-contaminated sediment, bank soil, and floodplain soil in the Rest of River through permanent removal of the material. Table 2 includes a summary of the approximate removal volume and corresponding PCB mass that would be removed under each alternative.

Short-Term Effectiveness

As no active remediation is proposed for Combinations 1 or 2, these would not result in any short-term risks to on-site workers or adverse effects to the environment or community during implementation. For the alternatives involving construction work (Combinations 3-9), the estimated durations of construction for the alternatives evaluated range from five years (Combination 8) to 52 years (Combination 7). Because any remediation would be conducted using a phased approach, these impacts would be spread out over the remedial action period and area, and thus, would not last for the entire duration of the project in all affected areas. Combinations 3-9 all have potential short-term impacts such as truck traffic, dust, and noise. Combinations 7 and 9 also have the potential for short-term increases in PCB concentrations in fish and/or surface water during and immediately after construction in Reach 5A. Phased construction, dust suppression techniques, and perimeter air monitoring, and other engineering controls would be undertaken to address potential risks from construction to the community. Standard safety measures would be taken to protect workers as part of any cleanup work. The alternatives that limit active remediation (Combinations 3 and 8) would have fewer short-term impacts than the alternatives that propose remediation across several reaches (Combinations 4, 5, 7, and 9), while more significant impacts would be likely with Combination 6 due to the amount of material being removed and the duration of the work, as this is the most extensive and lengthy alternative evaluated. Short term impacts to the environment would be expected to be commensurate with the areal extent and volume of soil/sediment addressed. Thus, Combinations 3, 4, 5, 8, and 9 would be expected to have fewer adverse short-term impacts than Combinations 6 or 7 based on their extent of river and floodplain remediation. Estimated construction durations for the various alternatives are included in Table 2.

Implementability

Combination 1 does not present any implementability issues since no action is being taken. Combination 2, which relies on monitoring and institutional controls, has no construction-related implementability issues. Otherwise, the implementability of Combinations 3 through 9 includes the following considerations:

Combinations 3 through 9 are readily able to be constructed and operated, relying on established technologies, though the larger the scope of the remedy, the greater the effort required to construct. The equipment, materials, procedures, personnel and technologies anticipated for Combinations 3 through 9 are all readily available. Combination 9 relies on the use of activated carbon or other sediment amendment in certain portions of the river, backwaters, and vernal pools, which should be readily available. Combination 9 also provides for an adaptive management approach which includes evaluating the use of new or emerging innovative technology during the phased implementation of the remedy.

Those alternatives that rely to a greater extent on capping, MNR and Institutional Controls (such as Combinations 2 and 8) are less reliable than those alternatives that rely more on removal of contamination. While the scale of necessary temporary staging areas or access roads varies depending on the extent of remediation within each Combination, no Combination would involve complications that would serve to make it less desirable under this criterion.

In addition, habitat restoration techniques that would be a component of Combinations 3 through 9 are available and have been used successfully at other sites. Restoration can reliably reestablish pre-remediation conditions for these habitats over the timeframes of the various alternatives, which range from five (Combination 8) to 52 years (Combination 6), using a phased and adaptive management approach. Post-remediation monitoring and maintenance will ensure that the selected restoration

Table 4 Modeled Subreach Average Fish (Fillet) PCB Concentrations at End of Model Projection Period

Combination:		1	2	3	4	5	6	7	8	9
Reach	Initial Conc.	SED 1/ FP 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	SED 9 MOD/ FP 4 MOD
	Fish PCB Concentration (mg/kg wet weight)									
Reach 5A	*18*	7.3	7.3	0.3	0.3	0.3	0.2	0.3	4.2	0.3
Reach 5B	*17*	9.3	9.3	3.0	0.2	0.2	0.2	0.3	6.6	3.5^3
Reach 5C	*14*	7.4	7.4	1.8	0.2	0.2	0.1	0.2	5.8	0.8
Reach 5D (Backwaters)	*22*	9.5	9.5	6.3	0.4	0.4	0.3	0.4	11	1.1
Reach 6	*15*	8.6	8.6	0.7	0.2	0.2	0.1	0.2	3.7	0.7
Reach 7	*6.4 -13*	2.8 - 6.4	2.8 - 6.4	0.7 - 2.1	0.4 - 1.6	0.2 - 0.7	0.1 - 0.6	0.2 - 0.7	1.9 - 4.4	0.4 - 1.4
Reach 8	*6.3*	3.6	3.6	1.6	0.3	0.2	0.2	0.2	2.7	0.4
Connecticut (Bulls Bridge Dam Impoundment)	*0.4*	0.2	0.2	0.04	0.01	0.009	0.007	0.009	0.1	0.02

