4. Approach to Evaluating Remedial Alternatives for Floodplain Soils

This section provides a description of the approach that was used in evaluating the nine alternatives developed for addressing floodplain soils in the Rest of River area. The detailed evaluation of these alternatives is presented in Section 7.

4.1 General Approach

Overview of Alternatives

GE has evaluated nine alternatives for remediating floodplain soils – FP 1 through FP 9. These alternatives are summarized in Table 1-2. These alternatives (apart from FP 1, the no-action alternative) consist of three types – IMPG-based alternatives, threshold-based alternatives, and an alternative that is a combination of those two types.

The IMPG-based alternatives, FP 2, FP 3, FP 4, FP 7, and FP 9, involve the removal and backfill of soil as necessary to achieve certain specified average PCB concentrations within a given depth and averaging area in the floodplain. The average concentrations targeted for these alternatives are based on the PCB IMPGs that apply to the floodplain – or, where tissue-based IMPGs have been converted to target floodplain soil PCB levels (as discussed in Section 2.2.2.3), those target soil PCB concentrations. In describing and evaluating the remedial alternatives in this report, these target soil levels are included within the term "IMPGs" when used generally, and are sometimes referred to as "floodplain soil IMPGs." Averages for this evaluation were based on the 95% upper concentration limit (UCL) of the spatially weighted mean, as described in Section 4.4 below.

Different floodplain alternatives were developed to achieve different sets of IMPG values within the ranges of the IMPGs. The alternatives were developed following a sequential approach of first evaluating the extent of remediation necessary to meet human health IMPGs, and then considering (where relevant) the additional remediation necessary to meet ecological IMPGs. For human direct contact with soil and consumption of agricultural products, these alternatives were based on achieving different IMPG values within the ranges of the health-based RME IMPGs (i.e., the upper bounds of the ranges, mid-range values, or the lower bounds of the ranges) in the appropriate averaging areas.[70] Next, each of these alternatives (with the exception of FP 2 and FP 9) includes the additional soil removal/backfill

[70] For these IMPGs, the upper bounds of the ranges refer to the RME IMPGs based on a 10^{-4} cancer risk or non-cancer HI of 1, whichever is lower; the mid-range values refer to the RME IMPGs based on a 10^{-5} cancer risk or non-cancer HI of 1, whichever is lower; and the lower bounds of the ranges refer to the RME IMPGs based on a 10^{-6} cancer risk, except that, for human direct contact, they are no lower than 2 mg/kg, which is the CD standard for unrestricted use.

needed to achieve the upper or lower bounds of the relevant floodplain ecological receptor IMPGs within their respective averaging areas.[71]

Threshold-based alternatives, FP 5 and FP 6, involve the removal of all soils within a given depth having PCB concentrations that exceed certain concentration thresholds (50 mg/kg for FP 5 and 25 mg/kg for FP 6). Averaging areas were not used in the development of remedial alternatives FP 5 and FP 6, but only in the development of the IMPG-based alternatives.

The floodplain alternative identified by EPA, FP 8, involves a combination of the foregoing approaches in that it includes: (a) removal and backfill of soil as necessary to achieve certain sets of PCB IMPGs (the mid-range IMPGs for human health protection and the lower-bound IMPG for amphibians) in the relevant averaging areas; and (b) the removal of any additional soil in the top foot with PCB concentrations above a certain concentration threshold (in this case 50 mg/kg).

Each of these floodplain alternatives, except FP 1 (no action), focuses on excavation and backfill of the top foot of floodplain soil, which represents the soil to which human and ecological receptors would most likely be exposed, as approved by EPA in its April 13, 2007 letter conditionally approving the CMS Proposal. However, as directed in EPA's letter of May 22, 2007, alternatives FP 3 through FP 9 also include additional removal and backfill to a depth of 3 feet in certain heavily used areas (as discussed in Section 4.2.1 below).

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[71] The ecological receptors considered are amphibians (represented by wood frogs), omnivorous mammals (represented by shrews), insectivorous birds (represented by wood ducks), and piscivorous mammals (represented by mink).

As discussed in Section 2.2.2.3, the target floodplain soil IMPG levels developed for wood ducks and mink are dependent on the associated sediment concentrations due to the mixture of aquatic and terrestrial dietary items consumed by those receptors (i.e., separate soil IMPGs have been developed based on sediment target levels of 1, 3, and 5 mg/kg). In developing the floodplain alternatives designed to achieve these IMPGs, GE assumed that the associated average sediment concentration in the wood duck and mink averaging areas would be 1 mg/kg or below, and thus developed these alternatives to achieve the wood duck and mink floodplain soil IMPG levels associated with a target sediment level of 1 mg/kg. However, in the detailed evaluation of these alternatives in Section 7, GE has also considered the extent to which these alternatives would achieve the floodplain soil IMPG levels associated with the higher target sediment levels and, where they would not, has identified the additional volumes of soil removal/backfill that would be necessary to achieve those IMPGs. Furthermore, as discussed in Section 4.2.3.5, the evaluations in Section 8 of whether the combinations of sediment-floodplain alternatives would achieve the IMPGs for these two receptors were made through a procedure which avoids the use of the pre-selected target sediment levels and associated target floodplain soil levels (since the actual sediment PCB levels predicted to be achieved under the sediment alternative are used to calculate the floodplain soil IMPG for that combination of alternatives).

Evaluation Approach

To evaluate these floodplain alternatives, GE first estimated the areal extent and volume of soil removal for each alternative (with that volume assumed to be replaced with clean backfill material). For the IMPG-based alternatives, this required determining the locations and volume of soil removal/backfill necessary to achieve the specified average concentrations in particular averaging areas. The averaging areas used for this determination, which vary depending on the human or ecological receptors being evaluated, are described in detail in Section 4.2.[72] The methodology used to estimate the areal extent and volume of soil removal/backfill for both the IMPG-based alternatives and the threshold-based alternatives (as well the combination of those types) is summarized in Section 4.4. Each alternative was then evaluated in detail based on the nine Permit criteria (General Standards and Selection Decision Factors) described in Section 2. That evaluation is presented in Section 7.

4.2 Exposure/Averaging Areas

In the HHRA and ERA, EPA divided the floodplain into various areas, over which soil PCB concentrations were averaged to evaluate potential risk.[73] As described in the CMS Proposal, this approach is also applicable for evaluating attainment of IMPGs and thus has been used herein for the assessment of floodplain remedial alternatives. This section describes the averaging areas used in this Revised CMS Report (which are largely the same as those used in the March 2008 CMS Report). As discussed in Section 4.1, these averaging areas were used in the development of the IMPG-based floodplain alternatives (FPs 2, 3, 4, 7, and 9, as well as the IMPG-based component of FP 8), but not the threshold-based alternatives (FPs 5 and 6). In addition, they have been used in the evaluation of all alternatives in assessing the extent to which each alternative would achieve the IMPGs.

The types of floodplain averaging areas described here include human direct contact exposure areas (Section 4.2.1), farm areas evaluated based on the assessment of human consumption of agricultural products (Section 4.2.2), and separate averaging areas developed for the evaluation of the various ecological receptors (Section 4.2.3) – i.e., amphibians, omnivorous/carnivorous mammals, insectivorous birds, and piscivorous mammals. The development of these averaging areas and the detailed evaluation of IMPG attainment have focused on the floodplain areas within Reaches 5 through 8 for the human

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[72] In addition, Section 4.3 presents a screening-level analysis of IMPG attainment for portions of the Rest of River floodplain where averaging areas were not developed or PCB concentrations are low and data are limited – namely, areas downstream of Rising Pond Dam for human health, and areas downstream of Woods Pond Dam for ecological receptors.

[73] The floodplain for the Rest of River is defined as the area within the 1 mg/kg PCB isopleth in Reaches 5 and 6, and the portion of the 100-year floodplain containing PCBs in reaches below Woods Pond Dam.

health IMPGs and Reaches 5 and 6 for the ecological IMPGs. To evaluate achievement of the IMPGs for these receptor groups in downstream reaches of the floodplain, a general screening-level approach was taken, as described in Section 4.3.

4.2.1 Assessment of Human Direct Contact

General Approach

EPA's HHRA divided the floodplain in Reaches 5 through 8 into 90 exposure areas for the assessment of direct human contact with floodplain soils. During the risk assessment, EPA assigned specific exposure scenarios, including assumed age groups for human receptors (e.g., adults, older children), to each of these 90 exposure areas (EAs). Several of these areas contain overlying direct contact subareas, which are typically characterized by a different and/or more frequent exposure scenario (e.g., a large exposure area considered for general recreation may contain as a subarea a stretch of soil along the River that is considered for the bank fishing scenario); EPA delineated 30 such subareas within the floodplain in Reaches 5 through 8. The 90 exposure areas and 30 subareas are referred to jointly herein as EAs. A map of the direct contact EAs delineated by EPA is provided on Figures 4-1a (Reaches 5 and 6) and 4-1b (Reaches 7 and 8). In the HHRA, EPA screened out the human direct contact pathway for floodplain soil in Reach 9, as well as reaches farther downstream, so no additional assessment of direct contact was conducted for those reaches. Table 4-1 provides a listing of the direct contact EAs, and includes the specific exposure scenario(s) that were assigned to each by EPA. These EAs have been used in the floodplain evaluation for application of the IMPGs based on direct human contact.

The Revised CMS has evaluated all EAs (with two exceptions) based on their current use as described in EPA's HHRA and summarized in Table 4-1.[74] The two exceptions are EAs 21 and 34. EPA designated those areas as agricultural areas (which would require evaluation of direct contact by farmers). These two EAs have been evaluated based on recreational use scenarios rather than the farmer scenario. The reason for this change is that, due to a change in ownership, these two EAs are not being used for agricultural purposes, as discussed further in Section 4.2.2. Instead, EA 21 has been evaluated for high-use general recreation by adults and older children, and EA 34 has been evaluated for intermediate-use general recreation by adults (see Table 4-1).

[74] Where a different and less restrictive use of a given area is reasonably anticipated in the future, it would be addressed, as necessary, through the use of a deed restriction or Conditional Solution, as discussed in Section 4.6 below.

Frequently Used Areas

As noted in Table 1-2, FP 3 includes removal and backfill of soil to achieve the mid-range human health-based RME IMPGs in certain "frequently used" areas. For direct contact exposure, these include such areas as trails, access points, and known recreational areas. The following EAs were identified in the CMS Proposal as frequently used areas:

- EAs 4 and 12 – established foot trails running through both MA Fish & Wildlife land and private land located close to residential properties;
- EA 26a – MA Fish & Wildlife land with trail access and an adjacent parking area;
- EA 35a and 37b – trail along easements running through both private property (EA 35a) and MA Fish & Wildlife land (EA 37b) with an adjacent parking area;
- EA 39 – John Decker Canoe Launch (MA Fish & Wildlife land) and parking area;
- EA 40 – MA Fish & Wildlife land adjacent to the Lenox Sportsman Club property;
- EAs 47, 52, and 53 – River access/canoe launches with corresponding parking areas located along October Mountain Road;
- EAs 57, 58, and 59 – land surrounding Woods Pond with road access; and
- EA 60a – canoe launch adjacent to Woods Pond Footbridge with an adjacent parking area.

Figure 4-2 shows the location of these areas, which are referred to in this report as "Frequent-Use EAs." These areas are also identified in Table 4-1.

In its April 13, 2007 conditional approval letter for the CMS Proposal, EPA directed GE to increase the depth of removal in these Frequent-Use EAs from 1 foot to 3 feet in alternatives FP 3 through FP 7. GE disputed this direction on the basis that, although these EAs are frequently used, it is not "reasonably anticipated" or "realistic" to expect that people would be exposed to soil in these areas to depths below the top foot. Following discussions between GE and EPA, EPA amended its direction in a May 22, 2007 letter, stating that "GE may provide justification for the reclassification of specific areas of the parcels designated as 'heavily used' that would not meet the 'heavily used' designation and therefore would not be subject to the evaluation of 3-ft removal/replacement."

In response to that directive as well as certain EPA comments on the CMS Report relating to this issue (notably EPA's Specific Comment 95), GE has delineated certain subareas within the Frequent-Use EAs as subject to 3-foot removal in FP 3 through FP 7, and has also used those subareas in FP 8 and FP 9. These subareas (referred to as "Heavily Used Subareas") are displayed on Figures 4-2 and 4-3a-j. As stated above, the Frequent-Use EAs consist of areas such as trails, access points, and known recreational areas. For the purposes of delineating the Heavily Used Subareas, the heavily used portions of the EAs containing trails were defined as approximately 10-foot wide corridors down the center of the trails (due to scale, these are not shown on the map on Figure 4-2). The heavily used portions of the remaining access points and recreational areas, which consist of easily accessible areas, were defined based on observations from site reconnaissance and aerial photography, as shown on Figure 4-3 (e.g., paths/driveways and parking lots associated with canoe launch areas). This procedure also took into account areas mapped by EPA as "difficult access" in the HHRA (also shown on Figure 4-3) by excluding such areas from the delineation. For example, the EPA "difficult access" mapping was used in part to bound the extent of the Heavily Used Subareas within the canoe access points at EAs 47, 52, and 53 (see Figure 4-3f). Below is a summary of the rationale used for the delineation (or lack thereof) of the Heavily Used Subareas within each of the Frequent-Use EAs listed above:

- EAs 4 and 12 – Heavily Used Subareas were defined as an approximate 10-ft wide corridor down the center of these trails (see Figure 4-3a).

- EA 26a – The Heavily Used Subarea was defined as the trail/parking area based on review of aerial photography, excluding EPA-delineated "difficult access" areas (see Figure 4-3b).

- EA 35a and 37b – EA 35a includes portions of two separate utility corridors. While these utility corridors both have foot trails running through them, these trails remain outside the 1 mg/kg isopleth and thus outside the EA, so no Heavily Used Subarea was identified in EA 35a (see Figure 4-3c). EA 37b also includes a utility corridor with a foot trail running through it. In this EA, however, the foot trail section is within the 1 mg/kg isopleth and thus within the EA boundary, and hence the section of the trail within EA 37b was defined as a Heavily Used Subarea (see Figure 4-3d).

- EA 39 – The Heavily Used Subarea was defined as the road, canoe launch, and parking area within this EA, based on review of aerial photography (Figure 4-3e).

- EA 40 – The Heavily Used Subarea was defined as the portions of this EA containing trails based on review of aerial photography (Figure 4-3e).

- EAs 47, 52, and 53 – Heavily Used Subareas were defined as the roads, canoe launches, and parking areas within these EAs, based on review of aerial photography (Figure 4-3f).

- EAs 57, 58, and 59 – These EAs border Woods Pond to the east and south. Based on review of aerial photography, a dirt road runs through and adjacent to these EAs. The sections of this road that fall within the 1 ppm isopleth include sections in EAs 58 and 59 but none in EA 57 (Figures 4-3g through 4-3i). As a result, Heavily Used Subareas were defined for the sections of this road in EAs 58 and 59 (shown on Figures 4-3h and 4-3i), but not for EA 57.

- EA 60a – The Heavily Used Subarea was defined as the road/parking area and canoe launch that comprise this EA, based on review of aerial photography (Figure 4-3j).

In FP 3 through FP 9, certain removal criteria under those alternatives – namely, attainment of the pertinent set of direct contact IMPGs for FP 3, FP 4, FP 7, FP 8, and FP 9 and the threshold removal concentrations for FP 5 and FP 6 – were applied to the top 3 feet (as well as the top foot) of soil in these Heavily Used Subareas.

4.2.2 Assessment of Agricultural Products Consumption

There are a number of farm areas (or farm areas that are no longer in use) located fully or partially within the floodplain of the Housatonic River. The farm areas located in Reaches 5 through 8, as delineated by EPA in the HHRA, are shown on Figures 4-4a (Reaches 5 and 6) and 4-4b (Reaches 7 and 8). With several exclusions (discussed below), these are the areas that have been used for application of the floodplain soil IMPGs based on agricultural products consumption; they are identified herein as FA 1 through FA 14, as shown on Figures 4-4a and 4-4b.

The CMS Proposal stated that the areas designated by EPA as farm areas would be used in the CMS for the evaluation of IMPGs based on agricultural products consumption, unless a given farm area is no longer used or is anticipated to no longer be used for raising farm animals or the growing of crops intended for consumption by humans. Based on these criteria, several of the designated areas in Reaches 5 and 7 have been excluded from agricultural products consumption evaluations presented in this Revised CMS Report.

First, several “farm areas” have a use category, as identified by EPA in the HHRA, that is not associated with agricultural products consumed by humans, and were therefore not included in these evaluations. The use categories not associated with the production of agricultural products consumed by humans consist of those identified by EPA as “wetland,” “open land/wetland,” “open land,” “horse,” and “not in use”; farm areas with these use designations are identified on Figure 4-4b (with hatching) as “Farm Area Not in Agricultural Use.”

Second, there are three areas identified as farms in the HHRA for which GE has determined that no current or future agricultural use within the floodplain is anticipated, and which have thus been excluded from the evaluations of agricultural product consumption:

- For the two farms located in the PSA (Figure 4-4a) that include direct contact EAs 21 and 34 (see Figure 4-1a), GE has purchased the portions of those areas located within the floodplain and will maintain those areas as open land with no agricultural use (these areas are labeled as "Not in Use" on Figure 4-4a). For the northern such farm in the PSA, the remaining area of farm field (not owned by GE) is located completely outside the floodplain, and therefore was not evaluated for consumption of agricultural products.

- There is also an area located in Reach 7 that EPA classified as "beef cattle grazing" in the HHRA. GE's discussions with the then-owner of this property in 2006 indicated that this property was actually an estate where a few cattle were raised as domesticated animals and were not intended for human consumption. Since that time, this property has been sold. In these circumstances, this property is not currently used or anticipated to be used in the future for the classification of "beef cattle grazing" that was assigned to that area by EPA in the HHRA (this area is labeled and designated as "Not in Use" on Figure 4-4b).

For the purposes of these evaluations, individual farm averaging areas were defined based on land ownership and parcel boundaries. For example, one farm polygon (as defined by EPA in the HHRA) may have been split into two averaging areas if that particular polygon spanned two parcels having different ownership.[75] In contrast, if one farm polygon spanned two or more parcels with the same owner, the entire farm polygon was used as the averaging area. In some cases, two or more farm polygons are located within a single parcel boundary; in this case, all polygons having the same owner and use type were combined into a single averaging area. In the case where separate farm polygons having the same owner had different use types (i.e., "vegetables" in one polygon versus "hay" in another), the averaging areas were separated based on use type since different IMPGs would be applied to each area. Figures 4-4a and 4-4b show the individual averaging areas (i.e., labeled as FA 1 through FA 14 and shaded in unique colors) that have been used for the evaluations of farm areas.

[75] One exception to this approach is the farm area designated FA 2 (shown on Figure 4-4a). In this case, the farmed area spans multiple parcels having different owners, but has been combined into a single averaging area since GE's discussions with the owners has indicated that the area is farmed as one continuous field.

Table 4-2 provides a summary of the 14 agricultural averaging areas within Reaches 5 through 8 that have been used in the evaluations of agricultural products consumption. As shown in the table, all of these areas have EPA use classifications of either "hay," "corn/silage," or areas of "open land" (which is then described as either "possibly hay" or "formerly grazing" areas). Given these use classifications, for the purposes of evaluating agricultural product consumption, all of these farm areas in Reaches 5 through 8 were assigned to the "commercial dairy" IMPG category based on the assumption that all these areas provide feed (or could potentially provide feed) for commercial dairy cows.

The floodplain soil IMPG levels for commercial dairy farms were shown in Table 2-5. As discussed in Section 2.2.2.3, those levels were derived based on the assumption that the entire portion of the agricultural land is located within the floodplain. For the agricultural product consumption assessments, as described in the CMS Proposal, only the portions of agricultural fields within the floodplain are considered areas of potential exposure. To account for the fraction of a given farm area that is located outside the floodplain, the floodplain soil IMPGs shown in Table 2-5 have been adjusted by a weighting factor. For example, for a farm with 80% of the total cropland or grazing land located within the floodplain, the initially calculated soil IMPG levels shown in Table 2-5 were divided by a factor of 0.8 to determine a farm-specific IMPG value. Table 4-2 shows, for each farm area evaluated, the adjusted target floodplain soil levels that have been calculated from the commercial dairy IMPGs in Table 2-5, based on application of the pertinent weighting factor for that farm area. These adjusted soil levels have been used in the evaluations of IMPGs for the applicable farm areas.

In addition to those farm areas identified in Reaches 5 through 8, the HHRA identified several farm areas in Reach 9. A more general, screening-level evaluation has been conducted for the farms located in this reach and is described in Section 4.3.1.

4.2.3 Assessment of Ecological Receptors

This section describes the averaging areas that were used for the evaluation of the ecological receptor groups subject to IMPGs for floodplain soil – i.e., amphibians, omnivorous/carnivorous mammals, insectivorous birds, and piscivorous mammals.

4.2.3.1 Amphibians

As discussed in GE's revised IMPG Proposal (GE, 2006a), the PCB IMPGs for amphibians (3.27 to 5.6 mg/kg) were based on an assessment of potential risks to wood frogs as the representative species for this receptor group. As relevant to the floodplain, these IMPGs

apply to the sediments of vernal pools in the floodplain.[76] As stated in the CMS Proposal, EPA's database identifies 68 vernal pools (including both temporary and permanent pools) in the floodplain of the PSA; the vernal pools located within the PSA are shown on Figure 4-5. Two of these 68 vernal pools are located upstream of the Confluence (IDs 8-VP-1 and 5-VP-2) and therefore have not been considered herein. Also, while EPA's ERA states that only 27 of these vernal pools were identified as suitable breeding habitat for wood frogs, to be conservative and since the amphibian IMPGs apply to species other than wood frogs, GE has included the 66 EPA-identified vernal pools located within the PSA in the IMPG evaluations for amphibians.

