

Priority Riparian Areas in the Upper Connecticut River Mitigation and Enhancement Fund (MEF) Service Area

Appalachian Mountain Club

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Goals and Purpose

The goal of this Report is to identify priority riparian areas within the larger Mitigation and Enhancement Fund (MEF) service area at an ecologically and landscape-relevant scale. The eight MEF Priority Riparian Areas recommended in this report were derived by overlaying existing data and reports where critical resources already were identified by a) state and federal agencies, b) other recognized watershed-scale natural-resource plans, and c) individual community plans. This report revises the priority areas identified in the first and second versions of this project dated April 30, 2011 and August 12, 2013 by incorporating completed conservation projects and updated and new databases since these reports.

The intent of the Priority Riparian Areas is to prioritize and catalyze comprehensive, multi-resource grant applications to the MEF that involve protection of areas with high concentrations of documented important riverine, wetland, and shoreland resources. Organizations working within the Priority Riparian Areas are encouraged to identify medium to large-scale, on-the-ground projects (not additional studies) that have a strong nexus with one or more of the three MEF resource categories: (i) river restoration, (ii) wetland restoration, protection and enhancement, and (iii) shoreland protection. It is envisioned that project proposals developed within the Priority Riparian Areas would provide watershed-level benefits and may require significant funds for implementation (possibly as much as \$1 million for large, complex, multi-resource projects). Additional funding to protect meander widths will also be considered.

The conclusions in this report are based solely on available natural-resource information. It is recognized that some portions of the Priority Riparian Areas might not yield feasible projects or proposals due to lack of landowner interest or other constraints.

The published criteria for the geographic boundary and relative importance of a project proposal to the MEF are based on the terms of the Fifteen Mile Falls (FMF) Settlement Agreement. The MEF Advisory Committee places special emphasis on and gives funding priority to major project proposals within the eight identified *Priority Riparian Areas* described in this report. This does not preclude smaller proposals relevant to the MEF purpose, are within the broader MEF geographic area of interest, or proposals that bring forth information on high value priority resources that was not available or overlooked by the authors of this report.

Studies Reviewed

Relevant, publicly vetted resource management plans that functioned at the watershed-level scale reviewed in this analysis included, but were not limited to, the following:

- 2015 New Hampshire (NH) State Wildlife Action Plan
- 2005 Vermont (VT) State Wildlife Action Plan
- Draft Silvio O. Conte National Fish and Wildlife Refuge Comprehensive Conservation Plan and Environmental Impact Statement (August 2015)
 - Silvio O. Conte National Fish and Wildlife Refuge - Proposed Focus Areas
 - Silvio O. Conte National Fish and Wildlife Refuge - Vision, Goals, and Objectives
- Upper Connecticut River Important Bird Areas (NH Audubon and VT Audubon)

- Connect the Connecticut 2014
- The Nature Conservancy (TNC), Trust for Public Land (TPL), and other relevant organizations' upper Connecticut River natural resource focal areas at the watershed level scale
 - Fragmentation Analysis in Connecticut River Watershed 2008
 - The Connecticut River Watershed: Conserving the Heart of New England 2006
 - Freshwater Mussels and the Connecticut River Watershed 2008
 - Staying Connected in the Northern Appalachians 2013
- River Management Plans for the upper Connecticut River and relevant tributaries
 - Connecticut River Management Plan 2008
 - White River Basin Plan A Water Quality Management Plan
 - Basin 14 "Little Rivers" Water Quality Management Plan Covering the Stevens, Wells, Waits, and Ompompanoosuc River Watersheds
- State and Federal fish restoration plans
 - Connecticut River Joint Commission Plans
 - Northern River Assessment Project - Causes & Management of Bank Erosion on the Upper Connecticut River 2005
 - Where the Great River Rises - Atlas of the Upper Connecticut River Watershed 2009
 - Vermont Biodiversity Project 2002
 - VT Agency of Natural Resources
 - The Vermont Culvert Aquatic Organism Passage Screening Tool - March 2009
 - River Basin Plans
 - Basin 15 Passumpsic Basin – 6/2014
<http://dec.vermont.gov/watershed/map/basin-planning/basin15>
 - Basin 16 upper CT River Basin – 6/2014
<http://dec.vermont.gov/watershed/map/basin-planning/basin16>
- Northeast Association of Fish and Wildlife Agencies
 - Sub-watersheds Best for Protection/Enhancement/Restoration maps for both VT and NH for Eastern Brook Trout 2008
 - Secured Lands of the Northeast 2007
- Additional Communications with:
 - Julie Zimmerman – TNC Connecticut River Program
 - Katie Callahan – NH Wildlife Action Plan
 - David Sagan – Silvio O. Conte National Fish and Wildlife Refuge
 - Rick Hopkins – State of Vermont
 - James Steele – North Country Council
 - John Field – consultant and author of several geomorphic studies
 - Susi Von Oettingen – US Fish and Wildlife Service (USFWS)
 - Mark Zankel – NH TNC
 - Peter Steckler – NH TNC
 - Ken Sprankle - Connecticut River Coordinator, U. S. Fish and Wildlife Service