Notes:

1. PCB concentrations shown (except for the initial concentrations) represent subreach-average values predicted by EPA's model at the end of the model projection period (81 years for Combination 6, 52 years for all other combinations).
2. Values shown as ranges in Reach 7 represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches. For Combination 9, the Reach 7 reductions were calculated separately by subreach. Individual subreach initial concentrations were not provided by GE in the CMS, so reductions shown for Combination 9 were calculated from EPA model results.
3. For Combination 9, the Reach 5B PCB concentrations do not factor in the use of an amendment, such as activated carbon. The use of this amendment is expected to reduce fillet PCB concentrations to less than the 3.5 mg/kg predicted by the modeling; the modeling does not factor in the effects of the amendment.
4. The results from the Connecticut model are very uncertain due to the empirical, semi-quantitative nature of the analysis.

Table 5 Percent Reductions in Fish PCB Concentrations for Combinations of Alternatives

Combination:	1	2	3	4	5	6	7	8	9
Reach	SED 1/ FP 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	SED 9 MOD/ FP 4 MOD
	Percent Reduction in Fish PCB Concentration Relative to Initial Conditions								
Reach 5A	60%	60%	99%	99%	99%	99%	98%	77%	99%
Reach 5B	47%	47%	83%	99%	99%	99%	98%	62%	80%
Reach 5C	48%	48%	87%	99%	99%	99%	99%	59%	94%
Reach 5D (Backwaters)	57%	57%	72%	98%	98%	99%	98%	51%	95%
Reach 6	44%	44%	95%	99%	99%	99%	99%	76%	95%
Reach 7	45 - 63%	45 - 63%	80 - 91%	84 - 97%	94 - 98%	94 - 99%	93 - 98%	59 - 75%	86 - 95%
Reach 8	43%	43%	75%	95%	97%	97%	96%	57%	94%
Connecticut (Bulls Bridge Dam Impoundment)	60%	60%	91%	97%	98%	98%	98%	73%	95%
Percent Reduction in Fish PCB Concentration Relative to Combination 1 or Combination 2 (MNR)									
Reach 5A			96%	96%	96%	97%	96%	42%	96%
Reach 5B			68%	98%	98%	98%	97%	29%	61%
Reach 5C			76%	97%	97%	99%	97%	22%	89%
Reach 5D (Backwaters)			34%	96%	96%	97%	96%	-16%	89%
Reach 6			92%	98%	98%	99%	98%	57%	91%
Reach 7			67 - 75%	75 - 86%	89 - 93%	91 - 96%	89 - 93%	31 - 32%	75 - 88%
Reach 8			56%	92%	94%	94%	94%	25%	87%
Connecticut (Bulls Bridge Dam Impoundment)			80%	95%	96%	97%	96%	50%	81%

Notes:

1. Percent reduction represents the change in annual average PCB concentrations predicted by EPA's model between the beginning and the end of the projection period.
2. The results from the Connecticut model are very uncertain due to the empirical, semi-quantitative nature of the analysis.

WHAT'S THE DIFFERENCE BETWEEN IMPGS AND PERFORMANCE STANDARDS?

This Statement of Basis and the Draft Modification of the RCRA Permit include discussion of two related measures for the Rest of River remedy – the Interim Media Protection Goals (IMPGs), and the Performance Standards.

In the investigation of Rest of River, EPA completed a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment. Taking into account the conclusions of the risk assessments, GE was required to propose IMPGs, which consist of preliminary goals that are shown to be protective of human health and the environment, and which served as points of departure in evaluating potential corrective measures in the Corrective Measures Study. Most of these IMPGs were identified as residual PCB concentrations in sediment, soil, or environmental media (like fish fillet tissue) across numerous risk-based benchmarks, including cancer risk (at 10^{-6}, 10^{-5}, and 10^{-4} risk levels) across a number of exposure scenarios (residential, recreational, etc.), non-cancer risks, and ecological risks calculated at an "upper bound" (less stringent) and "lower bound" (more stringent) risk level. The discussion in the "Comparative Analysis of Combined Sediment/Floodplain Alternatives" in this document includes a discussion of how each alternative performs in attaining these various IMPGs.