In the CMS Proposal, GE proposed to use EPA's wood frog population model, with certain modifications, to evaluate which of the vernal pools would require remediation in order to protect the local amphibian population in the PSA. However, in its April 13, 2007 conditional approval letter, EPA directed GE not to use the wood frog population model for this purpose (Condition # 13), and it reaffirmed that directive in its May 22, 2007 letter.

GE does not agree with that directive.[77] However, given EPA's directive not to use the model as proposed, the amphibian IMPGs have been applied to each of the 66 vernal pools in the PSA. Thus, both for purposes of developing floodplain remedial alternatives designed to achieve the upper or lower bound of the amphibian IMPGs and for purposes of evaluating whether a given alternative would achieve the amphibian IMPGs, each of the 66 vernal pools was treated as a separate averaging area.

For reaches downstream of the PSA, EPA did not identify specific vernal pools within the floodplain of the Housatonic River. For these areas, a general screening-level evaluation of floodplain vernal pools has been performed, as described in Section 4.3.2.

4.2.3.2 Omnivorous/Carnivorous Mammals

As discussed in GE's revised IMPG Proposal (GE, 2006a), the soil IMPGs for omnivorous and carnivorous mammals (21.1 to 34.3 mg/kg) were based on an assessment of potential risks to northern short-tailed shrews (*Blarina brevicauda*, referred to hereafter as shrews), which EPA selected as the representative species for this receptor group. The CMS Proposal

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[76] As discussed in Section 3, amphibian IMPGs were also evaluated for the sediments in backwater regions of the River.

[77] As discussed in Section 2.1.1 and recognized in EPA guidance (EPA, 1999), the objective of ecologically based remediation is to protect local populations and communities of biota. As discussed in the CMS Proposal, GE believes that use of EPA's wood frog population model, with modification and application to all 66 vernal pools, provides a reasonable method of evaluating the effects of floodplain remedial alternatives both on the local wood frog population and the broader amphibian population in the PSA. The reasons for GE's position are set forth in more detail in GE's April 27, 2007 Statement of Position in its dispute on EPA's April 13, 2007 letter (GE, 2007a).

noted that the habitat for shrews coincides with much of the floodplain, and thus GE proposed to use the overall portion of the floodplain in the PSA that provides suitable shrew habitat as a single averaging area for evaluating attainment of the IMPGs for shrews. In its April 13, 2007 conditional approval letter, EPA directed GE not to use the overall floodplain as a single averaging area for evaluating the effectiveness of floodplain remedial alternatives to protect shrew populations. EPA stated that, although shrew habitat is widespread throughout the floodplain, the home ranges of shrews are much smaller, and thus averaging over the entire floodplain "may result in an alternative being considered protective when, in fact, some shrew populations may remain impacted" (Condition #79). Instead, EPA directed GE to develop averaging areas that "relate specifically to the appropriate habitats, home ranges, and/or foraging ranges for the receptor species" for which the IMPGs were established (Condition #81).

Based on the habitat descriptions provided by EPA's consultants, the majority (~80%) of the floodplain within the PSA contains suitable habitat for shrews, as shown on Figure 4-6a.[78] Shrew habitat is contiguous throughout that area without significant natural boundaries. In these circumstances, GE does not agree with EPA's directive in its conditional approval letter.[79]

However, given that directive, GE has developed an alternative approach to establishing averaging areas for shrews within the PSA floodplain. As required by EPA, this approach takes into account the habitats, home ranges, and foraging ranges of shrews, but is still focused on protecting local shrew populations, consistent with EPA guidance (EPA, 1999). This approach is based on conservation principles, in which the area necessary to sustain a "minimum viable population" (MVP) of the animals in question is determined. Specifically, this approach has involved: (1) estimating the size of the MVP of shrews; (2) determining the size of areas within the floodplain that would sustain such an MVP, based on the foraging/home range of shrews; and (3) establishing defined areas of shrew habitat within the floodplain with a size equivalent to that determined in the prior step, and then using those defined areas as the averaging areas for application of the IMPGs. These concepts are discussed further below.

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[78] Shrew habitat is described by Woodlot (2002), pp. 6-24 - 6-25. Figure 4-6a is based on a map of shrew habitat provided by EPA to GE, modified to eliminate areas that are permanently under water.

[79] Shrews populate most of the floodplain, and the shrew population within the floodplain is not divided into biologically discrete or distinct population segments. Rather, it is one large, contiguous local population that is part of a larger population in the Appalachian Mountains (Brant and Ortí, 2003). In this situation, given the objective to protect local populations and communities of biota, the entire area shown as shrew habitat on Figure 4-6a should be considered as the averaging area for evaluating protection of the local shrew population.

Area of Minimum Viable Population

As stated above, the shrew population is contiguous in the PSA. Thus, creation of spatial averaging areas to protect smaller local "population subunits" in the PSA must rely on either (1) arbitrarily defined boundaries or (2) boundaries based on conservation principles. For present purposes, we have used a conservation-based approach involving determination of the size of areas required to sustain an MVP. By definition, an MVP for any given species is the smallest isolated population having a strong (i.e., 90 to 99%) chance of remaining extant for a long period of time (i.e., 100 to 1,000 years) despite the foreseeable effects of demographic, environmental, and genetic stochasticity, and natural catastrophes (Shaffer, 1981; Thomas, 1990). The U.S. Fish and Wildlife Service (USFWS) recovery plan guidelines for threatened and endangered species require recovery goals that consider this long-term viability concept (USFWS, 1990). Many recovery plans (e.g., grizzly bear, emerald dragonfly, gray wolf) have set local population targets equivalent to general MVP sizes recommended in the conservation biology literature or developed from population viability models that are species-specific.

Using the MVP to define the size of the averaging area provides a basis for defining independent population subunits that are viable through time, even if they become isolated from the larger population by events such as fires or flooding. The use of the MVP approach in guiding remediation is extremely conservative because it assumes each MVP population subunit is isolated and must be sufficiently robust to sustain itself through major random events. In reality, each individual shrew MVP averaging area is not isolated and all would contribute to an interchangeable supply of animals. The approach essentially ensures that the large local population of shrews, which are already abundant in the floodplain (Woodlot, 2002; Boonstra and Bowman, 2003), continues throughout the floodplain.

Selection of a Minimum Viable Population Size

The MVP size for shrews was selected based on the population size needed to maintain demographic stability (i.e., to avoid crashing to low population levels), not genetic variability (which would be larger). The conservation biology literature was reviewed to determine recommended sizes of an MVP. Lehmkuhl (1984) recommended an MVP of 500 animals for vertebrates to attain long-term persistence of the population. Thomas (1990) similarly recommended no less than 500 animals, based on his model simulations of bird and mammal populations averaging a 1.2-order of magnitude variability, a magnitude frequently observed over 50-year periods. Five-hundred animals met Thomas' definition of an MVP as the geometric mean number of animals in a population that fell below 100 animals only once every 100 years during his simulations. He used 100 as the threshold because, below 100, animals frequently fall into an extinction vortex. Overall, based on empirical evidence, Thomas recommended that 1,000 animals is conservative and adequate to attain

demographic stability for species that do not have extremely high fluctuations in population size through time, which appears to be true of the shrew (see Getz, 1989; Lima et al., 2002).

No recommended MVP for shrews was found in the literature, and in general MVPs were difficult to find for small, placental mammals. One was found for the spiny rat (*Tinomys eliasi*) in South America. Based on the results of a population viability model for that species, Brito and Figueiredo (2003) recommended an MVP of 200 rats to maintain demographic stability and 2000 rats to maintain genetic variability. To err on the conservative side for maintaining population viability, 500 shrews were selected as the MVP unit to be used for calculating the size of the averaging areas. This number is more appropriate than the 200 developed for the spiny rat because it is based on analyses (i.e., Lehmkuhl, 1984; Thomas, 1990) of mammals that include the omnivorous and carnivorous small mammal species that the shrew represents for application of the IMPGs.

Application of MVP Size and Foraging/Home Range To Determine Size of Averaging Areas

Having determined the size of the MVP, the next step was to determine the size of areas that would support that MVP, taking into account the foraging and home ranges of shrews. According to the ERA (EPA, 2004a, p. J-6), shrews have home range sizes of 0.024 hectares (ha) to 0.07 ha in areas of high prey density, and 0.1 to 0.2 ha in areas of low prey density during non-breeding periods in winter. Assuming that the former estimates would apply during the breeding season (spring, summer, and fall) when food is more plentiful, and that the latter estimates apply only in winter, the averages of these values can be seasonally weighted to yield a mean yearly home range size of ~0.07 ha. Assuming no overlap of home ranges (since shrews are highly territorial), this represents an estimated year-round density of approximately 14 shrews/ha. Based on this estimate, the size of an area required to support an MVP of 500 animals is about 35 ha (500 shrews/14 shrews per ha = 35.7 ha).

Establishment of Averaging Areas

Based on the above estimates, cells of ~ 35 ha each were overlaid on the floodplain in the PSA, excluding areas of unsuitable shrew habitat and bounded laterally by the 1 mg/kg PCB isopleth. These cells (as well as the excluded areas of unsuitable shrew habitat) are shown on Figure 4-6b. These cells have been used as the averaging areas in the PSA for evaluating attainment of the IMPGs for omnivorous/carnivorous mammals. For a given floodplain remedial alternative, the spatial average PCB concentration in each cell has been compared to the upper or lower bound of those IMPGs (as appropriate) to identify which cells exceed those IMPG values.

For areas downstream of the PSA, where such cells have not been defined and the floodplain PCB data are less dense, a more general comparison has been made of PCB concentrations

in various portions of the floodplain to the IMPGs for omnivorous/ carnivorous mammals, as described in Section 4.3.3.

4.2.3.3 Insectivorous Birds

As discussed in GE's revised IMPG Proposal (GE, 2006a), the underlying PCB IMPG for insectivorous birds was based on an assessment of potential risks to wood ducks as the representative species for this receptor group. Further, as discussed in Section 2.2.2.3, since this IMPG applies to PCB concentrations in the aquatic and terrestrial invertebrate prey of wood ducks, GE has developed target floodplain soil concentrations associated with that IMPG, based on achieving certain specified target sediment concentrations. Those target floodplain soil concentrations, which vary by subreach within the PSA (i.e., Reaches 5A, 5B, 5C/D, and 6), are described in Section 2.2.2.3 and Appendix D to this Report. This section describes the averaging areas to which the target soil concentrations have been applied.

The CMS Proposal proposed to apply the target floodplain soil concentrations for protection of wood ducks over the entire portion of the floodplain within the PSA. However, in is April 13, 2007 conditional approval letter, EPA directed GE to use smaller averaging areas. EPA stated, based on the ERA, that "[t]he foraging range of wood duck is approximately 1 km from their nest site," that therefore averaging of PCB concentrations over the entire PSA "is inappropriate," and that GE must "use appropriately smaller subareas" in evaluating whether remedial alternatives would achieve the target levels for protection of wood ducks (Condition # 46).

Again, GE does not agree with that directive.[80] However, in response to EPA's directive, GE has developed smaller averaging areas for application of the wood duck target levels. In this case, GE has developed such areas based on the foraging range of an individual wood duck. While this approach is clearly over-conservative (since the local population necessarily includes numerous wood ducks, not just an individual duck foraging near its nest), it has been used as a simple means of complying with EPA's directive.

Reported sizes of home ranges and foraging ranges for wood ducks are quite variable, depending upon habitat quality, season, gender, breeding status, and region.[81] However, for

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[80] Although a few limited segments of the PSA contain poor or marginal wood duck habitat (as discussed below), given the high mobility of birds, it is not realistic to assume that the PSA wood duck population is divided into biologically discrete or distinct population segments. In these circumstances, given the objective to protect local populations and communities of biota, the PSA represents the most appropriate averaging area for evaluating impacts on the local wood duck population.

[81] For example, in southern Illinois, fall home ranges averaged 91 ha (225 acres) (range = 24-186 ha or 59-460 acres) (Parr et al., 1979). Costanzo et al. (1983) reported that winter home ranges were larger for males (42.3 ha or 105 acres; n = 5) than for females (12.0 ha or 30 acres; n = 5). Gilmer et al. (1978) reported an average home range of 169 ha (418 acres; n = 2) for breeding pairs and 87 ha (215 acres)

present purposes, GE has used the 1-kilometer (km) foraging range (for pre-incubating females) identified in EPA's April 13, 2007 letter based on the ERA. Based on this foraging range, GE has established averaging area boundaries every 1 km within the PSA, such that the averaging areas range from 16 to 49 ha (40 to 120 acres) and average 36 ha (90 acres). These averaging areas are shown on Figure 4-7. Even for an individual wood duck, such averaging areas are conservative compared with the estimates from the literature.[82]

Within these 1-km averaging areas, limited subareas that lack suitable wood duck habitat have been excluded. While the vast majority of the PSA offers habitat that is suitable for wood ducks, the ERA's natural area designations have been used to judge microhabitat suitability within the PSA. Attachment C (Species: Habitat Matrix) to Woodlot's (2002) Ecological Characterization Report indicates that the following types of areas are not inhabited by wood ducks (either during the breeding season or year-round): high-gradient stream, spruce-fir-Northern hardwood forest, Northern hardwoods-hemlock-white pine forest, cultural grassland, agricultural cropland, and residential development. Such areas are marked in gray on Figure 4-7 and have been excluded from consideration in the evaluations of achievement of the target levels for protection of wood ducks.

Thus, in assessing whether particular floodplain remedial alternatives would achieve the wood duck IMPG, GE has utilized the averaging areas shown on Figure 4-7 for the PSA. Specifically, for a given floodplain remedial alternative, the spatial average PCB concentration in each such averaging area has been compared to the applicable target floodplain soil level for the subreach in which that area is located, based on assumptions about the sediment concentration in the same averaging area.

For areas downstream of the PSA, where specific averaging areas have not been identified and the floodplain PCB data are less dense, a more general comparison has been made of PCB concentrations in various portions of the floodplain to the target floodplain soil concentrations based on these IMPGs, as discussed in Section 4.3.4.

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for incubating females (n = 14). Cottrell et al. (1990) reported that home range of females with broods averaged 46.1 ha (114 acres) in Tennessee (n = 34), while Hepp and Hair (1977) reported average home ranges of 12.5 ha (31 acres) in South Carolina (SD = 11.0, range = 0.8–29.6 ha or 2-73 acres, n = 7). The U.S. Forest Service (USFS) (1971) reported that the daily foraging radius for wood ducks in the southeastern United States may be as much as 40 to 48 km (25 to 30 mi), which corresponds to an area of about 500,000 to 700,000 ha (1.2 to 1.8 million acres); these values are outliers relative to the other literature reports.

[82] The median of the reported average home range areas listed in the prior note, excluding the USFS outlier values, is 44 ha (109 acres), compared to a range of 16 to 49 ha for the averaging areas associated with a 1-km foraging range.

4.2.3.4 Piscivorous Mammals

As discussed in GE's revised IMPG Proposal (GE, 2006a), the underlying IMPGs for piscivorous mammals were based on an assessment of potential risks to mink as the representative species for this receptor group. Further, as discussed in Section 2.2.2.3, since these IMPGs apply to PCB concentrations in the aquatic and terrestrial prey of mink, GE has developed target floodplain soil concentrations associated with the upper and lower bounds of those IMPGs, based on achieving certain specified target sediment concentrations. Those target floodplain soil concentrations are described in Section 2.2.2.3 and Appendix E to this Report. As discussed there, at EPA's direction, separate target floodplain soil concentrations have been developed for: (1) Reaches 5A and 5B; and (2) Reaches 5C, 5D (the backwaters), and 6. This section describes the averaging areas to which the target soil concentrations have been applied.

The CMS Proposal Supplement proposed to apply the target floodplain soil concentrations for protection of mink over the entire floodplain within the PSA. In addition, given that mink are wide-ranging predators and thus are likely to forage not only within the 1 mg/kg PCB isopleth, but also along tributaries and other areas outside that isopleth, GE proposed to adjust the target floodplain soil levels to account for the proportion of the mink's foraging range outside the 1 mg/kg isopleth. However, in its July 11, 2007 conditional approval letter, EPA directed GE: (1) not to use the entire PSA as the averaging area for application of these levels, but rather to use averaging areas that are no larger than subreaches; and (2) not to adjust the target levels to account for foraging outside the 1 mg/kg isopleth. GE invoked dispute resolution on these directives. In response, EPA issued a letter dated August 29, 2007, revising its first directive to require use of two averaging areas within the PSA – one consisting of Reaches 5A and 5B and the other consisting of Reaches 5C, 5D, and 6. However, EPA retained the requirement to limit the EA to the area within the 1 mg/kg isopleth.

GE continues to believe that the approach outlined in the CMS Proposal Supplement was appropriate.[83] However, given EPA's directives in its July 11 and August 29, 2007 letters, GE has used the two averaging areas specified by EPA – one consisting of Reaches 5A and 5B and one consisting of Reaches 5C, 5D, and 6 (shown on Figure 4-8) – for application of the target floodplain soil concentrations associated with the mink IMPGs, with no adjustments for

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[83] The reasons for GE's position are set forth in its July 25, 2007 Statement of Position in the dispute resolution proceeding on EPA's July 11, 2007 letter (GE, 2007b). In brief, given the fairly large foraging or home ranges of mink, the PSA could support, at most, only a subset of the local mink population. Moreover, it is reasonable to expect that mink utilizing the PSA would also use areas outside the 1 mg/kg isopleth (e.g., areas near the shoreline but outside that isopleth and areas along tributaries) as part of their foraging range. In its August 29, 2007 letter, EPA asserted that it is reasonable to limit the mink exposure area to within the 1 mg/kg isopleth because approximately 90% of the mink diet is from the aquatic environment. However, the target floodplain soil levels are based on the terrestrial, not aquatic, portion of the mink's diet.

foraging beyond the 1 mg/ kg isopleth. Specifically, for a given floodplain remedial alternative, the PCB concentration in each such averaging area has been compared to the applicable target floodplain soil levels, based on assumptions about the sediment concentration in the same averaging area.

For areas downstream of the PSA, where specific averaging areas have not been identified and the floodplain PCB data are less dense, a more general comparison has been made of the PCB concentrations in the floodplain with the target floodplain soil concentrations based on the mink IMPGs, as described in Section 4.3.5.

4.2.3.5 Evaluation of IMPG Attainment for Insectivorous Birds and Piscivorous Mammals for Combined Sediment and Floodplain Alternatives

As noted in Section 1.8, Section 8 of this Revised CMS Report presents a comparative evaluation of a number of combinations of sediment and floodplain alternatives. For these combinations, the evaluation of the attainment of the IMPGs for insectivorous birds and piscivorous mammals did not need to use the pre-selected target sediment levels and associated target floodplain soil levels used in the evaluation of the individual sediment and floodplain alternatives, as discussed above. Rather, since each of these combinations involves a specific sediment alternative and a specific floodplain alternative, an assessment of the achievement of these IMPGs has been made more directly.

The first step in this evaluation was to determine, for the sediment alternative within each combination, the sediment PCB concentrations predicted by the EPA model at the end of the model projection period in all relevant averaging areas in the PSA for the receptor group in question, using the same averaging areas described above for insectivorous birds and piscivorous mammals. Next, for each such sediment concentration, an associated target floodplain soil level was calculated for the same averaging area using the same methods employed for calculating target floodplain soil levels associated with the previously selected target sediment levels. Thus, for insectivorous birds, the calculation of target floodplain soil levels associated with attaining the IMPG at the modeled sediment endpoint concentrations was performed using the method described in Appendix D; and for piscivorous mammals, the calculation of target floodplain soil levels associated with attaining the upper- and lower-bound IMPGs at the modeled sediment endpoint concentrations was performed using the method described in Appendix E. Then, for each combination of alternatives, the post-remediation floodplain soil exposure point concentration (EPC) in each relevant averaging area in the floodplain (described above) was compared to the target floodplain soil concentration calculated for that area based on the associated sediment alternative. This comparison allows a determination to be made as to whether the combined sediment-floodplain alternative would attain the IMPGs for insectivorous birds and piscivorous mammals.

4.3 Assessment of Achievement of Human and Ecological Receptor IMPGs in Downstream Reaches

In floodplain areas downstream of those described in the preceding sections, GE has conducted general screening-level evaluations of whether the floodplain soil PCB concentrations would achieve the IMPGs. This section describes those evaluations. For the human health IMPGs, this evaluation focuses on agricultural products consumption in farm areas downstream of Reach 8. (As noted above, risks associated with human direct contact with floodplain soil in reaches downstream of Reach 8 were screened out by EPA in the HHRA, and hence are not reevaluated here.) For the ecological receptor IMPGs, these screening evaluations focus primarily on Reach 7, where the majority of the downstream data were collected, utilizing the EPA-designated subreaches in that reach (i.e., Reaches 7A through 7H).

4.3.1 Agricultural Products Consumption

As discussed in Section 4.2.2, the HHRA identified various farm areas (approximately 65) within the floodplain of Reach 9 (downstream of Rising Pond Dam). Given the limited floodplain soil PCB data in these farm areas, a general screening-level approach was conducted to assess agricultural products consumption for the types of farms located in this reach, using all available surficial floodplain PCB data (0- to 6-inch or 0- to 12-inch) within Reach 9. Within Reach 9, these data indicate that surficial floodplain soil PCB concentrations range from 0.02 mg/kg to 1.7 mg/kg, and average approximately 0.46 mg/kg, with a 95% UCL on the mean of 0.50 mg/kg (based on the non-parametric Halls Bootstrap method).