Approach and Methods

Key Assumptions:

- Because the impacts of the Fifteen Mile Falls hydroelectric project are related more to larger-order stream and river-reach ecosystems and for appropriate nexus to these impacts, prioritization focused on 1st and 2nd order streams that flow directly into the Connecticut River and all 3rd order

or higher river and stream reaches¹ and their related aquatic/riparian resources. The river and stream networks used for all analyses are based on the USGS National Hydrography Dataset 1:24,000 (2016).

- The riparian zone was buffered at ¼ mile (1,320 feet) on each side of the previously selected river segments (the river corridor width used for designated rivers in NH) and a reasonable ecological scale for a riparian river corridor.
- Only the higher ranked habitat areas were utilized. This was done to focus the analysis on those known areas of greatest ecological importance. The North Atlantic LCC - 2014 - Ecological Systems Map was used for both NH and VT. However, the 2015 NH Wildlife Action Plan (NH WAP), 2016 VT Nongame Natural Heritage Program (VT NNHP), VT Agency of Natural Resources (VTANR), TNC, Biofinder² and MEF funded projects data were also incorporated into this analysis. To select the highest ranked habitat in NH the NH WAP Tier 1 and Tier 2 areas were used. In VT the Biofinder Tiered Contribution to Biodiversity, Tiers 1, 2 and 3 were utilized.
- Bank erosion can occur due to natural river meandering, therefore all identified bank stability locations are not necessarily bad and at times are beneficial to river ecosystems. Bank stability data was available for the main stem of the Connecticut River, and several of its major tributaries. However, these data sets—in their current form—made it difficult to differentiate the problematic erosion areas (that were the result of man-made changes and are detrimental to river values) from those erosion areas resulting from natural river-meandering processes.
- Improved science has resulted in some changes to stream order identification since the last report and where feasible has been incorporated into this analysis.

Step 1 - Study Units for Selecting Projects

The MEF service area encompasses the upper Connecticut River watershed in northeastern Vermont and northwestern New Hampshire, extending from the Canadian border to the confluence of the White River and the Connecticut River (including the entire White River watershed).

Study unit sub-watersheds were selected from the hydrologic unit boundary layer at the sub-watershed (12-digit) 6th level developed by the U.S. Geological Survey (2016). The study area is approximately 4,092 square miles (2,619,116 acres) in size. There are 108 sub-watersheds ranging from 7,843 acres to 40,883 acres. The river and streams from the National Hydrography Dataset NHD (1:24,000 scale) were ordered using the Strahler method³. There are 9,055 miles of 1st order and above streams which contain 2,142 miles of 3rd order and above streams within the sub-watersheds. The attached table and corresponding map (Appendix A: Table 1, page 18 and Map 1, page 22) contain the sub-watershed

¹ Based on the discussion at the September 30, 2009 meeting with MEF committee members, 1st and 2nd order streams that flow directly into the Connecticut were included with 3rd order and above streams in this revised analysis.

² BioFinder was created by the Vermont Agency of Natural Resources with help of its partners. BioFinder is 21 components contributing to biological diversity which represent, at various scales and aspects, terrestrial and aquatic biological, ecological, and natural heritage for more information go to <http://biofinder.vermont.gov/index.htm>.