In the Draft Permit, EPA adopts certain of these IMPGs as Performance Standards. GE will be required to meet these and other Performance Standards as part of the remedy, as outlined in more detail in the Draft Permit. See Section II as well as Tables 1 through 4 of the Draft Permit for specific details.

One example of the relationship of the IMPGs and the Performance Standards is the following. In the HHRA, EPA evaluated risks to humans from consuming PCB-contaminated fish tissue. GE used the information from the HHRA to develop the IMPGs for fish consumption, which are presented as a range of concentrations associated with different risk levels that correspond to different consumers and to different points on the EPA risk range. IMPGs were developed for both deterministic and probabilistic risk analyses. The range of concentrations for probabilistic IMPGs is shown on Figure 9. EPA selected one point in this range of concentrations to serve as the Performance Standard for fish consumption, the PCB concentration of 1.5 mg/kg in fish fillet tissue which is associated with the non-cancer probabilistic risk for the average adult fish consumer who is assumed to consume 14 fish meals per year, half of those from the Housatonic River. This Performance Standard is met when fish fillet concentrations are less than 1.5 mg/kg in all Reaches. Other fish tissue IMPGs were retained as benchmarks in the Draft Permit, whereas other IMPGs for fish tissue were not carried over into the Permit.

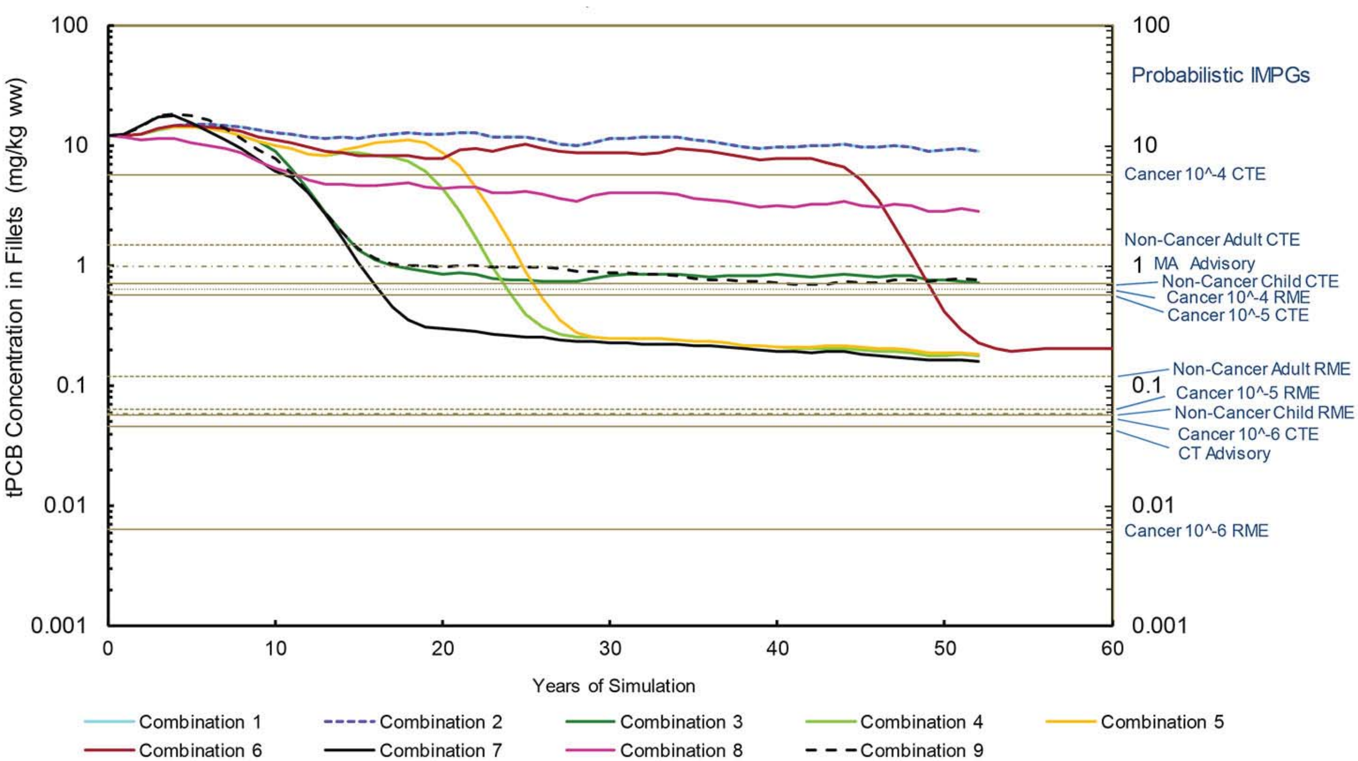


Figure 9
Average Fillet PCB Concentrations in Largemouth Bass (Average for Fish Ages 5 to 9)
Compared to Probabilistic IMPGs

techniques reestablish the prior conditions and functions of the affected habitats.

None of the Combinations preclude the implementation of additional corrective measures if deemed necessary. Additional corrective actions, such as cap or bank repairs, if necessary, should provide the same implementation challenges for all active alternatives.

EPA anticipates a robust monitoring program to monitor the effectiveness of the remedy. Each of the components of the active remedy combinations (Combinations 3-9) can be monitored effectively. However, alternatives that have little or no active remediation are less reliable, therefore, they would require more extensive monitoring.

No regulatory and/or zoning restrictions are known that would affect the implementability of the sediment/floodplain Combinations. Implementation of all alternatives (except alternatives 1 and 2) would require GE to obtain access from all property owners. Issues associated with obtaining access would be similar for alternatives 3-9, except that alternative 9 avoids the large-scale use of sheet pile and large cranes, which may facilitate access negotiations.