Based on the use types identified by EPA in the HHRA, there are three types of farm areas located within the Reach 9 floodplain that are relevant to the IMPGs based on human consumption of agricultural products: “commercial dairy,” “commercial vegetable,” and “commercial poultry”; the locations of these farm areas in Reach 9 are shown on Figure 4-9. Based on the Reach 9 floodplain data summarized above, the entire range of surface soil PCB concentrations in Reach 9 are below all “commercial dairy” IMPGs, with the exception of the RME level based on a cancer risk of 10^{-6} (0.24 mg/kg; see Table 2-5), and are also below the lowest RME IMPG for human consumption of “exposed vegetables” and “root vegetables” (13.3 mg/kg and 100 mg/kg, respectively; see Table 2-5). Based on this screening comparison, floodplain soil PCB concentrations in Reach 9 are sufficiently low that the IMPGs for “commercial dairy” and “commercial vegetable” farms would be expected to be met in the applicable averaging areas within that reach.

With respect to “commercial poultry” farms, only one such farm has been identified in Reach 9 (shown on Figure 4-10); this farm sells poultry meat. A refined evaluation was conducted for this property. No floodplain soil samples have been collected within this farm property itself; therefore, samples collected within a distance of approximately one mile were selected as

representative of that area. In this analysis, the data were segregated into groups of samples located within the 10-year and 100-year floodplains, as these areas are indicative of the relative depositional frequency of PCBs.[84] Spatially weighting these data by the fraction of the poultry farm within these floodplain areas resulted in an area-weighted average floodplain soil PCB concentration of 0.21 mg/kg. This value is within the range of IMPGs (both cancer and non-cancer) considered protective for the consumption of poultry meat (see Table 2-5).

Below Reach 9 (in the Connecticut portion of the River), EPA collected seven near-shore samples from a few select areas of the floodplain. Four of these samples had non-detect PCB concentrations, and the maximum detected value was 0.037 mg/kg, which is much lower than the range of agricultural products consumption IMPGs.

Given the results described above, no additional assessment for agricultural products consumption IMPGs in the floodplain was conducted for Reach 9 and areas further downstream.

4.3.2 Amphibians

To evaluate attainment of the amphibian IMPGs for vernal pools located in floodplain reaches downstream of Woods Pond Dam, a GIS data coverage of vernal pools (compiled by the NHESP) was obtained from the State of Massachusetts MassGIS database, and used to identify vernal pools in those downstream reaches. Two NHESP datasets were used in this evaluation, showing, respectively, “certified” and “potential” vernal pools located within Massachusetts (NHESP, 2010, 2000). Based on these data, there are only four “certified” vernal pools (i.e., pools that have been field verified and certified by NHESP to function biologically as vernal pools) within the floodplain of Reach 7 (NHESP, 2010). An additional 18 “potential” vernal pools (i.e., areas that have been interpreted as vernal pools from aerial photographs, but have not been field verified) were also identified within the Reach 7 floodplain (NHESP, 2000). Conservatively, both these certified and potential vernal pools have been included in this evaluation; these are shown on Figure 4-11.[85]

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[84] Note that the 10-year floodplain was delineated in this area based on flood profile elevations published by the Federal Emergency Management Agency (FEMA) and 10-meter resolution Digital Elevation Model (DEM) data from USGS (see Figure 4-10).

[85] While additional vernal pools were identifed in reaches downstream of Rising Pond Dam, the sparse nature of the floodplain soil PCB data in the vicinity of these pools precluded an evaluation in these further downstream reaches. In any event, the maximum surficial (0 to 6 inches) floodplain soil PCB concentration downstream of Reach 8 is 1.7 mg/kg (RFI Report, Table 5-7 [BBL and QEA, 2003]), which is below the lower-bound amphibian IMPG of 3.27 mg/kg. For these reasons, the evaluation of amphibians downstream of the PSA focused on Reach 7.

As shown on Figure 4-11, these NHESP data sets present vernal pools as individual points (not polygons); therefore, they could not be treated as individual averaging areas as was done in the PSA evaluation. In addition, few floodplain soil PCB data points were located in close proximity to the vernal pools in Reach 7. Therefore, a general screening-level approach was taken, whereby all of the available surface soil (0- to 6-inch or 0- to 12-inch) floodplain PCB data within each of the Reach 7 subreaches that contain NHESP-identified certified or potential vernal pools (i.e., 7A, 7D, 7E, and 7F; see Figure 4-11) were deemed to be generally representative of the likely PCB concentrations in those subreaches, including the vernal pools within them, and were thus compared to the applicable wood frog IMPGs.

For this comparison, the 95% UCL (computed using the Halls Bootstrap method) on the mean of the floodplain data was calculated for each of these four subreaches containing vernal pools, and was compared to both the upper and lower bound of the amphibian IMPGs (5.6 mg/kg and 3.27 mg/kg, respectively) (see Table 4-3a). For all four Reach 7 subreaches containing vernal pools, the 95% UCLs were below the lower-bound amphibian IMPG. In these circumstances, no additional assessment for amphibians was conducted for floodplain reaches downstream of the PSA.

4.3.3 Omnivorous/Carnivorous Mammals

Similar to the evaluation for amphibians, existing surficial floodplain soil PCB concentrations in Reach 7 were compared to the IMPGs for omnivorous/carnivorous mammals (represented by shrews). Since mapping of shrew habitat is not available to delineate specific averaging areas in Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA (i.e., 7A through 7H). For this comparison, the 95% UCL on the mean of the floodplain data calculated for each subreach was compared to both the upper- and lower-bound IMPGs (34.3 mg/kg and 21.1 mg/kg, respectively) (see Table 4-3a). For all of the Reach 7 subreaches, the 95% UCLs were below the more conservative lower-bound shrew IMPG.[86] Accordingly, no additional assessment of attainment of the IMPGs for omnivorous/carnivorous mammals was conducted for floodplain reaches downstream of the PSA.

4.3.4 Insectivorous Birds

To assess achievement of the IMPGs for insectivorous birds (represented by wood ducks) in downstream reaches, existing surficial floodplain soil PCB concentrations in Reach 7 were compared to the target floodplain soil levels developed to achieve those IMPGs. Again, in the

[86] As the area of floodplain within Reach 8 is relatively limited, that area was excluded from this assessment. In Reach 9, the maximum surficial floodplain soil concentration is 1.7 mg/kg, and the levels observed in the Connecticut portion of the floodplain are much lower. These levels are far below the lower bound of the IMPGs for omnivorous/carnivorous mammals (21.1 mg/kg).

absence of specific wood duck averaging areas for Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA. However, as described in Section 2.2.2.3 (and shown in Table 2-6), subreach-specific target soil levels were only developed for wood duck in the PSA – not for downstream reaches. Also, since wood ducks derive a portion of their diet from food sources located in both the River and the floodplain, the floodplain soil levels that would achieve the wood duck IMPGs vary depending on the associated sediment level. In this situation, a target floodplain soil IMPG level was assigned to each of the Reach 7 subreaches by: (1) using, for each such subreach, the set of target soil IMPG levels developed for the PSA subreach that EPA considered "ecologically analogous" to that Reach 7 subreach in Table 3.6-9 of the EPA FMDR; and (2) using the EPA model end-of-validation average surface sediment (0- to 6-inch) PCB concentration in the pertinent Reach 7 subreach (rounded to the closest target sediment concentration -- i.e., 1, 3, or 5 mg/kg). For example, since EPA's FMDR considers Reach 7A analogous to Reach 5A, the target soil IMPG levels for Reach 5A were used for Reach 7A; and since the the average sediment concentration in Reach 7A was 0.41 mg/kg, the target soil IMPG level for Reach 5A that is associated with a target sediment level of 1 mg/kg was selected for Reach 7A (i.e., 50 mg/kg; see Table 4-3b).

The resulting target floodplain soil IMPG levels used for the Reach 7 subreaches (as well as the analogous subreaches and average sediment concentrations used in determining those levels) are shown in Table 4-3b. That table also gives the 95% UCL PCB concentrations for the Reach 7 subreaches. As shown in that table, the floodplain soil 95% UCLs in all of the Reach 7 subreaches are below the applicable target soil IMPG levels for wood duck.[87] Accordingly, no additional assessment of attainment of the IMPGs for insectivorous birds was conducted for floodplain reaches downstream of the PSA.

4.3.5 Piscivorous Mammals

Similar to the evaluation for wood duck in reaches downstream of the PSA, the assessment of achievement of the IMPGs for piscivorous mammals (represented by mink) in downstream reaches was made by comparing existing surficial floodplain soil PCB concentrations in Reach 7 to the target soil levels developed to achieve those IMPGs. Again, in the absence of specific averaging areas for Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA. Similar to the target floodplain soil levels developed to achieve the wood duck IMPGs, the target floodplain soil levels developed to achieve the mink IMPGs were developed only for the PSA, and vary both by subreach and by the associated sediment target level. Given this, representative floodplain soil target IMPG levels for each of the

[87] As noted above, for floodplain areas downstream of Reach 7, the surficial soil concentrations are all 1.7 mg/kg or less, which is well below the lowest soil IMPG level for wood duck (18 mg/kg for Reach 5B at the 5 mg/kg target sediment level).

Reach 7 subreaches were selected using the same procedure as for the wood duck (i.e., target soil IMPG levels were selected based on analogous PSA subreaches and on average end-of-validation surface sediment PCB concentrations predicted by the EPA model).

The resulting target floodplain soil IMPG levels used for the Reach 7 subreaches (as well as the analogous subreaches and average sediment concentrations used in determining them) are shown in Table 4-3b. That table also compares the 95% UCL PCB concentrations for the Reach 7 subreaches to those levels. With the exception of one subreach in Reach 7 (7C), the 95% UCLs are below the applicable upper-bound floodplain soil IMPG levels for mink in all subreaches evaluated. In addition, the 95% UCLs in four subreaches (7A, 7D, 7E, 7F) are below the applicable lower-bound floodplain soil IMPG levels for mink. Further, the one subreach that would not achieve either bound of the range (Reach 7C) at the specified target sediment concentration (5 mg/kg) is much smaller than the EPA-specified mink averaging areas in the PSA. That subreach spans approximately 0.8 miles of River and covers an area of approximately 20 acres, whereas the mink averaging areas specified by EPA for the PSA span 4 to 7 miles of River and cover areas of 300 to 450 acres (see Figure 4-8). Given that the two subreaches adjacent to Reach 7C (i.e., 7B and 7D) have 95% UCLs within or below the range of floodplain soil IMPG levels (Table 4-3b), it is likely that those IMPG levels would be met in this region if an averaging area comparable in size to those in the PSA were used. In these circumstances, it is reasonable to conclude that floodplain soil PCB concentrations throughout Reach 7 would achieve levels within the range of the IMPGs for mink.

While this approach does indicate that there could be some exceedances of the lower-bound IMPG in four of the eight Reach 7 subreaches, GE does not believe that those exceedances would translate into adverse impacts on the local mink population. The local population of mink clearly extends well beyond those Reach 7 subreaches. Even accepting EPA's interpretation of the mink feeding study in the ERA (which GE does not agree with), the lower-bound IMPG was based on a statistical analysis that yielded an assumed 20% effect level for kit survival in that study. Even if the exceedances of that IMPG value in four Reach 7 subreaches meant that the relatively few mink that may inhabit those subreaches would experience a 20% reduction in kit survival, it would not be expected that such a reduction would adversely impact the overall local mink population.[88]

Given the evaluations above, no additional assessment of attainment of the IMPGs for piscivorous mammals was conducted for floodplain reaches downstream of the PSA.

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[88] As noted previously, the surficial soil concentrations in floodplain areas downstream of Reach 7 are all 1.7 mg/kg or less. Furthermore, the surface sediment data from Reach 9 and the Connecticut portion of the River are generally 1 mg/kg or lower (i.e., see Table 4-9 of the RFI Report [BBL and QEA, 2003]). Thus, the floodplain levels are below the lowest floodplain soil IMPG level for mink at that sediment level (3.42 mg/kg for Reach 5A/B; see Table 2-7).

4.4 Determination of Areal Extent and Removal Volumes

This section provides a brief description of the approach and procedures used to estimate the areal extent and volume of floodplain soil to be removed under the floodplain remedial alternatives. A more detailed description of these procedures was provided previously as Appendix D to the CMS Proposal.

4.4.1 Overview

As described in Appendix D to the CMS Proposal, a spatially interpolated representation of the floodplain soil PCB data – based on the use of Thiessen polygons modified by natural community boundaries (EPA's "super habitats") in the PSA and by elevation in Reaches 7 and 8 – was developed to provide a continuous coverage of PCB concentrations over the floodplain within Reaches 5 through 8.[89] The resulting floodplain soil PCB coverage interpolated from the 0- to 1-foot data is shown on Figures 4-12a (Reaches 5 and 6) and 4-12b (Reaches 7 and 8). Using this interpolated data coverage, the procedures used to estimate the areal extent and volume of floodplain soil to be removed under a given remedial alternative depended on the type of alternative being evaluated. As described in Section 4.1, the three types of floodplain remedial alternatives evaluated are: (1) IMPG-based alternatives; (2) threshold-based alternatives; and (3) an alternative that is a combination of the foregoing types. The procedures used for each of these three types of alternatives are summarized below, based on the procedures described in Appendix D to the CMS Proposal, as well as in the Response to EPA's Specific Comment 98 in the Interim Response.

4.4.2 IMPG-Based Alternatives

Determination of areal extent and removal volume for the IMPG-based alternatives described in Section 4.1 (FP 2, FP 3, FP 4, FP 7, and FP 9) involved identifying the extent of removal necessary to achieve the applicable IMPGs as a spatially weighted average (95% UCL) soil PCB concentration in a given area. Estimates of areas/volumes for removal in each area were based on the spatially interpolated PCB data coverage described above. These estimates were developed first for each human health averaging area (i.e., direct contact EA or farm area), using the following four steps:

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[89] As discussed in GE's Response to Specific Comment 98 in the Interim Response, this PCB concentration data coverage was based on the EPA floodplain data set that GE received from EPA on October 2, 2008, supplemented with samples from 125 locations in Reaches 7 and 8 that appear to have been inadvertently omitted by EPA. GE used the EPA data set at EPA's direction, even though it believes that some of the samples in that data set should not have been included in the floodplain evaluation, as also discussed in the Response to Specific Comment 98.

(1) The specific IMPG for each averaging area of the floodplain was assigned based on the applicable human exposure scenario and target level of risk (e.g., cancer risk of 10^{-4}) specified for that alternative. For areas having multiple use types, the lowest IMPG value was used. For each farm area evaluated based on agricultural products consumption, the target PCB level was adjusted based on the portion of the agricultural field that is located within the floodplain, as described in Section 4.2.2 and shown in Table 4-2.

(2) The PCB EPC for the given area was then calculated. The EPC was defined as the 95% UCL (computed using the modified Halls Bootstrap method) of the spatially weighted mean of the data from that area or the maximum measured value, whichever is lower, consistent with the approach utilized by EPA in the HHRA (also described in Appendix D to the CMS Proposal).[90] Consistent with the HHRA, in computing the spatially weighted mean, the interpolated PCB concentrations were multiplied by EPA's "use accessibility factors" for all direct contact EAs.

(3) The EPC calculated for the area being evaluated was compared with the target IMPG for that area to determine if remediation of soil would be necessary to achieve the IMPG.

(4) If remediation was required to achieve the IMPG, the approximate areal extent and volume of removal was calculated using an iterative process. First, a portion of the given area was "flagged" for remediation (starting with the highest concentrations) and the interpolated PCB values were replaced with "clean" soil assumed to have a PCB concentration of 0.021 mg/kg.[91] The EPC was then recalculated (incorporating this area of removal/backfill) and compared again with the IMPG. This sequential removal and backfill of soils and recalculation of the EPC was repeated until the amount of remediation was sufficient to reduce the EPC to a level that was at or below the target IMPG for that area.

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[90] In accordance with EPA's Specific Comment 98 on the CMS Report, the 95% UCL calculation used the number of sample points within a given EA to define the degrees of freedom for that EA. However, as noted in GE's Response to Specific Comment 98, GE does not agree with that approach and believes that the degrees of freedom are better represented by the number of Thiessen polygons within an EA. Since the PCB Thiessen polygons were developed based on EPA's floodplain "super-habitats" (i.e., independent of EA boundaries), a polygon within an EA (either wholly or partially) derived from a sample located outside the EA boundary is still used in defining the concentration distribution within the EA. As a result, each polygon intersecting an EA should be recognized as an independent piece of information, and should therefore be included in the number of degrees of freedom for the 95% UCL calculation. Nevertheless, in this Revised CMS Report, GE has followed the approach specified by EPA.

[91] Consistent with the approved CMS Proposal, this value represents one-half of the average PCB detection limit used to characterize backfill sources, and is consistent with the assumed backfill PCB concentration applied to areas outside the River under the CD.

For the floodplain alternatives in which removal to a depth of 3 feet was evaluated in the Heavily Used Subareas (FP 3 through FP 7 and FP 9; see Section 4.2.1), this same procedure was applied, except that the 95% UCL needed to be at or below the IMPG for both the 0- to 1-foot and 0- to 3-foot depth increments in those areas.

For FP 3, FP 4, and FP 7, this same approach was then followed to determine the areal extent and volume of removal that was required to achieve the ecologically based IMPGs (or target floodplain soil levels) in the relevant ecological averaging areas. In these applications, the removal necessary to achieve the human health IMPGs was first taken into account. For example, when removal of a portion of a vernal pool located within a direct contact EA was necessary to reduce the spatial mean below the target risk level for the direct contact use, that removal was taken into account when the vernal pool was subsequently evaluated for the amphibian IMPGs.

The removal volume for a given floodplain alternative was calculated as the product of the total area delineated for removal using this procedure and the 1-foot removal depth, with the exception of the Heavily Used Subareas where a removal depth of 3 feet was used.

4.4.3 Threshold-Based Alternatives

Determination of areal extent and removal volume for the threshold-based alternatives (i.e., FP 5 and FP 6) was also based on the spatially interpolated PCB data coverage described above. This method consisted of identifying, from the interpolated PCB concentration coverage, the locations within the floodplain where soil PCB concentrations exceed the threshold concentration specified for the given alternative (i.e., 50 mg/kg for FP 5 and 25 mg/kg for FP 6). The use accessibility factors developed by EPA for the HHRA were not applied in the evaluation of the threshold-based alternatives. Removal volumes were calculated as the product of the total area of the locations identified to exceed the applicable threshold and a 1-foot removal depth. For the Heavily Used Subareas, where exceedances of the applicable threshold were identified at depths between 1 and 3 feet, the removal areas were multiplied by 3 feet to estimate the removal volumes.

4.4.4 Combined IMPG-Based and Threshold-Based Alternative (FP 8)

For FP 8, which involves a combination of the above approaches, determination of the areal extent and volume of soil removal necessary to achieve the target IMPGs (i.e., the mid-range IMPGs for human health in the direct contact EAs and the farm areas evaluated for agricultural products consumption, as well as the lower bound IMPG for amphibians in each vernal pool in the PSA) was made using the same procedures described in Section 4.4.2. After the extent of those removals was delineated, the locations of the remaining floodplain soil with PCB concentrations exceeding the threshold concentration of 50 mg/kg in the top foot were identified for removal, and the areal extent and volume of that additional soil

removal was calculated. The removal volumes from these steps were then added together to determine the total removal volume for FP 8.

4.4.5 Outputs to Support Evaluations

For each of the floodplain alternatives evaluated (other than the no-action alternative), areas selected for removal/backfill between the Confluence and Rising Pond Dam were depicted on maps to support the evaluation of those alternatives described in Section 7. Each of these maps for the IMPG-based alternatives differentiates, via separate colors, the bases for the various removals in terms of which exposure pathway or receptor group they were designed to address – namely:

- Direct Contact (separated into areas of 1-foot and 3-foot removal to differentiate removal in Heavily Used Subareas from that in the remaining EAs and subareas);
- Agricultural (for agricultural products consumption);
- Amphibians (i.e., removal, where necessary, in vernal pool areas to achieve the amphibian IMPGs); and
- Piscivorous Mammals (i.e., removal, where necessary, to achieve the target floodplain soil IMPG levels for piscivorous mammals, assuming that the associated sediment concentration is at or below 1 mg/kg).[92]

For the threshold-based alternatives (FP 5 and FP 6), in which removals were determined based on the PCB data and therefore are not associated with a specific exposure pathway or receptor group, the above pathway/receptor categories are not shown on the figures. For FP 8, the figures use the above categories to designate the removals attributable to achieving specific IMPGs, and show a separate category corresponding to the additional removals based on achieving the 50 mg/kg threshold.

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[92] As noted above, the floodplain alternatives have been developed on the assumption that the average sediment concentrations in the piscivorous mammal averaging areas (as well as the insectivorous bird averaging areas) would be at or below 1 mg/kg. However, the evaluations in Section 7 also consider the extent to which these alternatives would achieve the floodplain soil IMPG levels for these receptors if the associated sediment concentrations were higher. Moreover, the comparative analyses of combined sediment and floodplain alternatives in Section 8 evaluate the attainment of the IMPGs for piscivorous mammals directly, without the need to use pre-set target sediment levels, as discussed in Section 4.2.3.5.

It should also be noted that, based on application of the criteria for development of the various IMPG-based alternatives, no additional removal (beyond the removals to address the pathways and receptors listed in the text) would be necessary to achieve the floodplain soil IMPG levels for omnivorous/carnivorous mammals or insectivorous birds (see Section 7).