³ Stream order is determined by the Strahler method. This method of stream order increases when streams of the same order intersect. The intersection of two links of different orders will not increase in order - <http://webhelp.esri.com/arcgisdesktop/9.1/body.cfm?tocVisible=1&ID=3005&TopicName=Identifying%20stream%20net%20works>. VT rivers and streams data were extracted from the 2016 USGS National Hydrography dataset (1:24,000) which included stream order. This data was ordered using the Strahler method. All streams are included in the ordering. VT data does not distinguish between perennial and intermittent streams. Therefore both stream types are used in the ordering. NH rivers and streams were extracted from the 2016 USGS National Hydrography Dataset (1:24,000) which did not include stream order. Stream order was determined using the Strahler method for all streams including both perennial and intermittent streams. NH dataset did include classification of intermittent streams. However, to remain consistent with the VT classification all streams were used in determining stream order.

name, area, miles of 1st order and above streams, and miles of 1st and 2nd order streams that flow directly into the Connecticut River and 3rd order and above streams.

Each of the 108 sub-watersheds were quantitatively evaluated as to the extent to which they contained identified resources related to the three MEF funding categories – River Restoration, Wetland Protection & Restoration, and Shoreland Protection - and had been prioritized in vetted natural resource plans. The specific procedures used to assess each resource are described in the next section.

Step 2 - Resources

The assessment procedures and results for each of the 108 sub-watersheds for each resource follow:

River Restoration (In-stream Resources)⁴: All maps and charts refer to Appendix B (page 23 – 29).

1. *Special Concern, Threatened, and Endangered Animal Species*⁵

a. Federal Listed Species

- i. Number of miles of 1st and 2nd order streams that flow directly into the Connecticut River and 3rd order and above streams within each sub-watershed that contain the following river animals:

1. Dwarf Wedge mussel⁶

b. State Listed Species

- i. Presence (breeding site) within the sub-watershed of the following river animals:

1. Bald Eagle⁷

c. State Special Concern Species

- i. Presence within the sub-watershed of the following river animals:

1. Finescale Dace
2. Northern Redbelly Dace
3. Osprey
4. Wood Turtles
5. Northern Leopard Frogs
6. Round Whitefish

2. *Aquatic Areas*

- a. River and Stream (Lotic) Cores – (2010 – University of Massachusetts - Connect the Connecticut project) – number of miles of 1st and 2nd order streams that flow directly into the Connecticut River and 3rd order and above streams within each sub-watershed that contain aquatic areas.

- i. These areas were identified as having relatively high ecological integrity, high current habitat values for brook trout, and habitat for anadromous fish.

3. *River/Stream Connectivity Impediments*⁸

⁴ Bank stability information concerning erosion was collected along the main stem of the upper Connecticut River, Mohawk River, and Upper Ammonoosuc River. The available GIS data was reviewed but not included in this analysis based on recommendations of MEF Advisory committee.

⁵ Special Concern Species, Threatened, and Endangered Animal Species information was provided by NH Natural Heritage Bureau (2016), NH Fish and Game (2016), and VT Fish & Wildlife Dept. (2016).

⁶ Dwarf wedge mussel location information is represented as linear macrosites based on Ethan Nedeau's 2009 publication *Distribution, Threats, and Conservation of the Dwarf Wedge mussel (Alasmidonta heterodon) in the Middle and Northern Macrosites of the Upper Connecticut River* and is represented separately from the Special Concern Species. This information has not changed since 2013 based on correspondence with Ethan Nedeau.

⁷ The Bald Eagle is listed in NH as Threatened and in VT as Endangered. It has been removed from the federal listing.

- a. Dams, culverts, and water falls data were used to understand potential impediments to river connectivity. This information was used for display purposes only.
 - b. Dam information used for VT and NH was provided by the VT Agency of Natural Resources Fresh Water Resources and Characteristics (2015) and New Hampshire Department of Environmental Services (2015).
 - c. The following criteria were used to prioritize dams. The dams excluded were assumed to not significantly affect the passage of organisms along a river or stream channel relative to the focus of this fund, i.e.
 - i. Dams ≥ 100 ft from all 3rd order and higher river/stream reaches, and on all 1st and 2nd order streams that flow directly into the Connecticut River.
 - ii. Dams determined as not affecting the passage of aquatic organisms⁹.
4. *Wild or Wild and Hatchery Eastern Brook Trout*¹⁰
- a. Presences of either wild or wild and hatchery Eastern Brook Trout (EBT) within the sub-watershed.
 - i. For EBT all of the sub-watersheds have either wild or wild and hatchery EBT populations. Since there is universal presence of EBT populations in all sub-watersheds, the EBT presence information provided a limited functional breakout value of sub-watersheds. EBT habitat information was not available.
 - ii. The information provided by the fisheries biologists determined that the main stems of the 3rd order and above streams typically do not host wild EBT populations.