-All of the combinations would require coordination with EPA and state agencies to ensure compliance with state ARARs. In addition, implementation of Institutional Controls, obtaining access to State and municipally-owned properties, conducting public/community outreach programs and implementing biota consumption advisories will require both state and local coordination. The alternatives that require a greater extent of remediation and a longer implementation time would likely require more extensive and prolonged coordination activities. However, implementation of Institutional Controls where less remediation is performed would require more extensive Institutional Controls.

Lastly, regulatory and zoning restrictions, state and local coordination related to treatment, storage and disposal facilities, and the availability of suitable of such facilities and specialists is discussed below in the evaluation of Treatment/Disposition alternatives.

Cost

Estimated total and present worth for all of the Combination Alternatives are presented in Table 6. In addition, costs associated with these Combinations coupled with the Treatment/Disposal Alternatives can be found in Table 7. The costs are based primarily on information available at the time of the estimate and are based on GE's unit cost estimates provided in GE's Revised CMS. As shown in Table 6, Combination 1 is the least costly alternative while Combination 6 is the most costly. For purposes of direct comparison of treatment and disposal costs associated with EPA's preferred sediment and floodplain alternative, total treatment/disposal costs for Combination Alternative 9 have also been included in Table 7.

COMPARATIVE ANALYSIS OF TREATMENT/ DISPOSITION ALTERNATIVES

This section presents a summary of a comparative evaluation of the five alternatives for treatment and/or disposal of excavated contaminated river sediment and floodplain soil using the same criteria that were used for the sediment/floodplain combination alternatives. All five alternatives would involve disposition of the sediment, riverbank soil, and floodplain soil in a disposal facility, either directly or after treatment. The three alternatives involving disposal only are TD 1/TD 1 RR (off-site disposal in permitted landfill(s)), TD 2 (on-site in a Confined Disposal Facility (CDF)), and TD 3 (on-site in upland disposal facility or facilities). The other two alternatives would involve treatment, either by a chemical extraction process (TD 4) or by thermal desorption (TD 5), followed by disposition of the byproducts of the treatment and the treated soil/sediment.