In addition to these maps, results of the IMPG evaluations are presented in tabular form in Section 7. For each of the human health and ecological averaging areas described in Section 4.2, the tables include the following:

- The pre-remediation EPC calculated from the spatially interpolated data set used to delineate areas of removal;
- Removal volume and acreage within each averaging area;[93]
- The post-removal EPC (calculated for post-removal conditions using the same methods described previously – i.e., the 95% UCL on the spatially weighted mean); and
- The applicable IMPGs for each area:
    - For human health, both RME and CTE IMPG values corresponding to the various cancer risk levels (i.e., 10^{-6}, 10^{-5}, and 10^{-4}) and non-cancer impacts are shown. In areas that have multiple uses, the lowest applicable IMPGs are shown (e.g., for a subarea characterized as both "general recreation" and "dirt biking/ATVing," the lower IMPGs for "dirt biking/ATVing" are shown). Also, for areas with multiple receptors (i.e., adults and older children), the lower IMPGs are shown.
    - For ecological receptors, the upper- and lower-bound IMPGs are shown where applicable. Also, for receptors in which the floodplain soil IMPGs are tied to the PCB concentration in sediments (i.e., for insectivorous birds and piscivorous mammals), IMPGs associated with the 1, 3, and 5 mg/kg sediment target levels are shown.

To facilitate the comparisons between post-removal EPCs and the IMPGs (as discussed in Section 7), the IMPGs that would be achieved by the given alternative are shaded in blue in the tables.

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[93] Given the modified Halls Bootstrap method used to calculate the post-remediation EPCs, consecutive repetitions of the procedure described above were found to generate slightly different results. To recognize this variability, total removal volumes presented in the evaluation of floodplain alternatives in Section 7 and those shown in the tables broken down by averaging area have been rounded. As such, the volume totals shown on the tables were made to agree with those stated in the text for consistency, but they do not always agree with the sum of volumes from the smaller averaging areas. In addition, it should be noted that estimated removal volumes calculated using the methods described in this section are reliable on a total volume basis, but become uncertain in some of the relatively small exposure/averaging areas due to data limitations, data variability, and the random component inherent to the bootstrap method.

In the comparative evaluations of the combinations of sediment and floodplain alternatives in Section 8, similar tables are used to show the results of the IMPGs comparisons for those combinations, including IMPG comparisons for insectivorous birds and piscivorous mammals based on the model-predicted sediment concentrations for the combinations (rather than using pre-selected target sediment levels).

4.5 Approach to Post-Construction Operation, Maintenance, and Monitoring

A post-construction OMM program would be a component of each floodplain alternative (except FP1), and has been assumed to include a 5-year OMM program for restoration. No other long-term post-remediation OMM program has been developed for the floodplain alternatives. This section describes the general elements that will be assumed to be part of this program, to avoid repetition of that general description under each floodplain alternative.

Consistent with the sediment alternatives, the assumed approach to the OMM program for remediated floodplain areas has been developed in consideration of the OMM requirements specified in the documents listed in Section 3.7, as well as review of the additional information on floodplain restoration methods in Section 5.3 below. Based on review of this information, GE anticipates that the OMM program for restoration would include the following components for a 5-year period after completion of installation of restoration measures in the floodplain:

- Periodic inspections of affected floodplain areas to assess: (a) the effectiveness of erosion controls in areas where vegetation is not yet established; (b) any areas where excessive settlement has occurred relative to the surrounding areas; (c) any drainage problems; (d) any areas of erosion; and (e) other conditions that could jeopardize the performance of the completed restoration measures (e.g., burrows, vehicle ruts);

- Periodic inspections of areas of replanted trees, shrubs, and herbaceous vegetation in affected floodplain areas to assess planting survival rates, extent of herbaceous cover, and presence and extent of any invasive species – on a semi-annual basis for that 5-year period, with a qualitative assessment in the spring and a quantitative assessment in designated monitoring plots in the summer to evaluate the achievement of various specific performance standards;

- Annual spring inspections of the vernal pools that were subject to restoration measures to assess and document the conditions of the vernal pools, as well as semi-annual inspections of the replanted vegetation in and around the vernal pools (see second bullet above);

- Periodic inspections of other remediated wetland areas to assess pertinent hydrologic features as necessary, including any interferences with flow paths or other drainage features in reconstructed swales and drainageways;

- If appropriate, further evaluation to assess the causes or extent of any problematic conditions noted during the above inspections; and

- Performance of maintenance, repair, and other corrective actions as necessary to address any physical deficiencies noted during the above inspections – e.g., placement of additional topsoil in areas of erosion or settlement; additional planting, seeding, and/or fertilization (if necessary) to replace dead, dying, or sparse vegetation; removal or control of invasive species where necessary and practicable; removal of other vegetation that is adversely affecting the survival of the vegetation planted; repair of blocked drainage features or other conditions that are interfering with restored flow paths; and other actions identified in the applicable restoration plans as appropriate for correcting structural conditions that are not meeting applicable performance standards.

For purposes of cost estimating within this Revised CMS Report, it has been assumed that these OMM activities would be conducted for 5 consecutive years after completion of the remediation/restoration activities in a given area. While it is difficult to make a reliable estimate of the costs of the particular OMM activities identified above prior to the development and EPA review of a detailed restoration and OMM plan, a rough general estimate has been made for each floodplain alternative for purposes of this Revised CMS Report.

4.6 Approach to Consideration of Potential Future Land Uses

In addition to the remediation work described above, each floodplain remedial alternative other than FP 1 (no action) would include institutional controls and/or other mechanisms to address reasonably anticipated future uses and activities for which the alternative would not meet applicable cleanup criteria (e.g., residential use standards at non-residential properties, where residential use is reasonably anticipated and remediation would not meet those standards). These controls/mechanisms include deed restrictions and Conditional Solutions (as described in Section 1.6 above), as well as periodic inspections and reviews of floodplain properties to assess any changes in use and the need for additional remediation.

For certain types of properties, deed restrictions could be implemented to prohibit future uses or activities that are inconsistent with, and would involve greater exposure potential than, the current uses that are addressed by the cleanup. Deed restrictions include, for example, EREs, as provided for in the CD. They also include other types of restrictions such as Notices of Activity and Use Limitations (AULs), as provided for in the Massachusetts Contingency Plan (MCP), and conservation restrictions. Both GE and the City of Pittsfield agreed in the CD to provide EREs on their properties where restrictions on future use are necessary (CD ¶¶ 54 and 66). Similarly, the Commonwealth of Massachusetts agreed in the CD that, where EREs are necessary, it will “not unreasonably withhold consent” to the placement of EREs on state-owned properties in the Rest of River without compensation, so

long as the EREs do not interfere with recreational use of the properties or other uses that were made of the properties at the time of lodging of the CD (CD ¶ 60.b).

Deed restrictions would be appropriate at certain types of properties where a given future use is reasonably anticipated but which would not meet the applicable cleanup standards for that use. For example, for non-residential properties owned by GE, the City of Pittsfield, or the Commonwealth that would not meet residential standards, EREs would be executed as provided in the CD. For other properties that would not meet the applicable cleanup standards for a reasonably anticipated future use, deed restrictions could be executed where the property owners agree to do so; and if they do not, Conditional Solutions may be implemented. As provided for in the CD, a Conditional Solution requires GE to agree to conduct additional remediation in the future, under certain conditions, to address changes in the property's use that would require such remediation, provided that the property owner has all necessary permits and approvals for such use and demonstrates a commitment to that use.

For the Rest of River, however, it would not be practical to implement the ERE/Conditional Solution approach for all the many properties in the floodplain that could have *possible* uses with potentially greater exposure than current uses and that would not meet the most restrictive possible standards. For example, it would not be practical to request an ERE or implement a Conditional Solution at every property in the floodplain that does not meet residential or agricultural standards, simply to address the theoretical possibility that it may someday convert to residential or agricultural use. Rather, the deed restriction/Conditional Solution approach must necessarily be limited to those properties where a change to a use involving greater exposure potential (i.e., residential or agricultural use) is actually reasonably anticipated, based on some objective measure, and which (based on sampling data) would not meet the cleanup standards for that use.[94]

The remaining properties in the floodplain – i.e., those where a change from current use was not reasonably anticipated at the time of remedy selection (and thus are not subject to deed restrictions or Conditional Solutions) – would be subject to EPA's periodic (e.g., 5-year) reviews of the Rest of River remedy in accordance with Section 121(c) of CERCLA and Paragraph 43.c of the CD. Such periodic reviews are designed to evaluate potential changes in circumstances and conditions that could affect the protectiveness of the remedy. As such, they can and should be used to evaluate whether there have in fact been any changes in land use that were not previously anticipated and for which the applicable cleanup standards are not met. In such cases, EPA could select further response actions to address the situation as

[94] Examples of objective measures indicating that a change in use is reasonably anticipated would include development plans for individual properties or general plans for a change in local community land use in a given area. Other potential indications of a reasonably anticipated change in land use would be evaluated on a case-by-case basis.

necessary. This would be protective given that the assumed health risks are based on long-term exposures. Specifically, the assumed exposure durations used by EPA in its calculation of risks based on direct contact with floodplain soil in the HHRA range from a minimum of six years for young children to 47 years for adults.

For institutional controls, such as those discussed above, that would address potential future changes in land use, the inspection, maintenance, and monitoring requirements would include annual inspections of properties where deed restrictions or Conditional Solutions have been implemented (similar to the inspections required by the CD for such properties) and the EPA periodic reviews as described above. GE would submit reports on its inspections to EPA and the State.[95]

[95] Note that the estimated costs of the floodplain alternatives do not include costs for the institutional controls addressing future changes in land use. A reliable cost estimate cannot be made for such controls, because: (a) the costs of deed restrictions depend on the number of private properties where deed restrictions would be executed, which is unknown; and (b) the costs of implementing Conditional Solutions or the annual inspection approach depend on the number of future situations where GE may have to perform additional response actions, as well as the type and extent of such response actions, all of which are likewise unknown.

Section 4 Tables

Table 4-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
1	General recreation	older child, adult	60	Medium-use general recreation	older child, adult	
2	General recreation	older child, adult	90	High-use general recreation	older child, adult	
2a	General recreation	older child	30	Low-use general recreation	older child	
2b	General recreation	older child	90	High-use general recreation	older child	
3	General recreation	adult	90	High-use general recreation	adult	
4	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	X
5	General recreation	older child, adult	90	High-use general recreation	older child, adult	
6	General recreation	adult	30	Low-use general recreation	adult	
	Future residential	young child, adult	---			
7	General recreation	older child, adult	90	High-use general recreation	older child, adult	
8	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
9	General recreation	older child	30	Low-use general recreation	older child	
10	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
10a	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
11	General recreation	adult	90	High-use general recreation	adult	
12	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	X
13	General recreation	adult	90	High-use general recreation	adult	
14	General recreation	adult	90	High-use general recreation	adult	
15	General recreation	adult	90	High-use general recreation	adult	
16	General recreation	adult	90	High-use general recreation	adult	
17	General recreation	adult	90	High-use general recreation	adult	
18	General recreation	adult	60	Medium-use general recreation	adult	
	Future residential	young child, adult	---			
19	General recreation	adult	90	High-use general recreation	adult	
20	General recreation	adult	90	High-use general recreation	adult	
21	Farmer	adult	---	High-use general recreation	older child, adult	
21-22	Future residential	young child, adult	---			
22	General recreation	older child, adult	90	High-use general recreation	older child, adult	
22a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
23	General recreation	older child	60	Medium-use general recreation	older child	
24	General recreation	adult	90	High-use general recreation	adult	
25	General recreation	older child	90	High-use general recreation	older child	
26	General recreation (future)	older child, adult	90	High-use general recreation (future)	older child, adult	
26a	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
26b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	
27	General recreation	older child, adult	90	High-use general recreation	older child, adult	
27a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
28	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	
28a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
29	General recreation	older child, adult	30	Low-use general recreation	older child, adult	
30	General recreation	older child, adult	90	High-use general recreation	older child, adult	
31	General recreation	older child, adult	90	High-use general recreation	older child, adult	

Table 4-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
31a	General recreation	older child, adult	90	High-use general recreation	older child, adult	
32	General recreation	adult	90	High-use general recreation	adult	
33	General recreation	adult	90	High-use general recreation	adult	
34	Farmer	adult	---	Medium-use general recreation	adult	
	Future residential	young child, adult	---			
35	General recreation	older child, adult	90	High-use general recreation	older child, adult	
35a	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
36a	Groundskeeper	adult	---	Low-use commercial (groundskeeper scenario)	adult	
36b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	
37	General recreation	older child, adult	90	High-use general recreation	older child, adult	
37a	Angler	older child, adult	---	Bank fishing	older child, adult	
37b	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
38	General recreation	adult	90	High-use general recreation	adult	
38a	Angler	older child, adult	---	Bank fishing	older child, adult	
39	Marathon canoe	adult	---	Marathon canoeist	adult	X
	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
40	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	X
40a	Angler	older child, adult	---	Bank fishing	older child, adult	
40b	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
41	General recreation	adult	60	Medium-use general recreation	adult	
41a	Angler	older child, adult	---	Bank fishing	older child, adult	
42	General recreation	adult	60	Medium-use general recreation	adult	
42a	Angler	older child, adult	---	Bank fishing	older child, adult	
43	General recreation	adult	60	Medium-use general recreation	adult	
43a	Angler	older child, adult	---	Bank fishing	older child, adult	
44	General recreation	adult	90	High-use general recreation	adult	
45	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
46	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
47	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
48	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
49	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	30	Low-use general recreation	adult	
50	General recreation	adult	30	Low-use general recreation	adult	
50a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
51	General recreation	adult	30	Low-use general recreation	adult	
51a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
52	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
53	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X

Table 4-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
54	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
55	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
55a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
56	General recreation	older child, adult	60	Medium-use general recreation	older child, adult	
56a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
57	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	X
	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
58	Angler	older child, adult	---	Bank fishing	older child, adult	X
	General recreation	adult	90	High-use general recreation	adult	
59	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	X
59a	Angler	older child, adult	---	Bank fishing	older child, adult	
60	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
60a	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
61	Utility Worker	adult	---	Utility worker	adult	
62	Utility Worker	adult	---	Utility worker	adult	
63	Utility Worker	adult	---	Utility worker	adult	
64	Utility Worker	adult	---	Utility worker	adult	
65	Utility Worker	adult	---	Utility worker	adult	
66	Utility Worker	adult	---	Utility worker	adult	
67	General recreation	adult	90	High-use general recreation	adult	
68	General recreation	adult	90	High-use general recreation	adult	
69	Angler	older child, adult	---	Bank fishing	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
70	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
70a	Angler	older child, adult	---	Bank fishing	older child, adult	
71	Angler	older child, adult	---	Bank fishing	older child, adult	
	General recreation	adult	30	Low-use general recreation	adult	
72	Angler	older child, adult	---	Bank fishing	older child, adult	
72-73	Future residential	young child, adult	---	*Do Not Evaluate*		
73	General recreation	adult	90	High-use general recreation	adult	
74	General recreation	adult	90	High-use general recreation	adult	
75	General recreation	adult	90	High-use general recreation	adult	
76	General recreation	adult	90	High-use general recreation	adult	
	Future residential	young child, adult	---			
77	General recreation	adult	90	High-use general recreation	adult	
78	General recreation	older child	90	High-use general recreation	older child	
	Future residential	young child, adult	---			
79	General recreation	adult	90	High-use general recreation	adult	
80	Future residential	young child, adult	---	*Do Not Evaluate*		
80a	General recreation	adult	30	Low-use general recreation	adult	
80b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	

Table 4-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
81	General recreation	adult	30	Low-use general recreation	adult	
82	General recreation	adult	30	Low-use general recreation	adult	
83	Groundskeeper	adult	---	High-use commercial (groundskeeper scenario)	adult	
	Future residential	young child, adult	---			
84	General recreation	adult	30	Low-use general recreation	adult	
85a	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
85b	General recreation	older child	90	High-use general recreation	older child	
86	Groundskeeper	adult	---	High-use commercial (groundskeeper scenario)	adult	
	Future residential	young child, adult	---			
87	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
87a	Angler	older child, adult	---	Bank fishing	older child, adult	
88	General recreation	older child	60	Medium-use general recreation	older child	
89	General recreation	adult	90	High-use general recreation	adult	
90	General recreation	older child, adult	90	High-use general recreation	older child, adult	

[1] *EPA exposure scenarios from Human Health Risk Assessment Table 5-1 (Reaches 5 &6) and Table 5-325 (Reaches 7 & 8).*

Table 4-2. Summary of agricultural averaging areas and adjusted agricultural products consumption IMPGs.

Farm ID	EPA Designation	IMPG Category	Total Farm Area (acre)	Farm Area in Floodplain (acre)	Adjusted IMPG (mg/kg)[1]									
					Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
					RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	Corn	Commercial Dairy	22.8	8.0	0.68	3.1	6.8	31	68	312	7.7	12	36	44
FA 2	Hay		35.8	3.3	2.59	11.9	25.9	119	259	1187	29.1	46.4	138	168
FA 3	Formerly Corn		4.8	4.1	0.29	1.3	2.9	13	29	132	3.2	5.2	15	19
FA 4	Corn (Silage)		65.4	64.4	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 5	Corn (Silage)		12.4	12.2	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 6	Corn (Silage)		7.7	7.7	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 7	Corn (Silage) / Wetland		24.1	24.1	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 8	Hay		13.4	9.4	0.34	1.5	3.4	15	34	154	3.8	6.0	18	22
FA 9	Corn (Silage)		34.6	26.3	0.31	1.4	3.1	14	31	143	3.5	5.6	17	20
FA 10	Open Land (Possibly Hay)		2.7	0.3	2.1	9.5	21	95	206	946	23	37	110	134
FA 11	Open Land (Possibly Hay)		3.5	0.1	6.1	28	61	279	610	2794	69	109	325	396
FA 12	Open Land (Formerly Grazing)		12.4	8.0	0.38	1.8	3.8	18	38	176	4.3	6.9	20	25
FA 13	Open Land (Formerly Grazing)		4.1	4.0	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 14	Open Land (Possibly Hay)		6	2.6	0.55	2.5	5.5	25	55	253	6.2	9.9	29	36

[1] *Agricultural products consumption IMPGs from Table 2-3 adjusted to account for the portion of the farm area located outside the floodplain.*

Table 4-3a. Summary of Reach 7 IMPGs (mg/kg) for amphibians and omnivorous/carnivorous mammals compared to average floodplain concentrations.

Subreach	0-6" Floodplain Soil PCB Concentration (95% Hall's UCL)	Amphibian IMPGs[1]		Omnivorous/Carnivorous Mammal IMPGs	
		Upper Bound	Lower Bound	Upper Bound	Lower Bound
7A	3.1	5.6	3.27	34.3	21.1
7B	6.9	--	--	34.3	21.1
7C	4.5	--	--	34.3	21.1
7D	2.4	5.6	3.27	34.3	21.1
7E	2.5	5.6	3.27	34.3	21.1
7F	2.1	5.6	3.27	34.3	21.1
7G	5.4	--	--	34.3	21.1
7H	3.8	--	--	34.3	21.1

Note:

[1] *Only subreaches 7A, 7D, 7E, and 7F are presented because vernal pools (those classified as both "certified" or "potential") were identified only in these subreaches.*

Key

= 95% UCL is lower than the IMPG

Table 4-3b. Summary of Reach 7 IMPGs (mg/kg) for insectivorous birds and piscivorous mammals compared to average floodplain concentrations.