Wetlands (Riparian Resources): All maps and charts refer to Appendix C (page 30 – 38).

1. *Riparian Habitat Buffer*

- a. National Hydrography Dataset - 1:24,000 scale.
- b. First and second order streams that flow directly into the Connecticut River and third order and above rivers and streams with a 0.25 mile (1,320 feet) buffer.
- c. This riparian habitat buffer was also used with the shoreland protection resources.

2. *Wetlands/Floodplain/Marsh/Peatland/Vernal Pools*

- a. The highest ranked habitat of the following categories were determined via the intersection with
 - i. NH - NH WAP Tier 1 and Tier 2 areas
 - ii. VT - Biofinder Tiered Contribution to Biodiversity, Tiers 1, 2 and 3
- b. Wetlands - number of acres within the riparian habitat within each sub-watershed.¹¹
- c. Floodplain - number of acres within the riparian habitat within each sub-watershed.¹²
- d. Marsh/Shrub Lands - number of acres within the riparian habitat within each sub-watershed.¹³

⁸ Due to recent changes in NH and Vermont rules and legislation culverts are no longer prioritized by the FMF Committee.

⁹ Dam location and status were reviewed by fisheries biologists, Dianne Timmins, Len Gerardi and Rich Kirn. Dams included in the analysis were approved by the biologist. If the biologist was unsure of the dam status, the dam was included.

¹⁰ Eastern Brook Trout population survey sites were provided by the NH Fish & Game (2015) and VT Fish & Wildlife (2016).

¹¹ Wetland data was provided by North Atlantic LCC (2014), VT NNHP (2016), NH WAP (2015), VT ANR (2016), VT Biofinder study, West Fairlee Conservation Commission inventory project and the Town of Thetford Conservation Commission inventory project. West Fairlee Conservation Commission and the Town of Thetford Conservation Commission inventory projects received funding from MEF.

¹² Floodplain data was provided by TNC (2012) data and by the Essex County Natural Resources Conservation District (EC NRCD) inventory project which were funded by MEF, as well as NH WAP (2015).

- e. Peatland - number of acres within the riparian habitat within each sub-watershed.¹⁴
- f. Vernal Pools - number of pools within the riparian habitat within each sub-watershed.¹⁵
 - i. Pools were field verified.
- g. Vernal Pools Potential – number of pools within the riparian habitat within each sub-watershed.¹⁶
 - i. Pools were identified using aerial photography. They are not field verified. Only pools with a location confidence of high and medium-high were used.

3. Protected Lands

- a. Protected lands data (2016) from state and land trust GIS databases were used in prioritizing wetlands.

Shoreland Protection (Riparian Resources): All maps and charts refer to Appendix D (page 39 - 44).

1. Important Natural Areas

- a. VT Ecological Hotspots (Vermont Biodiversity Project) - number of acres within the riparian habitat within each sub-watershed.
 - i. These hotspots represent areas of high biological significance or diversity. The Vermont Biodiversity Project sought to identify a network of areas of high biodiversity value that deserve conservation attention.
- b. Quabbin-to-Cardigan Focus Area – (NH F&G) – number of acres within the riparian habitat within each sub-watershed.
 - i. Area recommended by NH Fish and Game (NH F&G).
- c. Important Bird Areas (Audubon) - number of acres within the riparian habitat within each sub-watershed.
 - i. Areas included Pondicherry Basin and Connecticut Lakes Headwater.
- d. Forested Riparian Buffer¹⁷ – number of miles of river banks of 1st and 2nd order streams that flow directly into the Connecticut River and 3rd order and above streams within each sub-watershed that contain forested riparian buffers.
 - i. Forested riparian buffers are >15m (50ft) width of trees and shrubs.
 - ii. Data does not cover the entire MEF service area.¹⁸
- e. Meander Width (TNC)
 - i. Meander width data from TNC was used in prioritizing the potential area of restoration within the *Priority Areas*.
- f. Wildlife Connectivity Structural Pathways (TNC)

¹³ Freshwater Marsh data was provided by North Atlantic LCC (2014) and NH WAP (2015).