Overall Protection of Human Health and the Environment

TD 1, 3 and 5 would provide high levels of protection to human health and the environment because all excavated contaminated material would either be removed from the site (TD 1), contained in an upland disposal facility (TD 3), or treated to levels safe for off-site disposal or potential reuse (TD5). TD 2 could also provide human health protection as long as monitoring, maintenance and/or Institutional Controls are effective in the long term, in order to avoid negative impacts to the river system. Alternative TD 4 (chemical extraction) may not be able to effectively treat PCB contamination from the site, calling into question the protectiveness of this alternative.

Control of Sources of Releases

All the treatment/disposal alternatives would control the potential for PCB-contaminated sediment and soil to be released and transported within the river or onto the floodplain, although some alternatives would provide more effective control of such releases than others. TD 1 best meets this criterion, followed by TD 3.

Under TD 1, placement of the removed PCB-contaminated sediment and soil into a licensed off-site landfill or landfills would effectively isolate those materials from being released into the Housatonic River and associated floodplain. Under TD 2, there is a potential for releases of sediment into the river during the CDF construction process. TD 3 would address future releases through the placement of the materials in an upland disposal facility that will have a double liner and the implementation of a long-term monitoring and maintenance program. Placement of the PCB-contaminated sediment and soil into an upland disposal facility could effectively isolate the removed materials from being released into the environment. However, there is the potential for PCB releases to the Housatonic watershed if the landfills are not properly operated, monitored and maintained. Under TD 4 and TD 5, the potential for the PCB-contaminated sediment and soil to be released within the river or onto the floodplain during treatment operations would be minimal as long as these facilities are properly operated and maintained.

Compliance with Federal and State ARARs

The ARARs identified for the treatment/disposal alternatives are discussed in more detail in the Administrative Record. Each of the TD alternatives would involve moving the sediment, bank soil, and floodplain soil from the point of excavation to the treatment/disposition point. Of all the disposal alternatives (TD 1, TD 2, TD 3), only TD 1 complies with all State ARARs. TD 4 and TD 5 could potentially meet all ARARs. TD 2 will not meet, without limitation, wetland and floodplain requirements; and not all potential locations of TD 2 or TD 3 will meet the requirements of 310 CMR 30.700, 310 CMR 16.40(3)(4), and/or 990 CMR 5.04, which prohibit, without limitation, hazardous waste and solid waste facilities in an Area of Critical Environmental Concern ("ACEC") or adjacent to or in close proximity to an ACEC such that it would fail to protect the outstanding resources of an ACEC.

Long-Term Reliability and Effectiveness

TD 1, 4, and 5 result in the greatest reductions in residual risk. With TD 1, all material is removed from the site and sent to an offsite disposal facility; with TD 4 and TD 5, all material that was treated but did not reach safe PCB levels would be removed from the site and sent to an offsite disposal facility. Contamination remains on-site untreated under TD 2 and TD 3 and therefore the residual risk is greater under these alternatives. However, TD 3 would permanently isolate those materials from direct contact with human and ecological receptors in a secure location outside the floodplain. Under TD 4 and TD 5, residual risk is decreased because treatment reduces the levels of contaminants, however the reductions may not be to levels allowing for unrestricted reuse.

There are considerable differences in the adequacy and reliability of the five treatment/disposal alternatives. TD 1 is adequate and reliable because it does not rely on operation, monitoring, and maintenance requirements (except at the receiving facility) to adequately and reliably address the contamination. The other alternatives rely on operation, monitoring, and maintenance requirements to address the contamination remaining onsite to be effective in the long-term. Both TD 4 and TD 5 rely on these requirements to ensure that material is safely treated to acceptable concentrations. TD 2 and TD 3 rely particularly on monitoring and maintenance in the long

Table 6 Cost Summary for Combinations of Sediment and Floodplain Alternatives

Combination:	1	2	3	4	5	6	7	8	9
	SED 1/FP 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	SED 9 MOD/FP 4 MOD
Total Capital Costs	0	0	$167 M	$307 M	$384 M	$900 M	$381 M	$84 M	$314 M
Total Operations Monitoring and Maintenance Costs	0	$5 M	$10 M	$12 M	$13 M	$17 M	$13 M	$10 M	$12 M
Total Cost for Alternative (excluding Transportation and Disposal)	**0**	**$5 M**	**$177 M**	**$319 M**	**$397 M**	**$917 M**	**$394 M**	**$94 M**	**$326 M**
Total Present Worth	0	$1.8 M	$133 M	$193 M	$219 M	$300 M	$251 M	$78 M	$228 M