Subreach	Analogous PSA Subreach	Average 0-6" Sediment Concentration[1]	0-6" Floodplain Soil PCB Concentration (95% Hall's UCL)	Insectivorous Bird IMPGs[2]	Piscivorous Mammal IMPGs[2]	
					Upper Bound	Lower Bound
7A	5A	0.41	3.1	50	16.63	3.42
7B	5C	5.1	6.9	46	11.78	*na*
7C	5A/5B	4.1	4.5	18	*na*	*na*
7D	5B	1.0	2.4	48	16.63	3.42
7E	5A	1.9	2.5	50	16.63	3.42
7F	5B	0.77	2.1	48	16.63	3.42
7G	6	6.1	5.4	46	11.78	*na*
7H	5A	0.40	3.8	50	16.63	3.42

Note:

[1] *Sediment concentration at the end of the model validation period (i.e., 2004).*

[2] *The insectivorous bird and piscivorous mammal IMPG presented for each subreach corresponds to the IMPG associated with the analogous PSA Reach (from the EPA Final Model Documentation Report, Table 3.6-9, based on habitat suitability for FCM species), and the corresponding average sediment concentration for that subreach.*

Key

	= 95% UCL is lower than the IMPG
	= 95% UCL exceeds the IMPG
na	= receptor IMPG is not achievable at corresponding sediment concentration

Section 4 Figures

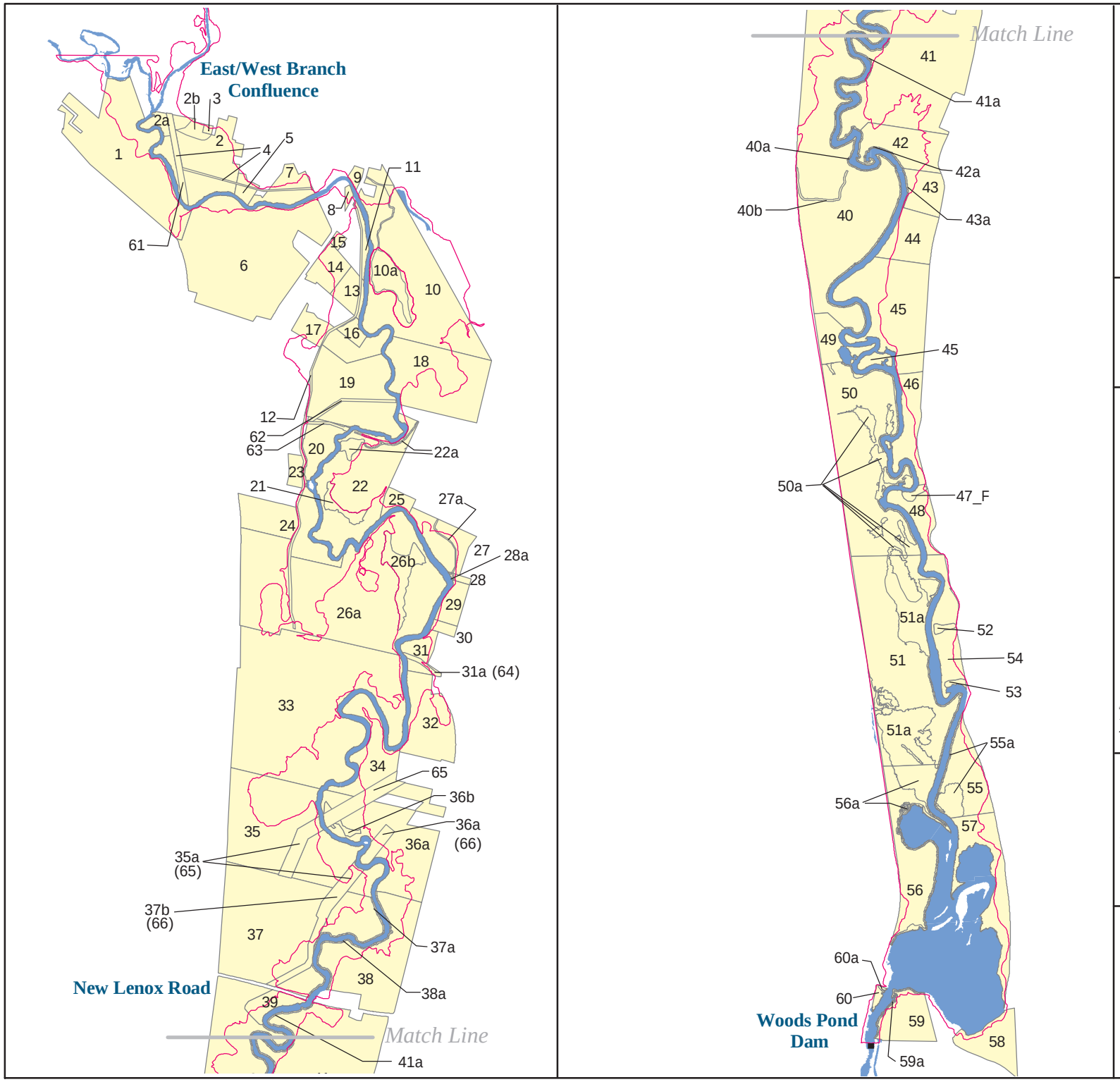

Figure 4-1a.
Map of exposure areas (EAs) for direct contact assessment in Reaches 5 & 6.

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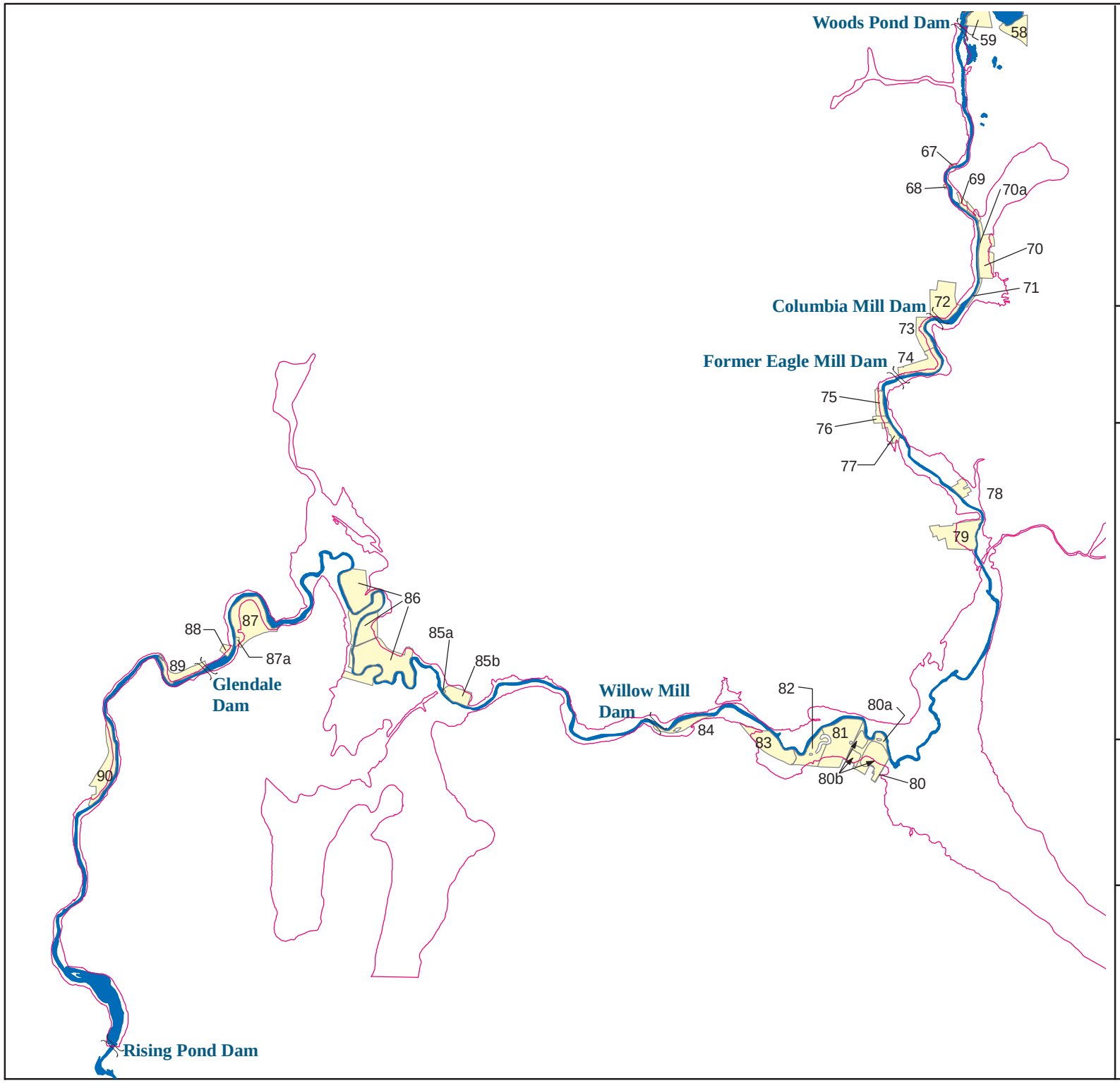

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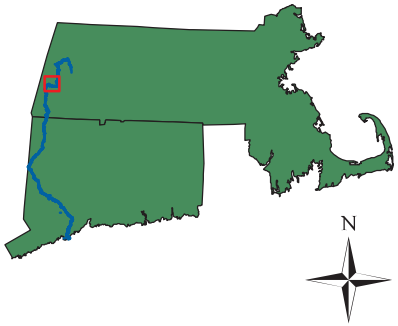

SCALE

0 0.5 1 Miles

LEGEND

- Housatonic River
- Dams
- 100-year Floodplain
- Exposure Areas

Note:
Labels posted represent EPA exposure area IDs.

Figure 4-1b.
Map of exposure areas (EAs) for direct contact assessment in Reaches 7 & 8.

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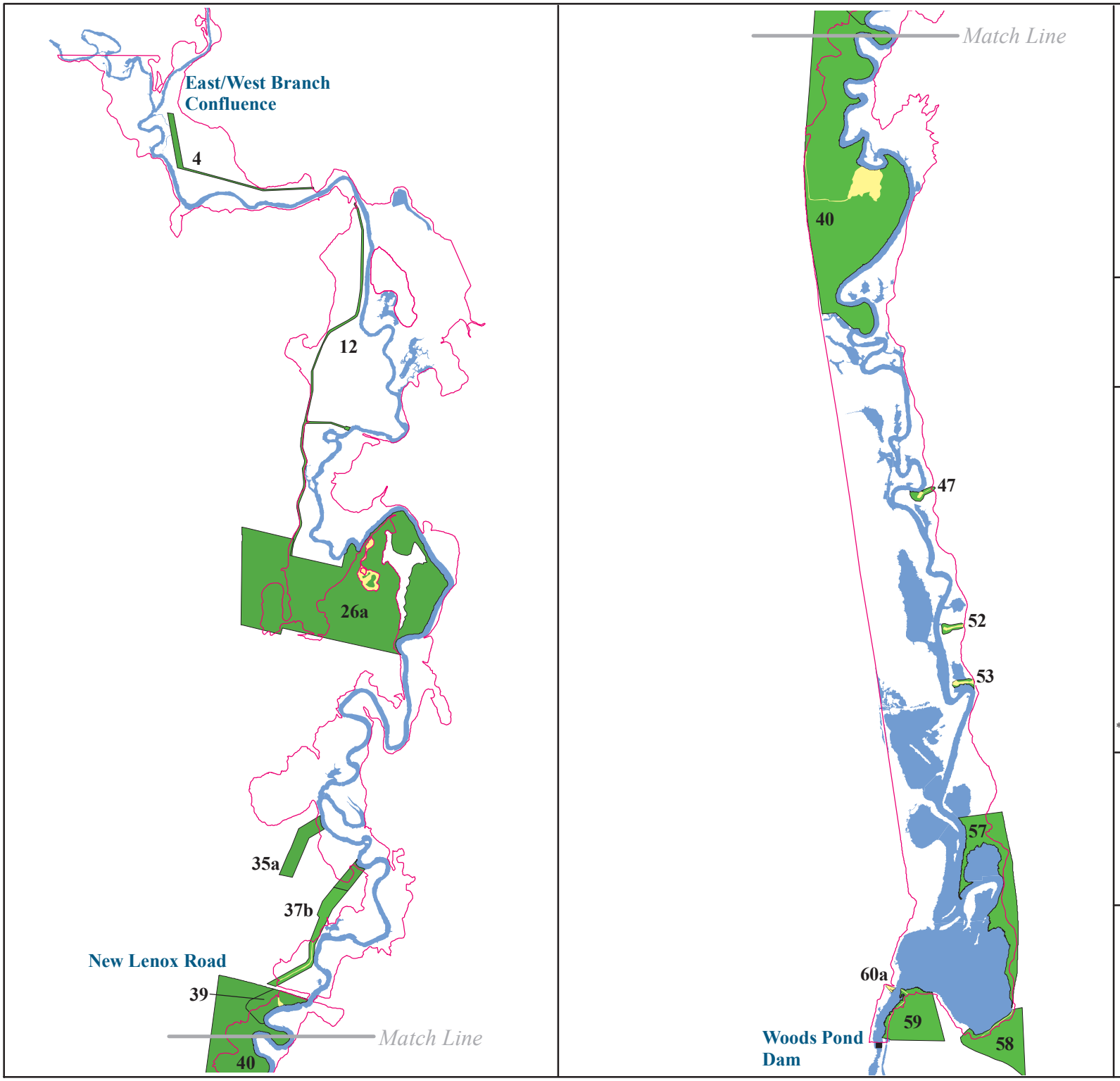

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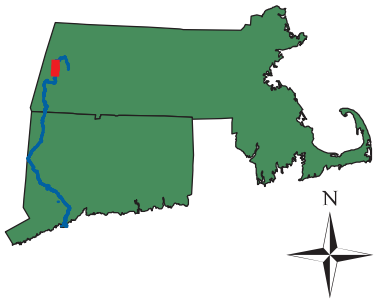

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Frequent-Use EAs
- Heavily Used Subareas*

** Approximately ten-foot wide corridors down the center of EAs 4 and 12 not shown.*

Figure 4-2.
Map of Frequent-Use EAs and Heavily Used Subareas for direct contact assessment in Reaches 5 & 6.

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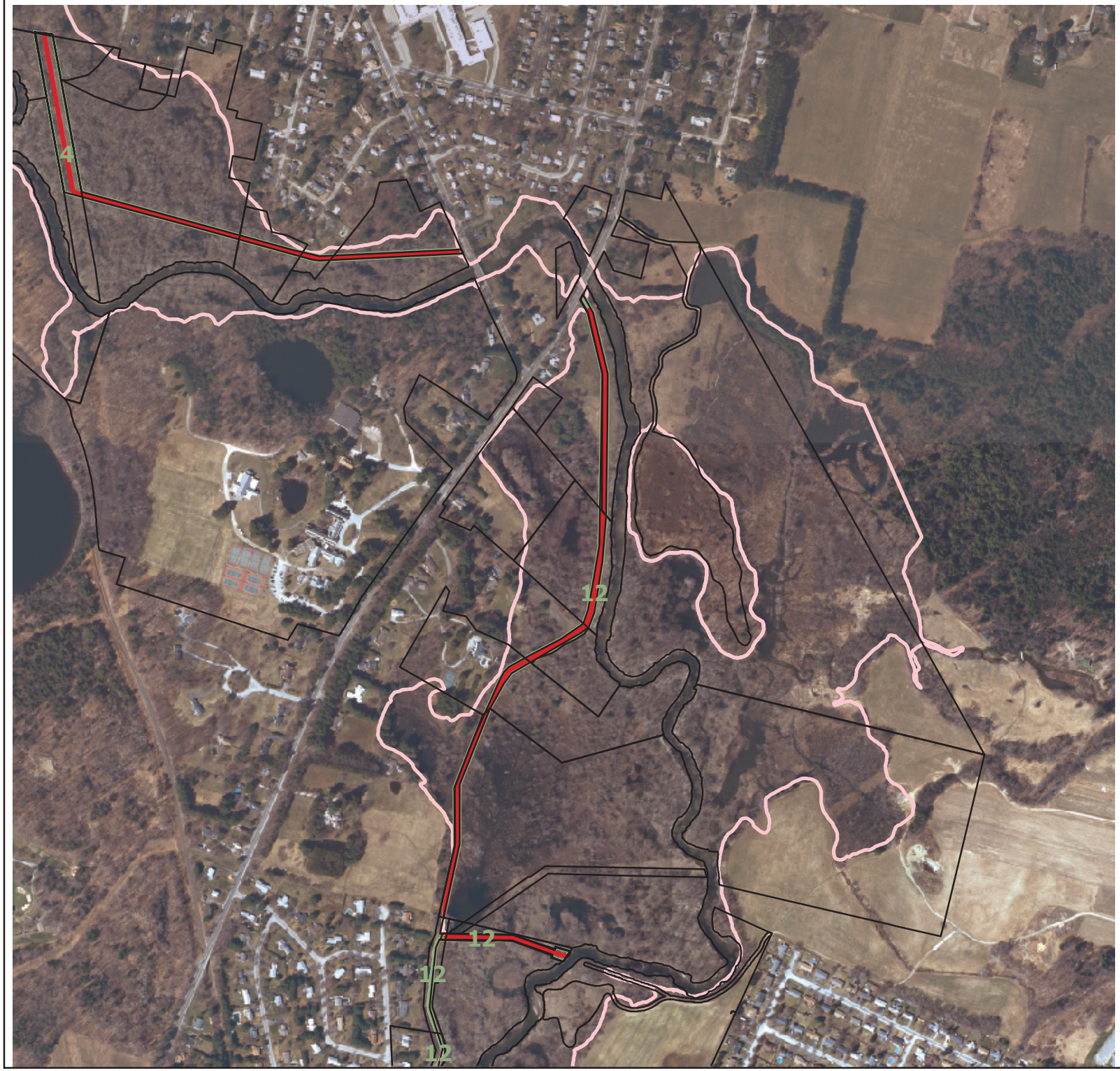

LOCATOR MAP

SCALE

0 500 1,000 Feet

LEGEND

- Heavily Used Subareas
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1-ppm PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3a.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 4 and 12.

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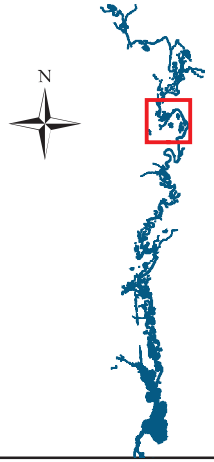
LOCATOR MAP



SCALE

0 300 600 Feet

LEGEND

- Heavily Used Subareas
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1-ppm PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3b.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 12 and 26a.

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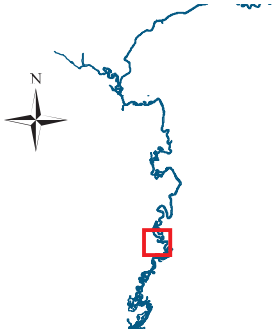
LOCATOR MAP



SCALE

0 200 400 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

No heavily used subarea(s) defined for EA 35a; trails/roads within EA boundary located outside 1 mg/kg PCB isopleth.

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3c.

Map of Heavily Used Subareas in Reaches 5 & 6: EA 35a

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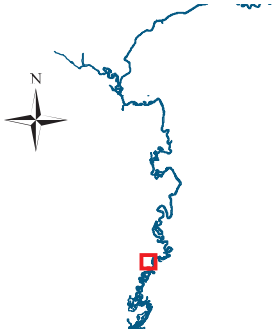

SCALE

0 100 200 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3d.

Map of Heavily Used Subareas in Reaches 5 & 6: EA 37b

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LOCATOR MAP

SCALE

0 300 600 Feet

LEGEND

- Heavily Used Subareas
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1-ppm PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3e.
Map of Heavily Used Subareas in Reaches 5 & 6: EAs 39 and 40.

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LOCATOR MAP

SCALE

0 350 700 Feet

LEGEND

- Heavily Used Subareas
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1-ppm PCB Isopleth

** Difficult access areas from HHRA.*

Figure 4-3f.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 47, 52, and 53.

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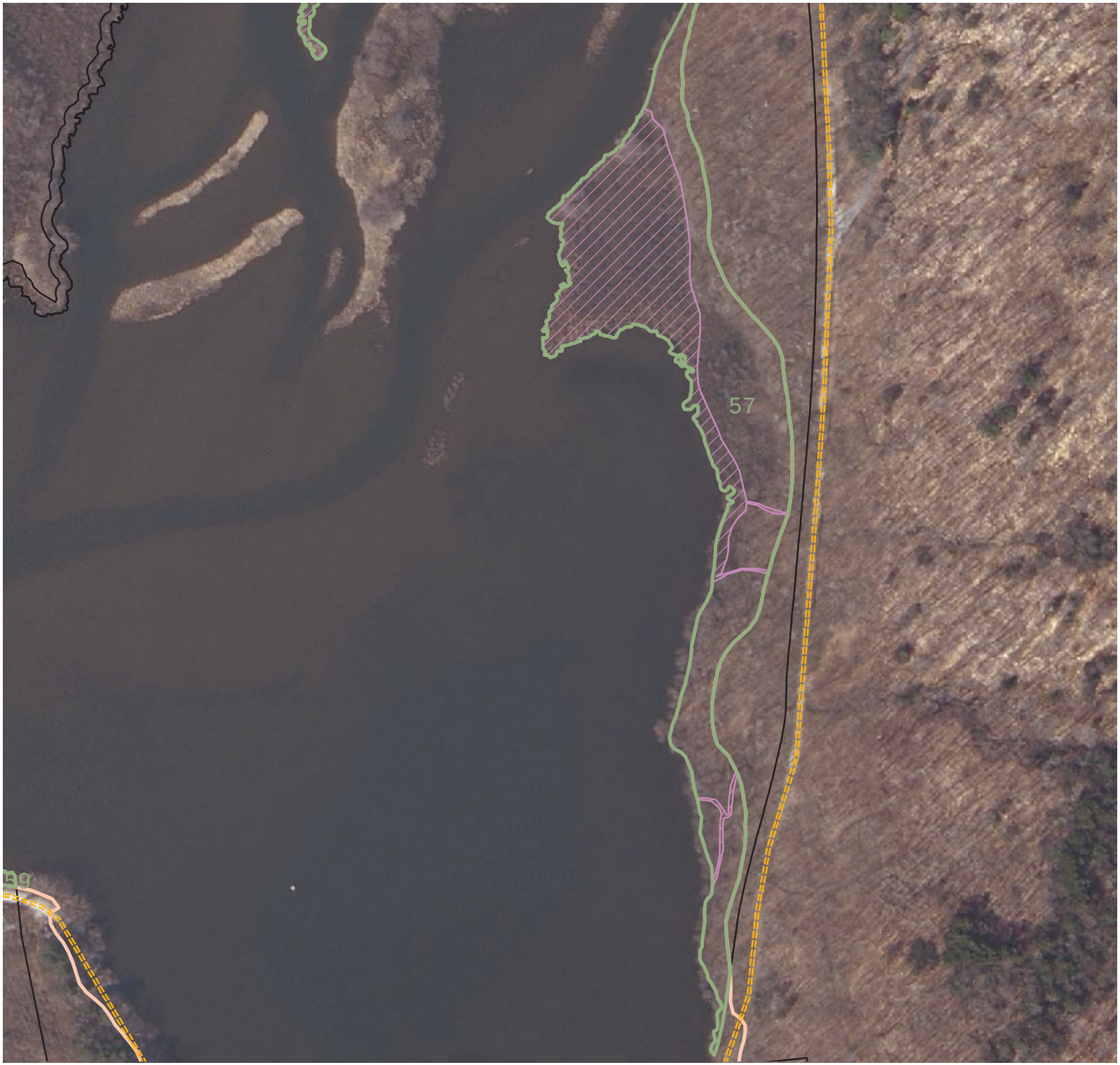

LOCATOR MAP

SCALE

0 200 400 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

No heavily used subarea(s) defined for EA 57; no trails/roads located within EA boundary.