¹⁴ Peatland data was provided by North Atlantic LCC (2014) and NH WAP (2015).

¹⁵ Vernal pool information was provided by Watershed to Wildlife, West Fairlee Conservation Commission, Vermont Vernal Pool Mapping Project conducted by Vermont Center for Ecostudies and Arrowwood Environmental with funding from the VT Dept. of Fish and Wildlife, Redstart Natural Resource Management, and VT Biofinder. All projects except the VT Biofinder received funding from MEF.

¹⁶ Vernal pool potential information was provided by VTANR, Vermont Vernal Pool Mapping Project conducted by Vermont Center for Ecostudies and Arrowwood Environmental with funding from the VT Dept. of Fish and Wildlife and VT Biofinder. Vermont Center for Ecostudies inventory received funding from MEF.

¹⁷ Riparian buffer data provided by Dr. Fritz Gerhardt from the 2010 study, *Restoring Floodplained Forests along the Upper Connecticut River: Restoration Plans for the Smart and LeFoll Farms*. Prepared for the Essex County Natural Resources Conservation District by Beck Pond, LLC, fgerhardt@newarkvt.net. Funding was provided by MEF.

¹⁸ Riparian buffer data was not developed for the entire MEF service area due to financial and time constraints.

- i. Structural pathways were identified by TNC and their partners as areas for wildlife to move between the landscape-scale conservation areas in the Northeast Kingdom of VT to Northern NH. These pathways represent areas with sufficient connected habitat to support wildlife movement over the long-term.¹⁹
- ii. Eleven focal species including American marten, black bear, bobcat, Canada lynx, fisher, long-tailed weasel, mink, otter, porcupine, snowshoe hare and wood turtle were used to develop the pathways. Out of these species the wood turtle, mink and otter are highly dependent on riparian areas.

2. Protected Lands

- a. Protected lands data (2016) from state and land trust GIS databases were used in prioritizing shorelines.

Step 3 – Analyses

Working with multiple parameters that are not necessarily of equal weighting in 108 sub-watersheds was insightful, but still problematic. In order to make the review process more manageable, the data were collapsed into seven geographic zones (Appendix E: In-stream and Riparian Resources Maps, page 45 – 52). Eight MEF *Priority Areas* were identified refer to Map 1: Selected Priority Sub-watershed and *Priority Areas* Map page 8.

Results and Recommendations

The study area was divided into seven zones (Appendix F, page 45) for displaying the key natural resources and eight MEF *Priority Areas* (Map 1, page 8). These include:

- Zone 1 (Appendix F, page 46)
 - *Priority Area A* (page 9) - Lower main stem of Indian Stream and confluence with the Connecticut River
 - *Priority Area B* (page 10) – Main stem of the Connecticut River in the Mohawk River – Stewartstown Tributaries Reach
- Zone 2 (Appendix F, page 47)
 - *Priority Area C* (page 11) – Main stem of the Nulhegan River and the North and Black Branches
- Zone 3 (Appendix F, page 48)
 - *Priority Area D* (page 12) – Main stem of the Connecticut River in Lancaster-Northumberland Reach
 - *Priority Area E* (page 13) – Lower main stem of Nash Stream and confluence with the Upper Ammonoosuc River
- Zone 4 (Appendix F, page 49) – no identified MEF *Priority Areas* within this zone
- Zone 5 (Appendix F, page 50)
 - *Priority Area D* (page 12) - Main stem of the Connecticut River in Lancaster-Northumberland Reach
 - *Priority Area F* (page 14) - Lower main stem of the Johns River and confluence with the Connecticut River
 - *Priority Area G* (page 15) - Main stem of the Israel River