Notes:
1. All costs are in 2010 dollars. $ M = million dollars.
2. Total capital costs are for engineering, labor, equipment, and materials associated with implementation.
3. Total OMM costs include cost for monitoring, post-construction inspections and repair activities (if necessary), long-term monitoring (fish, sediment, water column, visual), and for the maintenance of institutional controls and EREs.
4. Total present worth cost is based on using a discount factor of 7%, considering the length of the construction period and an OMM period of 100 years on a reach-specific basis.
5. Estimates do not include costs for treatment or disposition of any soil/sediment removed; those costs are outlined below (see Table 7).

term to ensure that material remains adequately contained, and TD3 may require long-term transport of leachate to the GE facility in Pittsfield or construction of a separate facility to treat leachate.

Labor and materials are available for operation, monitoring, and maintenance for all of these alternatives. While TD 1, 2, 3 have been used under similar conditions, TD 4 has not been demonstrated at full scale on sediment and soil representative of those in the Rest of River. TD 5 has been used to treat PCB-contaminated soil but only in limited cases for treatment of sediment, thereby creating some uncertainty regarding the adequacy and reliability of this alternative.

None of the alternatives are expected to have long-term adverse impacts on human health, however TD 2 will have significant long-term impacts on wetlands and floodplain areas. TD 3 may have long-term environmental impacts depending upon where the upland facility is located.

Attainment of IMPGs

Attainment of IMPGs is directly applicable to the sediment and floodplain remediation approaches outlined and evaluated for the various Combination Alternatives discussed earlier in this document. IMPG attainment is not directly applicable to the transportation and disposal alternatives, thus EPA did not conduct a comparative analysis for these alternatives for this criterion.

Reduction of Toxicity, Mobility, or Volume

Reduction of Toxicity: TD 1 through TD 3 would not include any treatment processes that would reduce the toxicity of, or directly affect, PCB concentrations in the removed sediment and soil. TD 4 and TD 5 would incorporate treatment processes that can, to varying degrees, reduce concentrations of PCBs. Under TD 4, the chemical treatment process would reduce the toxicity of the sediment and soil by permanently removing some PCBs from these materials but likely will not reduce concentrations to levels allowing reuse of the material, and as such would still require landfilling. Under TD 5, the thermal desorption system would reduce the toxicity of the PCB-contaminated sediment and soil by permanently removing PCBs from these materials. The PCBs in the liquid stream would be sent to a licensed off-site disposal facility for additional treatment. The degree of expected reduction in toxicity, and the amount of hazardous materials to be destroyed or treated are dependent on the sediment/floodplain alternatives selected, with Combinations 3 through 9 providing varying levels of expected removal of PCBs from the River and floodplain. For TD4 and TD5, the treatment process would be irreversible and the reduction in toxicity would be permanent.

Reduction of Mobility: All of the alternatives would reduce the mobility of PCBs in the sediment and soil. In TD 1, TD 2, and TD 3, these materials would be removed and disposed of in off-site permitted landfill(s) (TD 1) or contained within on-site CDF(s) (TD 2) or an on-site upland disposal facility (TD 3). TD 4 and TD 5 would reduce the mobility of PCBs present in the sediment/soil via ex-situ chemical extraction or thermal desorption.

Reduction of Volume: TD 1, TD 2, and TD 3 would not reduce the volume of PCB-contaminated material, although, TD 1 would reduce the volume of material that remains at the Site. For TD 4, treatment of sediment/soil would reduce the volume of PCBs present in those materials by transferring some of the PCBs to an aqueous waste stream for subsequent treatment. PCB-contaminated sludge would be generated from the wastewater treatment system and would be sent to a permitted off-site facility for disposal. For TD 5, treatment of sediment/soil in the thermal desorption system would reduce the volume of PCBs present in those materials, with the liquid condensate transported to an off-site facility for destruction.