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3g.

Map of Heavily Used Subareas in Reaches 5 & 6: EA 57

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LOCATOR MAP

SCALE

0 75 150 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3h.

Map of Heavily Used Subareas in Reaches 5 & 6: EA 58

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LOCATOR MAP

SCALE

0 75 150 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

Notes:
**Difficult access areas from HHRA, clipped by frequent-use EAs.*
Aerial photos in 0.5m resolution downloaded from MassGIS (2005).

Figure 4-3i.

Map of Heavily Used Subareas in Reaches 5 & 6: EA 59

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LOCATOR MAP

SCALE

0 40 80 Feet

LEGEND

- Heavily Used Subareas
- Trails/Roads
- Frequent-Use EAs within 1 mg/kg PCB Isopleth
- Difficult Access Areas*
- Exposure Areas
- 1 mg/kg PCB Isopleth

** Difficult access areas from HHRA.*

Figure 4-3j.
Map of Heavily Used Subareas in Reaches 5 & 6:
EA 60a.

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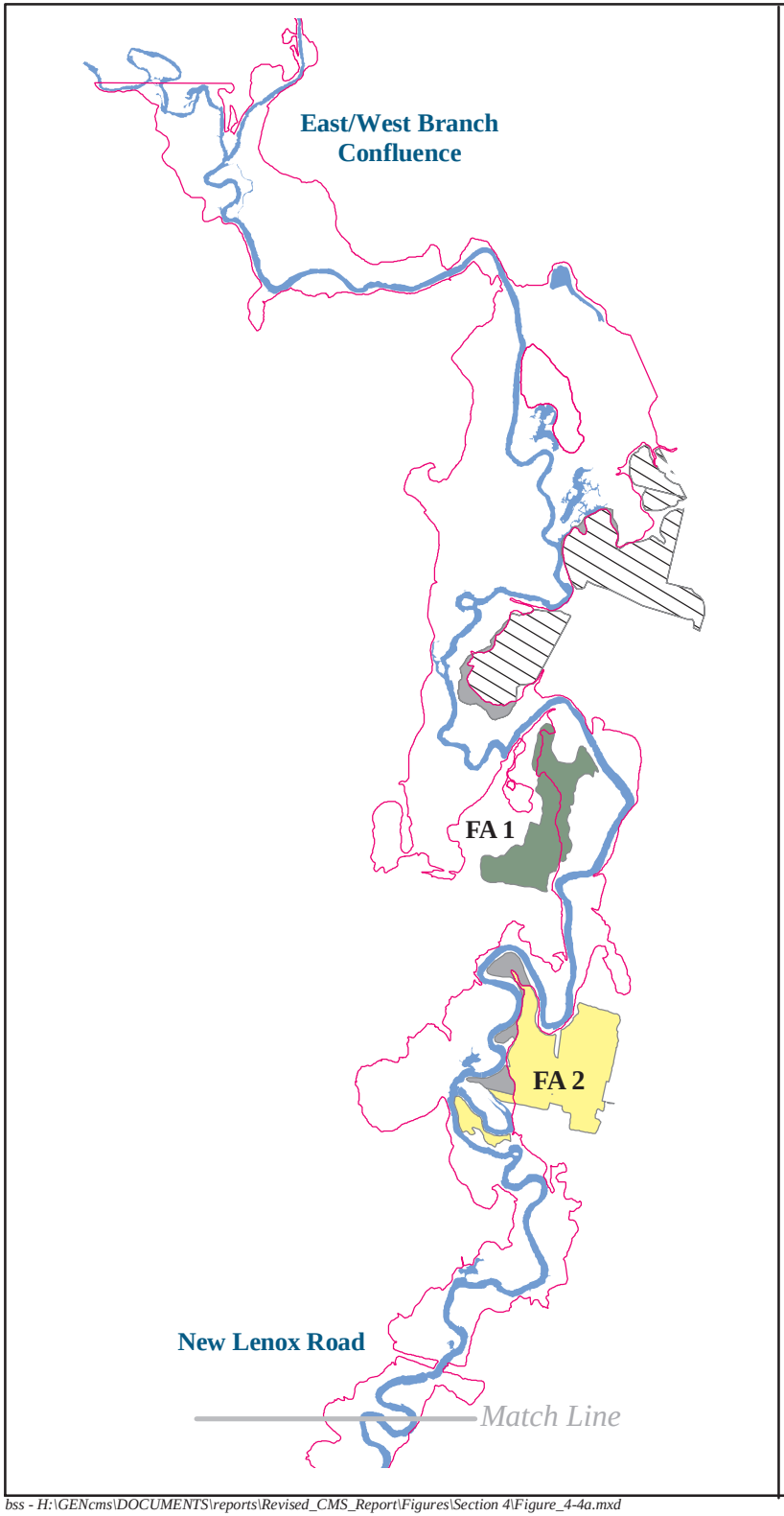

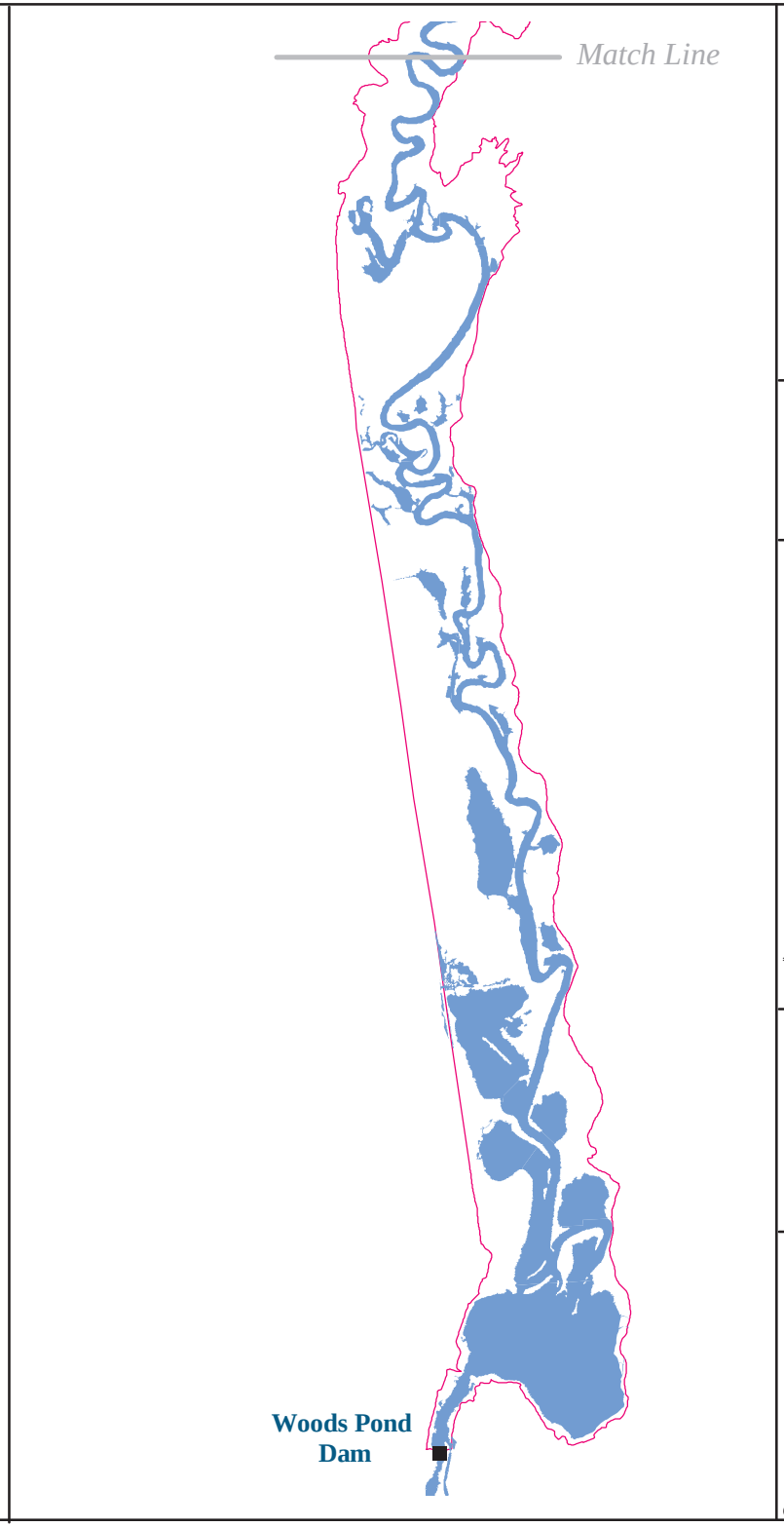

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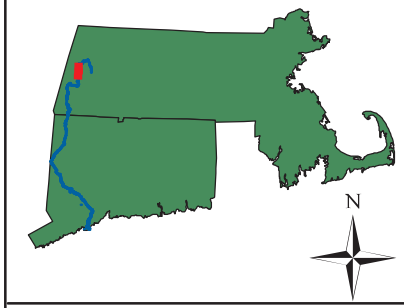

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Farm Areas Included in CMS Evaluation*

Farm Areas Excluded from Evaluation:

- Outside Floodplain
- Not in Use

** Farm areas included in the CMS evaluation are shown as different colors to differentiate individual farm areas. Labels (e.g., FA 2) represent farm area IDs.*

Figure 4-4a.
Farm areas evaluated for agricultural products consumption in Reaches 5 & 6.

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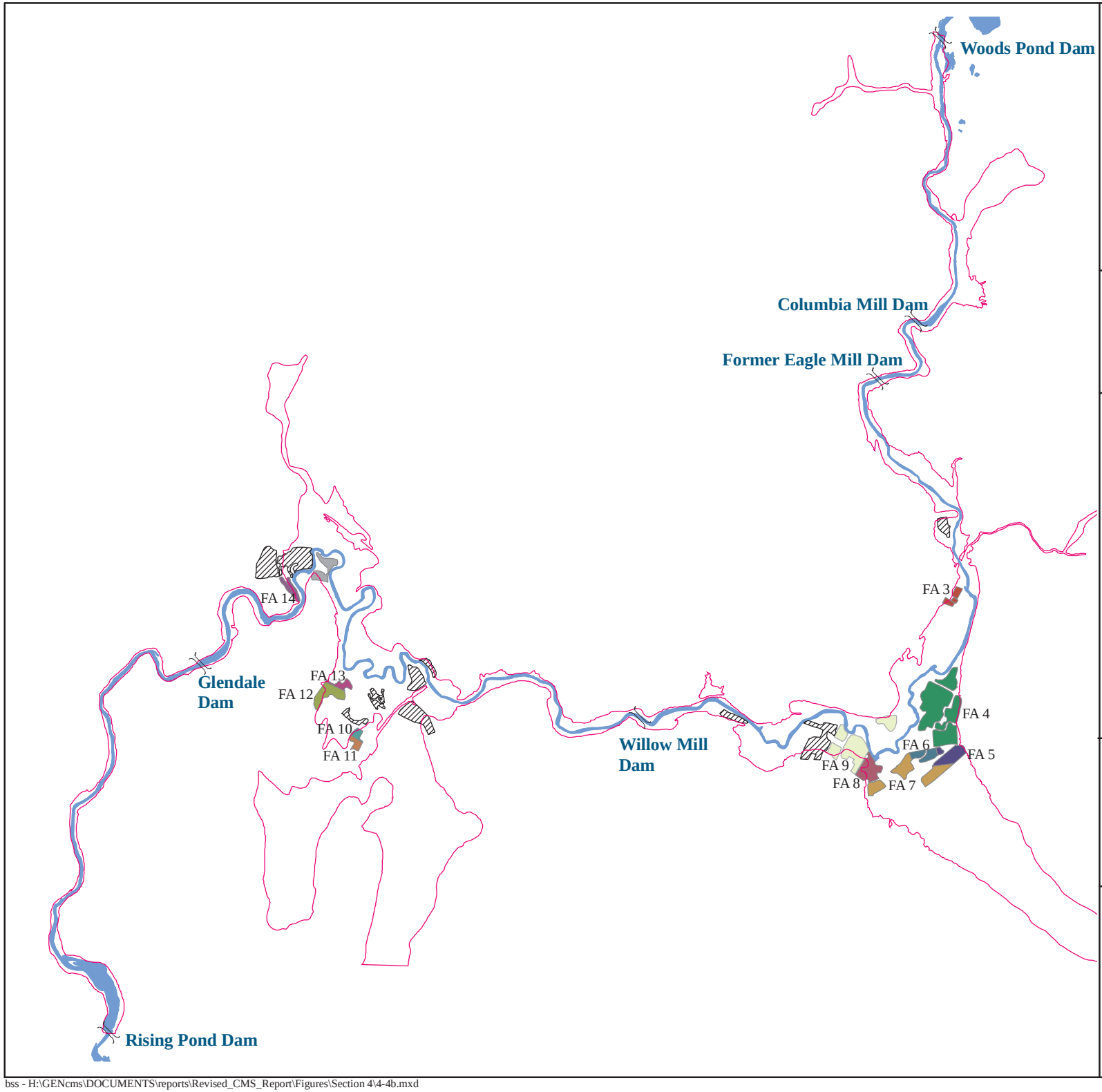

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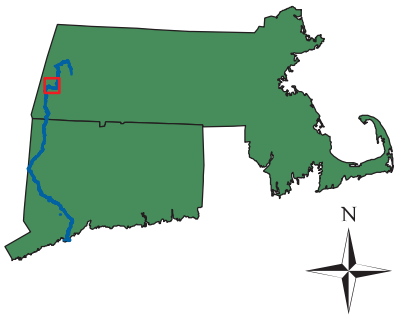

SCALE

0 0.5 1 Miles

LEGEND

- Housatonic River
- Dams
- 100-year Floodplain
- Farm Areas Included in CMS Evaluation*

Farm Areas Excluded from Evaluation:

- Farm Area Not in Agricultural Use
- Not in Use

** Farm areas included in the CMS evaluation are shown as different colors to differentiate individual farm areas. Labels (e.g., FA 9) represent farm area IDs.*

Figure 4-4b.
Farm areas evaluated for agricultural products consumption in Reaches 7 & 8.

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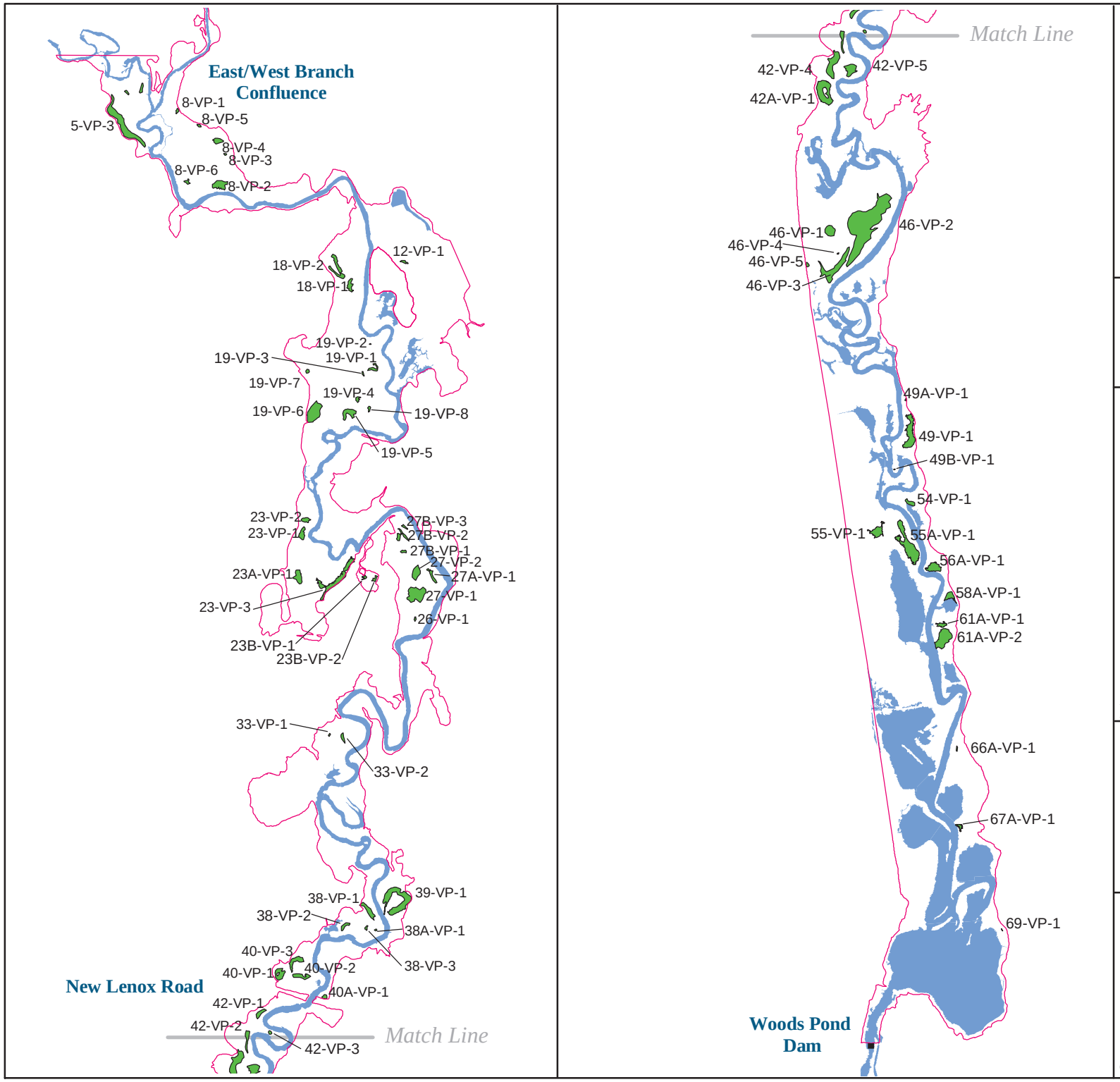

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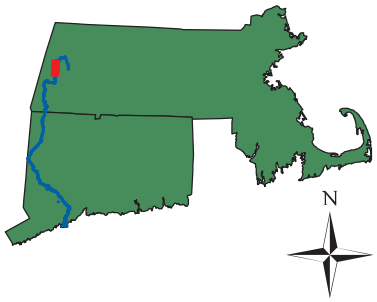

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Vernal Pools

Note:
Labels posted represent EPA vernal pool IDs.

Figure 4-5.
Vernal pools evaluated for the amphibian (wood frog) floodplain soil assessment in Reaches 5 & 6.

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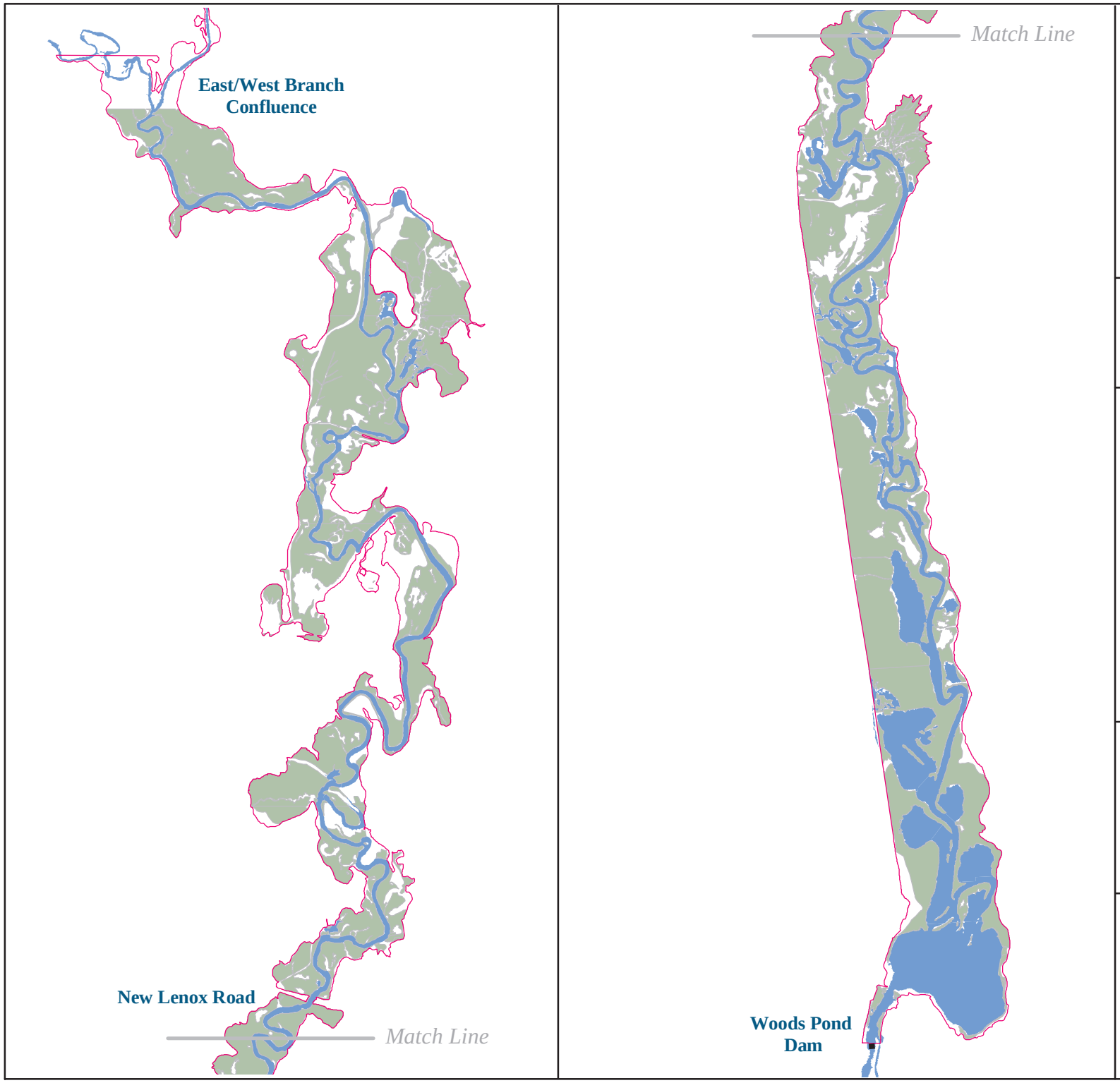

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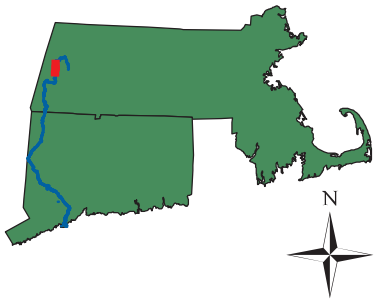

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Suitable Shrew Habitat

Figure 4-6a.
Areas of suitable omnivorous/carnivorous mammal (shrew) habitat in Reaches 5 & 6.