Short-Term Effectiveness

Each of the alternatives has the potential for short-term impacts to the community. Alternatives that require on-site treatment (TD 4 and TD 5) require operation of a treatment facility, which would have air emissions albeit at very low levels, which could be treated prior to discharge if needed to meet regulatory levels. Alternatives that require on-site containment (TD 2 and TD 3) would also have additional short-term impacts to the areas and community surrounding the disposal sites. Construction of such facilities will temporarily increase community impacts during the time work is done in these areas. The alternative with off-site disposal (TD 1/TD 1 RR) will have short-term impacts during transport of the waste material; however, the impacts of truck traffic may be greatly reduced by reliance on rail transportation. The short-term impacts to workers are all relatively the same under all alternatives. All alternatives have the potential for accidental releases of various PCB-contaminated materials during transportation to off-site or local disposal or treatment facilities. However, actions will be taken to prevent these potential releases. All alternatives would require truck traffic. TD 1 and TD 4 require transportation of the most material, followed closely by TD 5, then TD 3. Depending on the location of the upland disposal facility under TD 3, TD 3 may have truck traffic comparable to TD 1. The impacts of truck traffic may be greatly reduced by reliance on rail transportation, consistent with EPA's intention to maximize use of rail.

There are also some differences in impacts to the environment under the different alternatives. TD 2 through TD 5 could cause permanent loss of habitat and loss or displacement of wildlife in the area depending upon where the disposal or treatment facility is located. TD 1 would have fewer impacts on the environment than the other alternatives.

Implementability

The implementability of TD1 through TD5 includes the following considerations:

All of the alternatives are readily able to be constructed and operated, with the acknowledgement that for off-site disposal via rail, some of the rail lines will need to be upgraded. The reliability of technologies depends on the specific alternative. TD 1 and TD 3 are both reliable landfilling technologies. CDFs (TD 2) have been implemented at many locations and have been shown to be reliable when constructed and operated properly. For both TD 4 and TD 5, there are several uncertainties regarding the reliability of full-scale application of both chemical and thermal processes to sediment (e.g., moisture content), particularly with some of the volumes associated with the sediment alternatives.

Regarding regulatory and zoning requirements and coordination with other agencies, the existing licensed off-site facility in TD 1 would already have satisfied regulatory requirements. Coordination with state and local agencies would be required to site the rail loading facility. Both state and local communities have expressed a strong preference for rail, which should facilitate resolution of any remaining regulatory, zoning, access or facility siting issues.

TD 2 could raise issues in accounting for sufficient flood storage compensation at the appropriate elevations/areas to provide for construction of a CDF(s) large enough to hold the necessary sediment disposal volumes, and permanent access to the CDF(s) would be required for inspections and maintenance. As discussed in the Compliance with Federal and State ARARs section above, TD 3 would have significant issues with the ACEC regulations, the Massachusetts Hazardous Waste Facility Site Safety Council Regulations, and the site suitability criteria in the Commonwealth's Site Assignment Regulations for Solid Waste Facilities. In addition, TD 2 and TD 3 would both require extensive coordination with state and local officials, increasing the period of time before these could be implemented, and both TD 2 and TD 3 would likely encounter significant local and state opposition that may render these alternatives more difficult, and potentially not feasible, to implement.

TD 4 and 5 would require access to large areas for the construction and operation of a treatment facility. Locating such a facility would require coordination would state and local agencies. Other access and zoning issues may also be present. Since state and local officials have expressed a strong preference for off-site disposal, these alternatives may encounter significant opposition, thus rendering these alternatives difficult to implement.

Regarding the availability of licensed off-site disposal facilities (TD 1) while the current universe of facilities is sufficient, there are uncertainties regarding the future availability of the necessary capacity in off-site landfills for the alternatives that have larger volumes and longer durations.

For TD 2 and TD 3, the availability of on-site disposal facilities may be limited by opposition from state and local officials and regulatory issues, as discussed above. However, if these obstacles are overcome, there is sufficient availability of facilities for TD 3. There may be limitations on the capacity of CDF(s) depending on the combination alternative selected.

Regarding the ease of undertaking additional corrective measures, if necessary, if additional wastes were generated as part of future actions, it is likely that the facilities constructed under TD 2 through TD 5 would no longer be available for additional treatment and/or disposal. While it may be technically feasible to expand an upland disposal facility after closure (TD 3), it would likely be administratively difficult and not cost-effective to implement this option. Thus, TD 1 is the most implementable in this regard.