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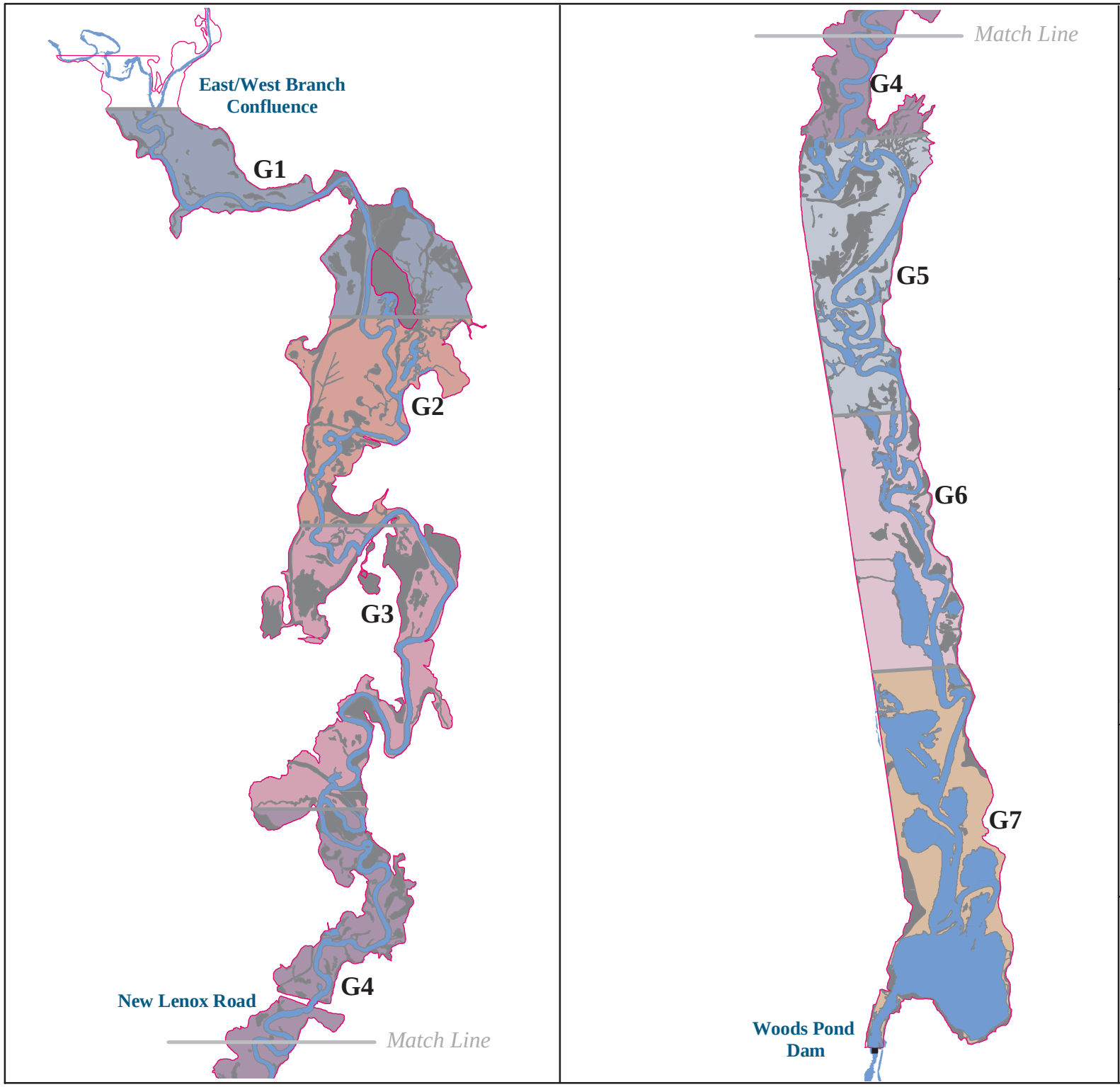

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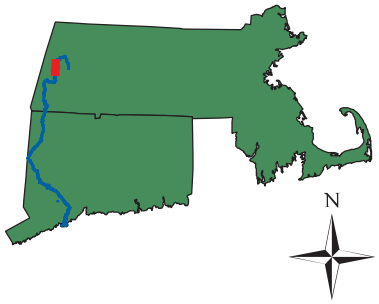

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Shrew Averaging Areas*
- Unsuitable Shrew Habitat

** Separate shrew averaging areas are shown as different colors, and labels (e.g., G3) represent averaging area IDs.*

Figure 4-6b.
Averaging areas used for the omnivorous/carnivorous mammal (shrew) assessment in Reaches 5 & 6.

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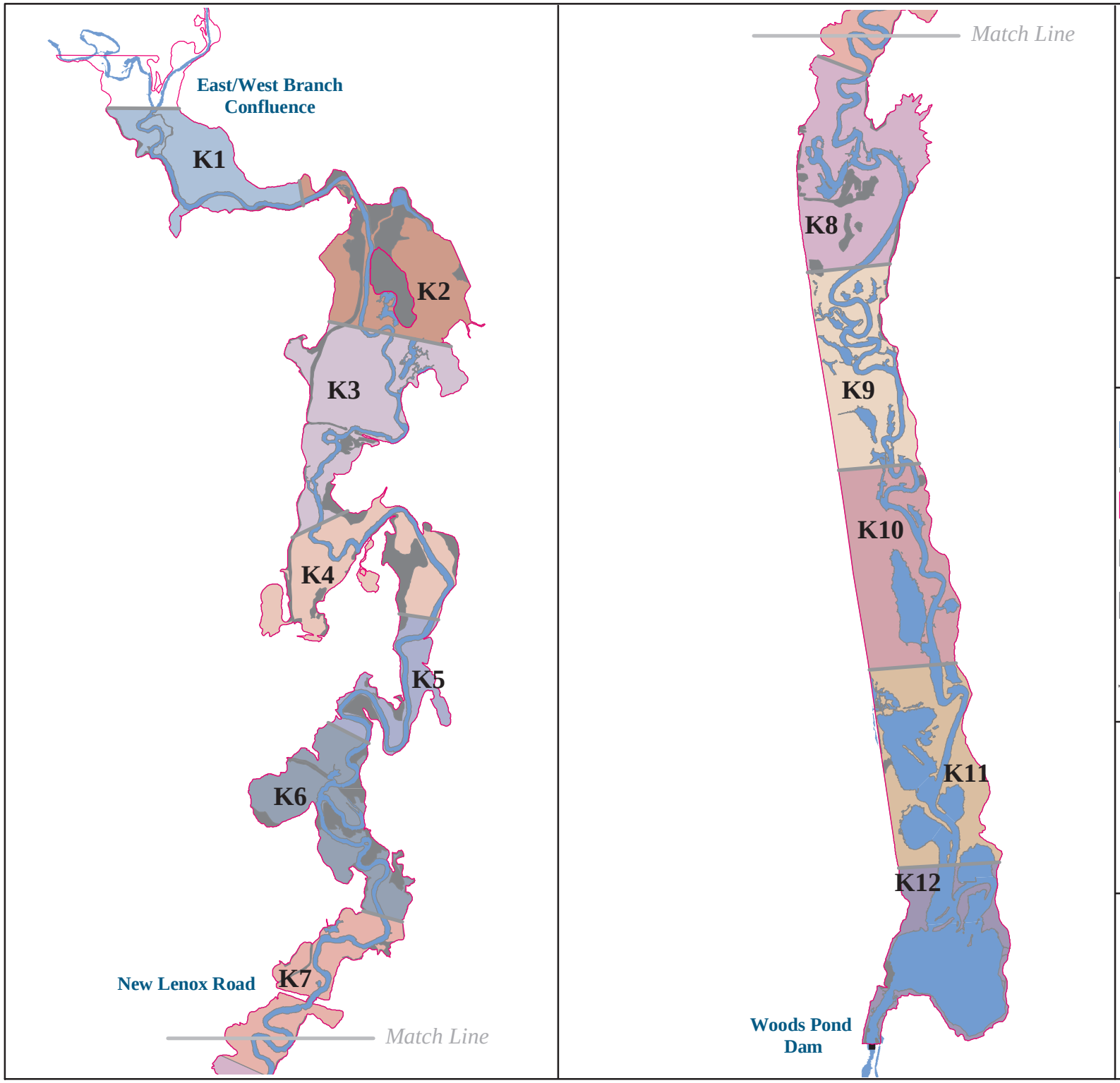

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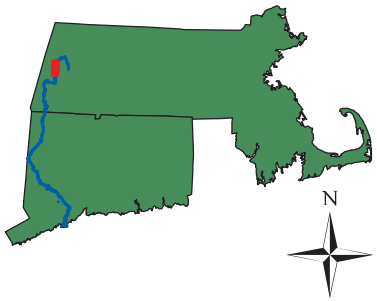

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Wood Duck Averaging Areas*
- Unsuitable Wood Duck Habitat

** Wood duck averaging areas were developed and provided by ENVIRON. Separate averaging areas are shown as different colors, and labels (e.g., K11) represent averaging area IDs.*

Figure 4-7.
Averaging areas used for the insectivorous bird (wood duck) assessment in Reaches 5 & 6.

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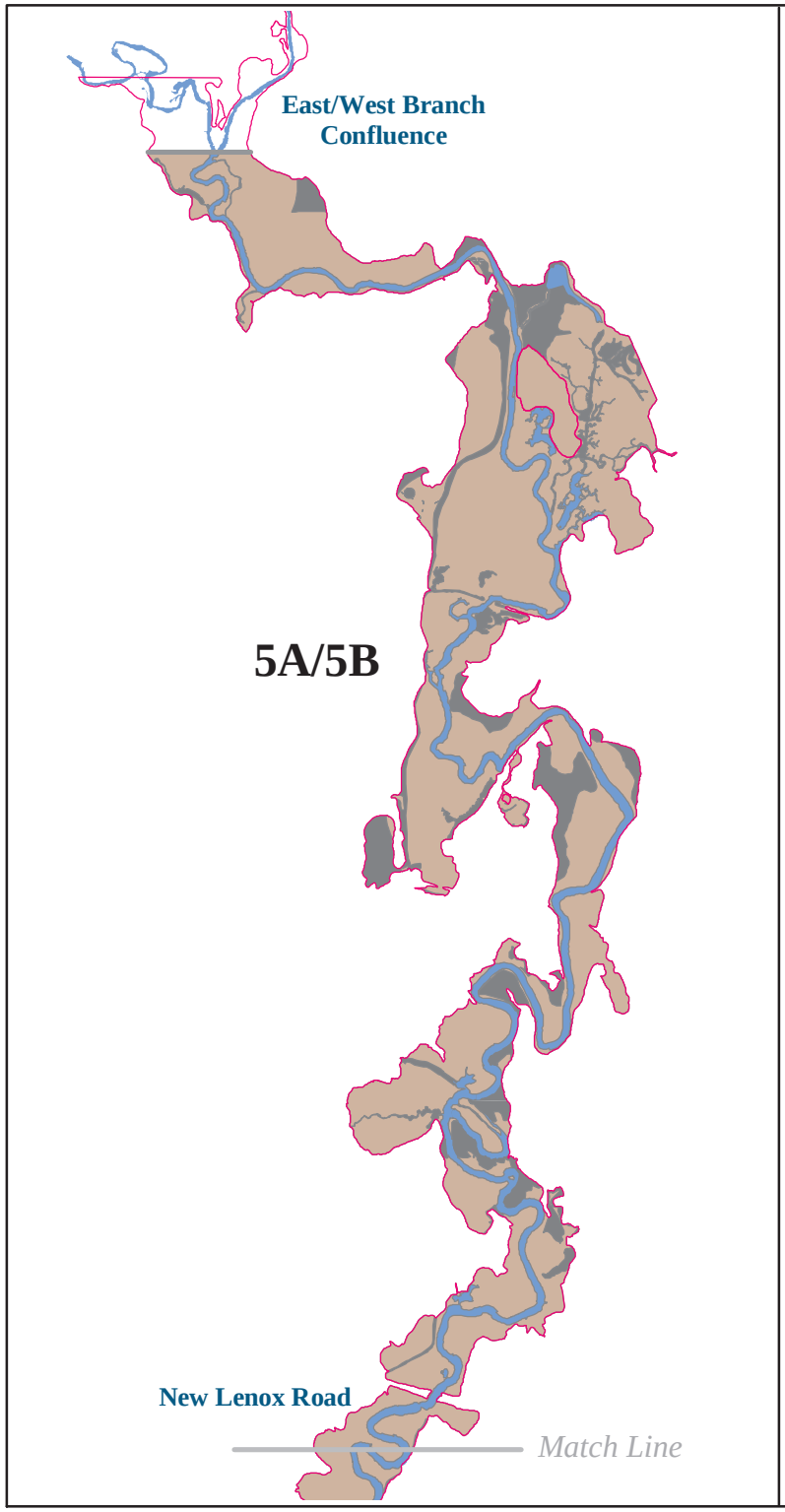

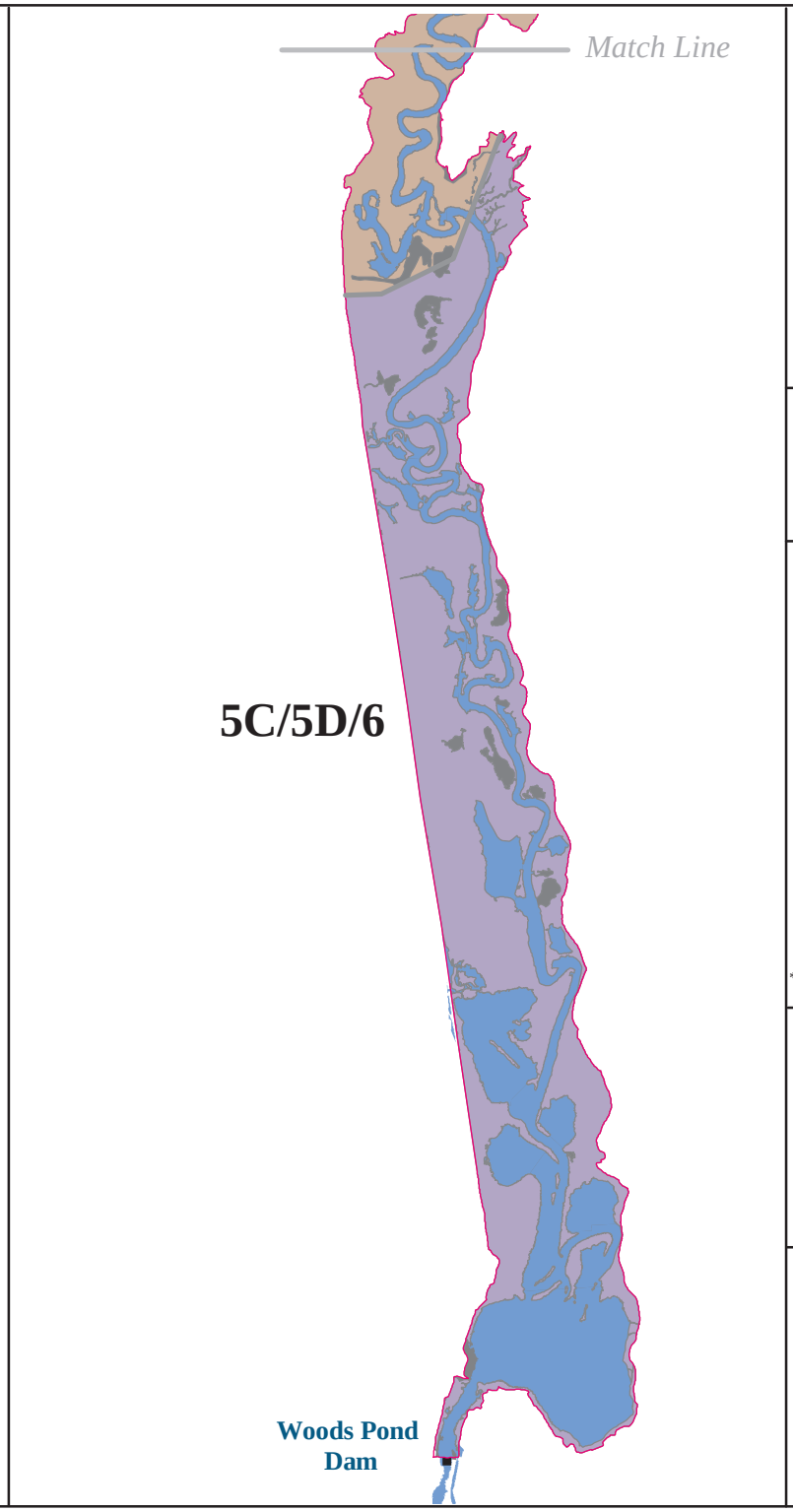

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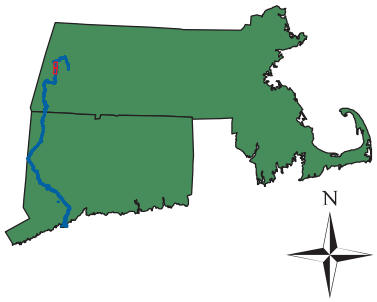

SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth
- Mink Averaging Areas*
- Unsuitable Mink Habitat

** Separate mink averaging areas are shown as different colors, and labels (e.g., 5A/5B) represent averaging area IDs.*

Figure 4-8.
Averaging areas used for the piscivorous mammal (mink) assessment in Reaches 5 & 6.

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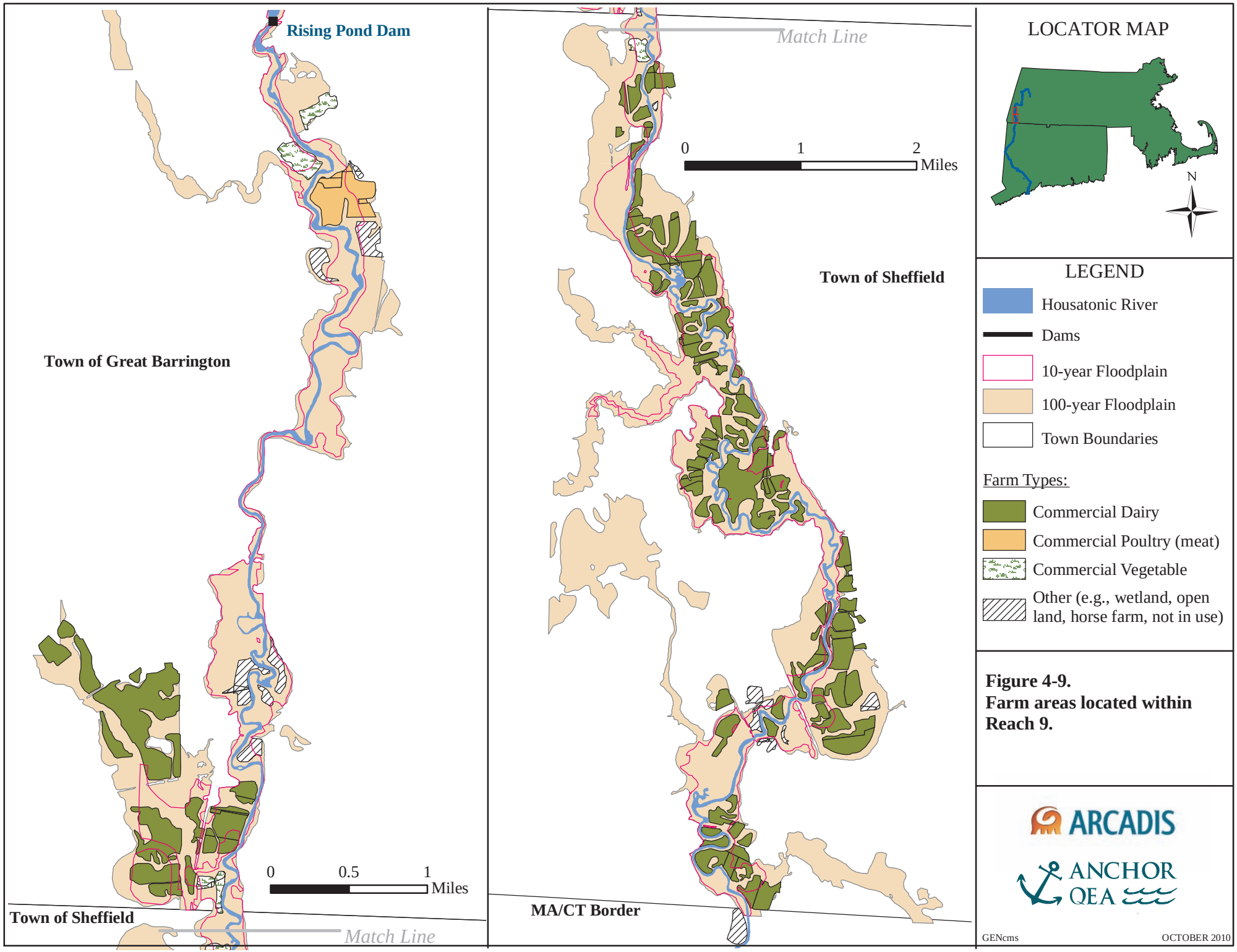

Figure 4-9.
Farm areas located within Reach 9.

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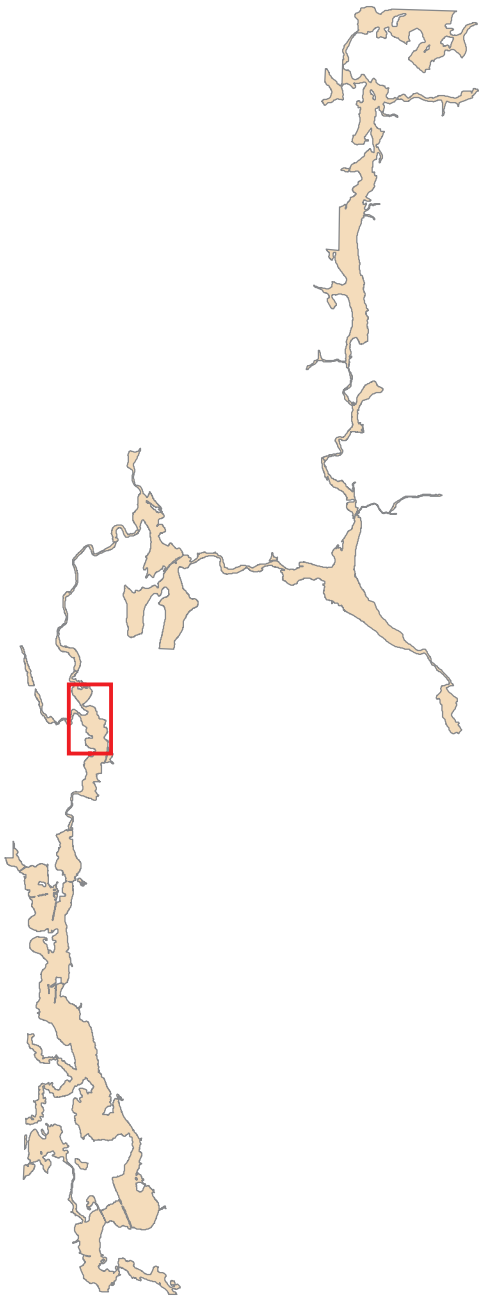
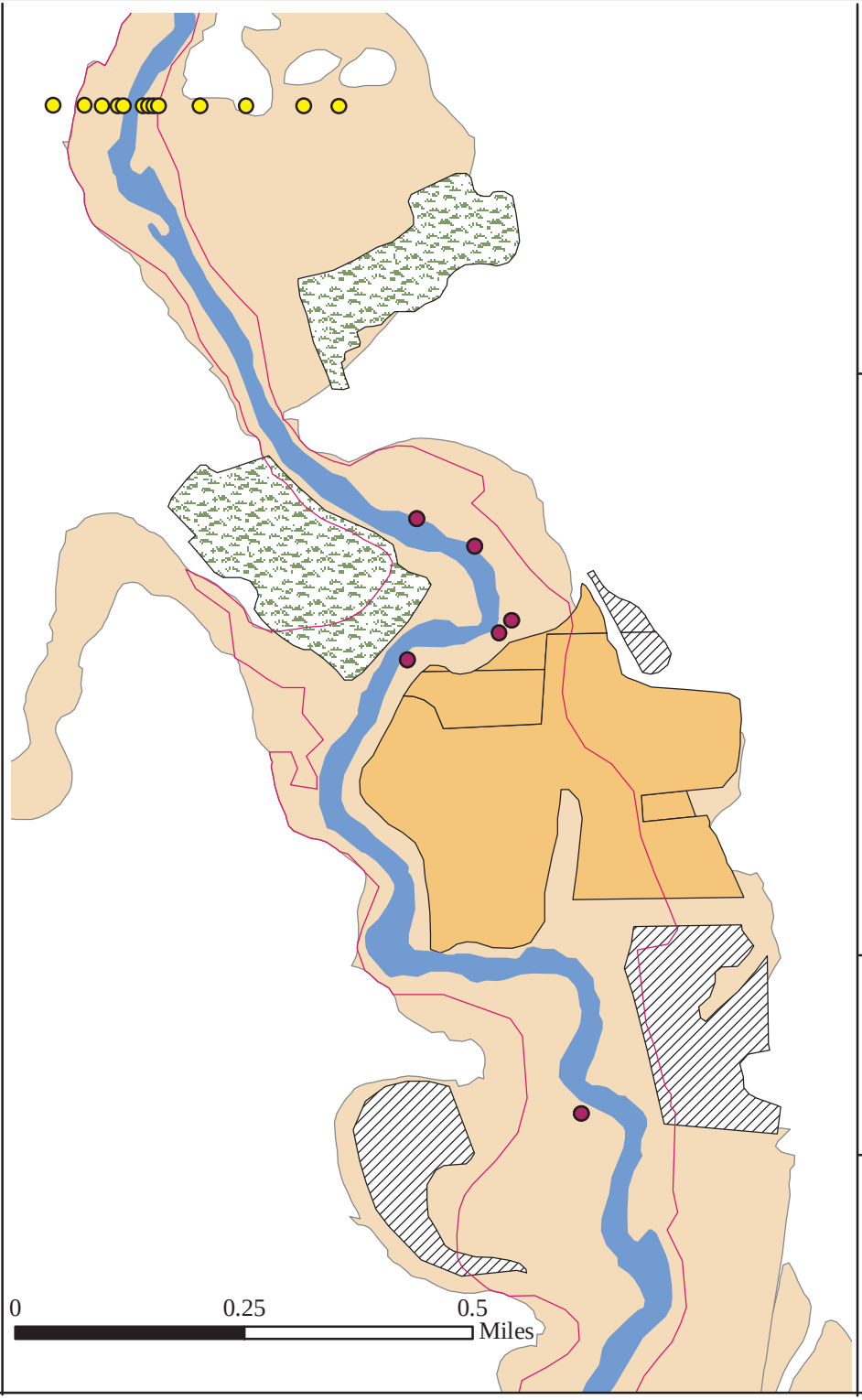
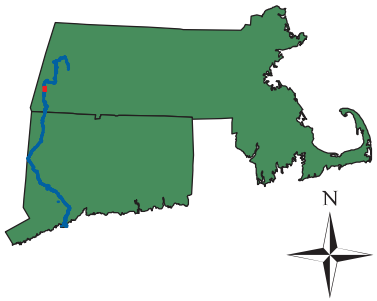
LOCATOR MAP FOR COMMERCIAL POULTRY FARM WITHIN REACH 9





LOCATOR MAP



LEGEND

- Housatonic River
- 10-yr Floodplain
- 100-yr Floodplain
- GE Floodplain Sample
- EPA Floodplain or Bank Soil Sample

Farm Types:

- Commercial Poultry (meat)
- Commercial Vegetable
- Other (e.g., wetland, open land, horse farm, not in use)

Figure 4-10.
Map of single commercial poultry (meat) farm within Reach 9.

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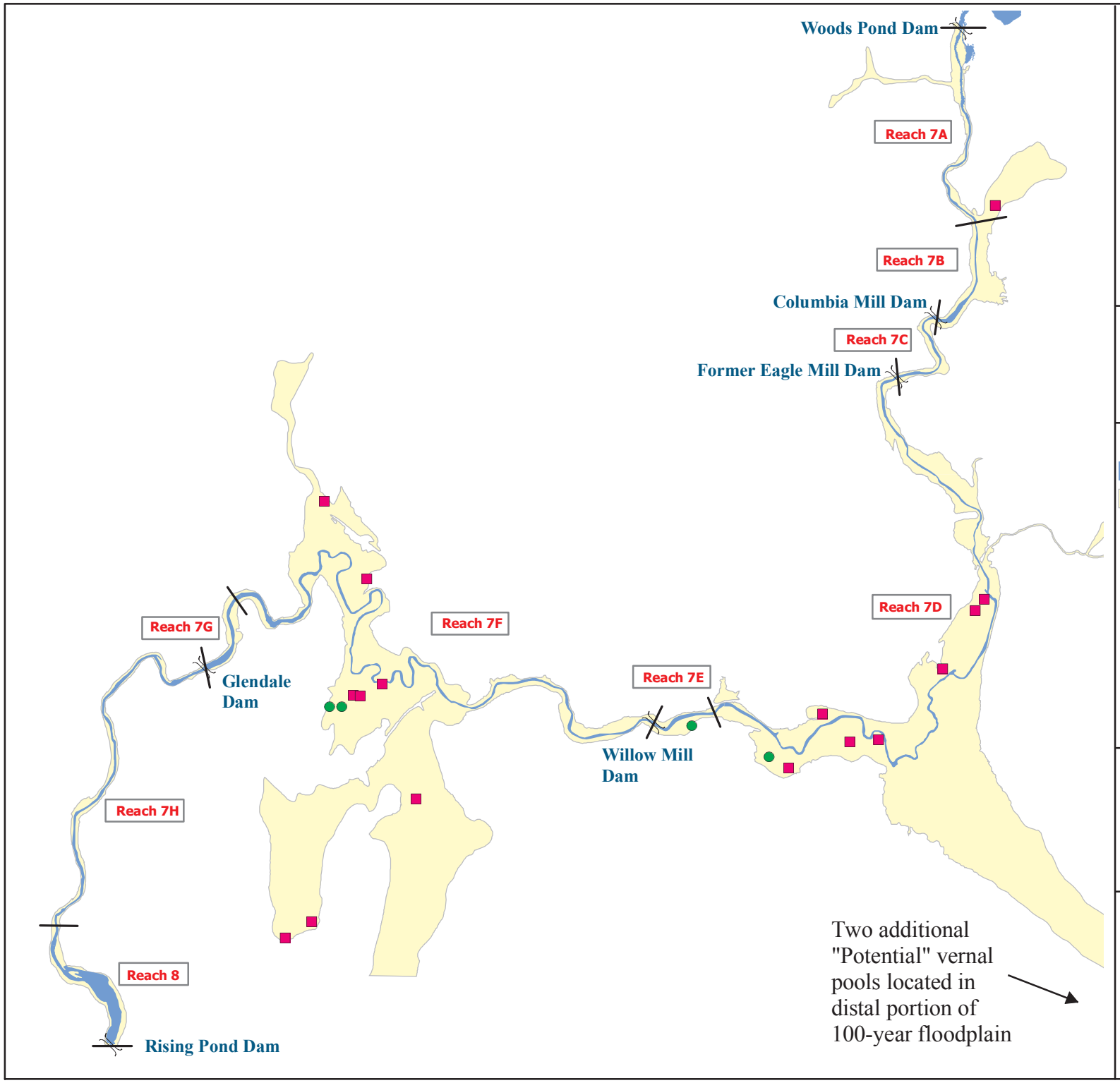
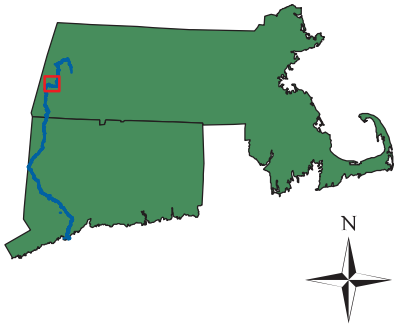


LOCATOR MAP



SCALE

0 0.5 1 Miles

LEGEND

- Housatonic River
- 100-year Floodplain
- Dams
- NHESP* Certified Vernal Pool (January 2010)
- NHESP* Potential Vernal Pool (December 2000) [not equivalent to certified vernal pools]

*Massachusetts Natural Heritage & Endangered Species Program

Figure 4-11. "Certified" and "potential" vernal pool locations within Reaches 7 & 8.

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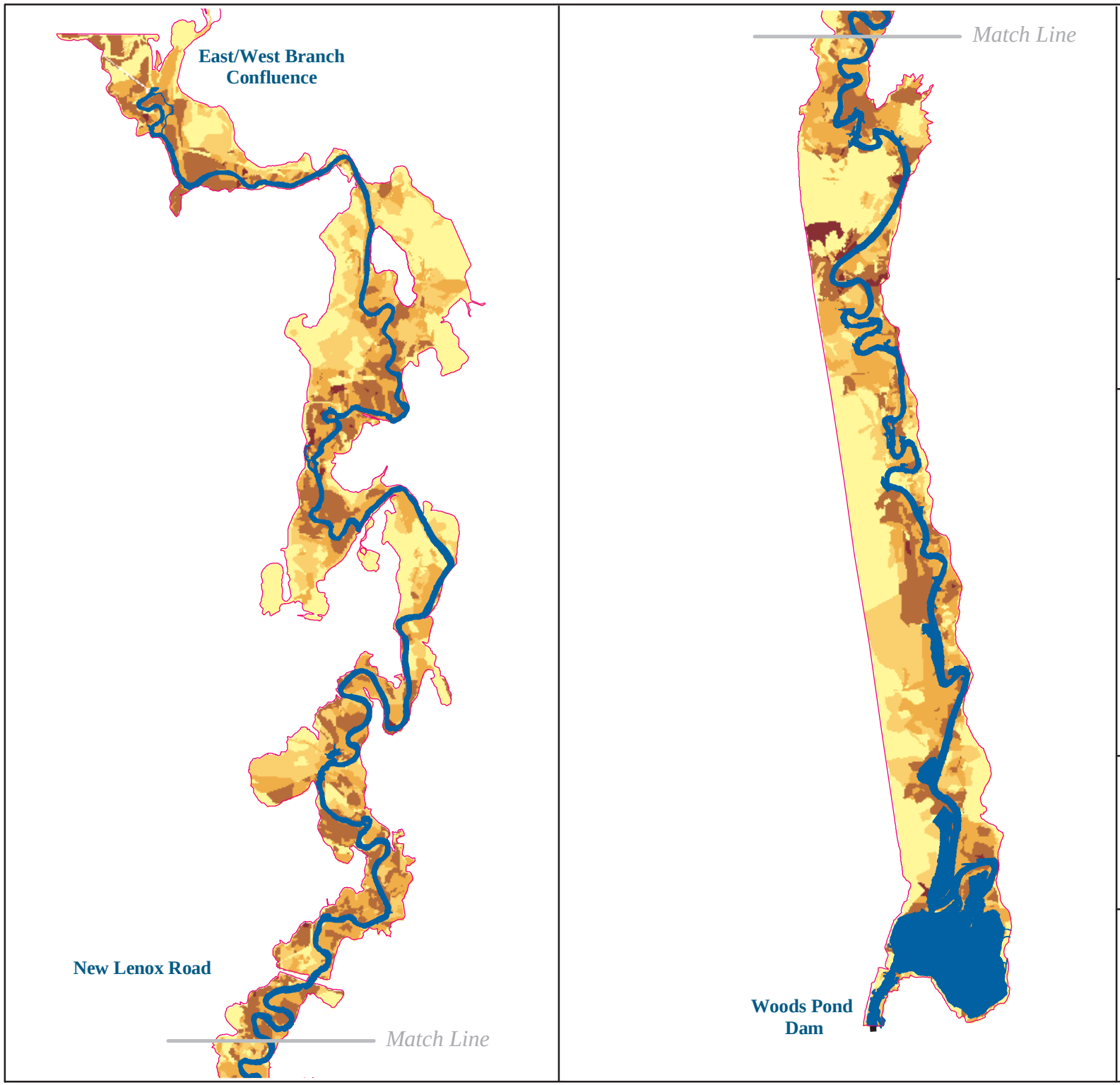
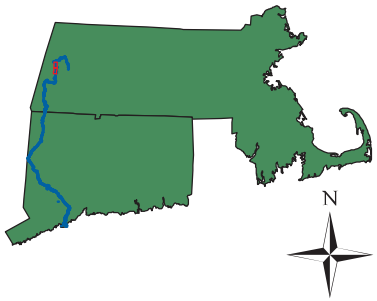


LOCATOR MAP



SCALE

0 0.25 0.5 Miles

LEGEND

- Housatonic River
- Dams
- 1 mg/kg PCB Isopleth

0-12" PCBs (mg/kg)

- 0 - 3
- 3 - 10
- 10 - 30
- 30 - 100
- > 100

Figure 4-12a.
Map of 0-12" Theissen Polygon PCB concentrations in Reaches 5 & 6.

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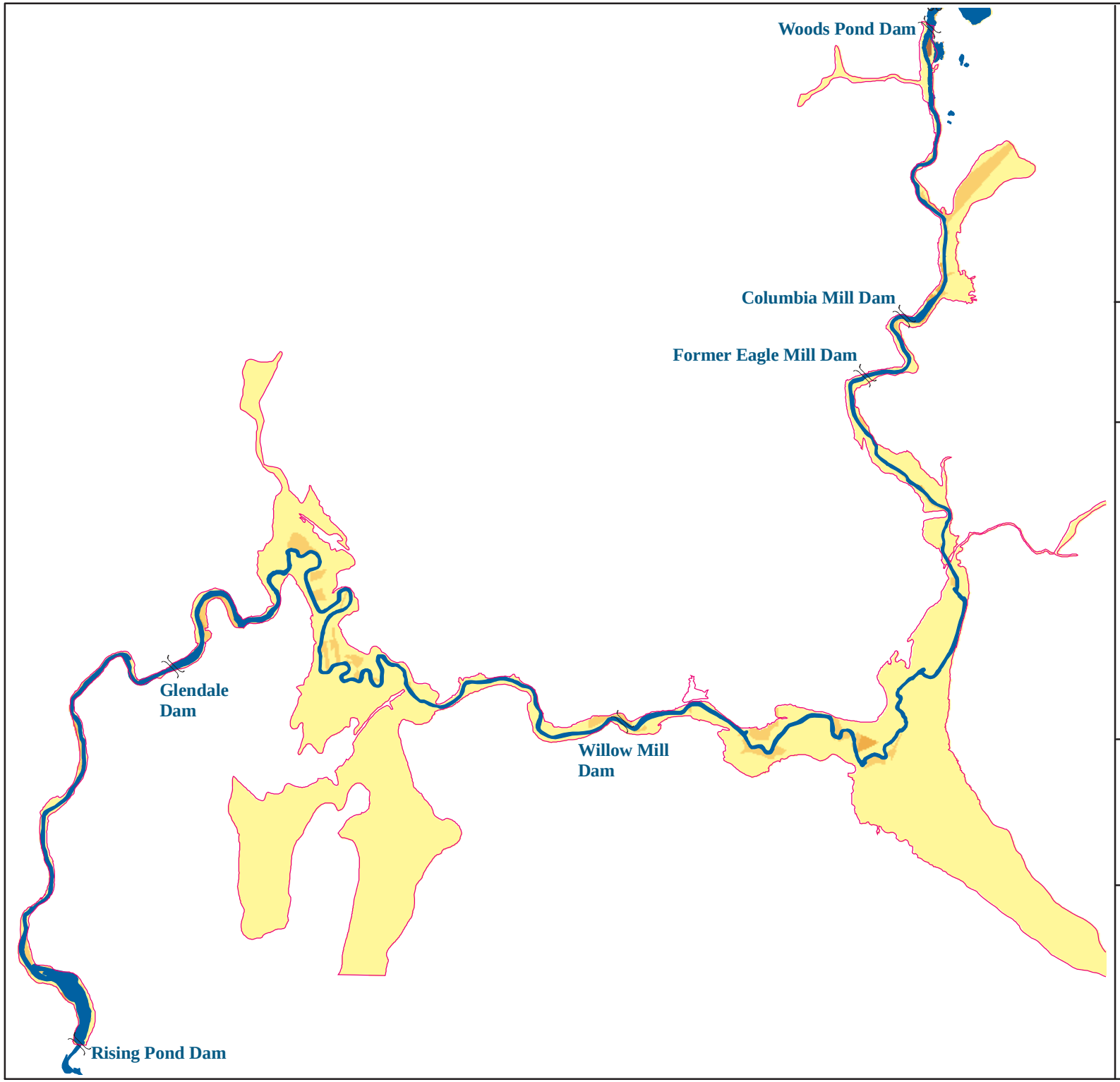
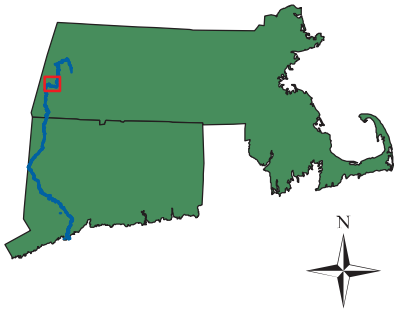


LOCATOR MAP



SCALE

0 0.75 1.5 Miles

LEGEND

- Housatonic River
- Dams
- 100-year Floodplain

0-12" PCBs (mg/kg)

- 0 - 3
- 3 - 10
- 10 - 30
- 30 - 100
- > 100

Figure 4-12b.
Map of 0-12" Theissen polygon PCB concentrations in Reaches 7 & 8.

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