TD 1 through TD 5 all can be monitored effectively. TD 1 would require the least amount of monitoring. TD 2 and TD 3 would require extensive long-term monitoring to ensure the integrity and effectiveness of the disposal facility(s). TD 4 and TD 5 would require extensive monitoring of the treatment facilities during treatment operations.

Cost

The estimated cost ranges for each treatment/disposal alternative, including total capital cost, estimated annual maintenance and monitoring cost, and total estimated present worth are summarized in Table 7. These costs are expressed as ranges since they account for treatment or disposal of a wide range of volumes depending on the sediment and floodplain remediation approach selected. As shown in Table 7. TD 3 is the least costly alternative while TD 4 and TD 5 are the most costly. For purposes of direct comparison of treatment and disposal costs associated with EPA's preferred sediment and floodplain alternative, total and present worth treatment/disposal costs for Combination Alternative 9 are also included in Table 7.

Table 7 Cost Summary for Treatment/Disposition Alternatives

	TD 1	TD 1 RR	TD 2	TD 3	TD 4	TD 5 (with reuse)	TD 5 (without reuse)
Total Capital Costs	0	$300,000	$6 – 20 M	$10 – 67 M	$17 – 20 M	$20 – 232 M	$20 – 232 M
Total Disposal, Operations, Monitoring, and Maintenance Costs	$55 – 832 M	$52 – 787 M	$94 – 490 M	$26 – 134 M	$72 - 979 M	$83 – 1,216 M	$86 – 1,293 M
Total Cost for Alternative	**$55 – 832 M**	**$52 – 787 M**	**$100 – 510 M**	**$36 – 201 M**	**$89 – 999 M**	**$103 – 1,450 M**	**$106 – 1,530 M**
Total Present Worth	$40 – 220 M	$38 - 210 M	$46 – 131 M	$17 – 49 M	$70 – 286 M	$81 – 569 M	$83 – 590 M
Total TD Cost for Combination 9	**$308 M**	**$287 M**	**$317 M**	**$100 M**	**$399 M**	**$515 M**	**$540 M**
Total Present Worth for Combination 9 TD Cost	$196 M	$183 M	$85 M	$33 M	$170 M	$280 M	$295 M

Notes:

1. All costs are in 2010 dollars, except total present worth values. $ M = million dollars,
2. The fraction of TSCA material has been assumed to be 35%. A density of 1.62 tons per cubic yard was assumed.
3. The Massachusetts hazardous waste transport fee is not included in these estimates. The fee would potentially apply to TSCA material transported off-site via truck. This fee would potentially apply to TD-1, and portions of TD-2, TD-4 and TD-5. The fee is currently $56.25 per ton, including a vehicle identification fee. For TD 1 for Combination 9, the total fee is estimated to be $31.3 million. The fee is not applicable to off-site disposal via rail (TD 1 RR).
4. With the exception of TD 2, the ranges of costs presented are the minimum and maximum anticipated costs based on the potential range of volumes that would be potentially removed under the sediment and floodplain soil alternatives (191,000 cubic yards to 2.9 million cubic yards). For TD 2, the lower-bound costs are based on the combined volume of SED 6 and FP 2 and the upper-bound costs are based on the combined volume of SED 8 and FP 7, with material not placed in the CDF(s) assumed to be transported off-site for non-TSCA disposal. Thus, the upper-bound costs, but not the lower-bound costs, for TD 2 are comparable to the costs for the other alternatives.
5. Total capital costs are for engineering, labor, equipment, and materials associated with implementation.
6. Total operations costs consist of the total of the average annual costs for operation, placement, and/or treatment of sediment and/or soil, estimated for the range of durations for implementing the alternatives.
7. Total monitoring and maintenance costs are for performance of post-closure monitoring and maintenance programs of 100 years for TD 2 and TD 3 and 5 years for TD 4 and TD 5.
8. Total present worth cost is based on using a discount factor of 7%, considering the range of total potential durations for the alternative, and post-closure monitoring and maintenance periods of 100 years for TD 2 and TD 3 and 5 years for TD 4 and TD 5.
9. For TD 5 with reuse, it is assumed that approximately 50% of the floodplain soil treated by thermal desorption would be reused on-site and that all remaining materials would be transported off-site for disposal.
10. Costs for TD 3 do not include the very likely extensive costs associated with the approval process required for an on-site landfill.