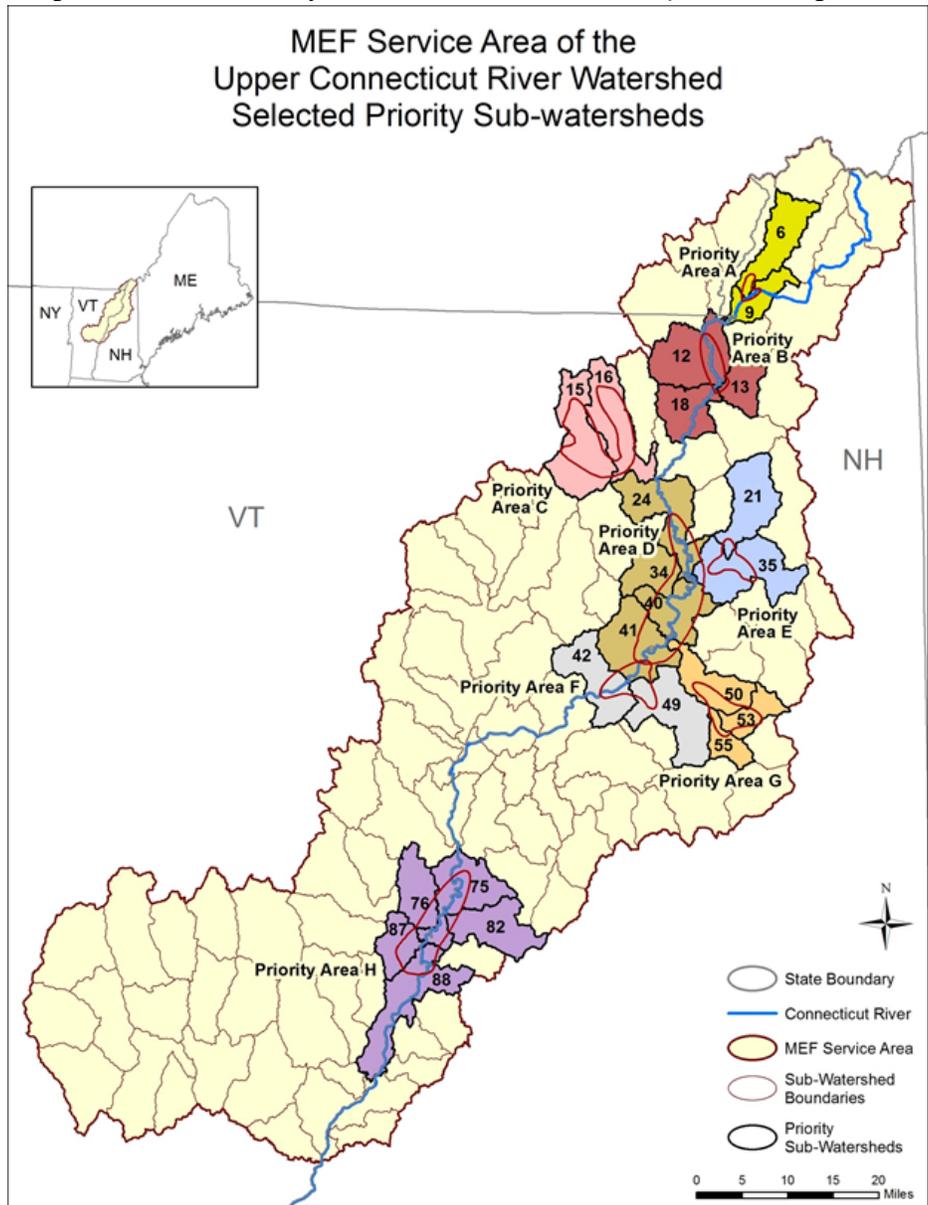
¹⁹ Steckler, P. & Bechtel, D., 2013. *Staying Connected in the Northern Appalachians, Northeast Kingdom to Northern New Hampshire Linkage: Implementation Plan to Maintain and Enhance Landscape Connectivity for Wildlife*. New Hampshire Chapter of The Nature Conservancy. Concord, NH.

- Zone 6 (Appendix F, page 51) – no identified MEF Priority Areas within this zone
- Zone 7 (Appendix F, page 52)
 - *Priority Area H* (page 16) – Main stem of the Connecticut River from Clark Brook to Eastman Brook

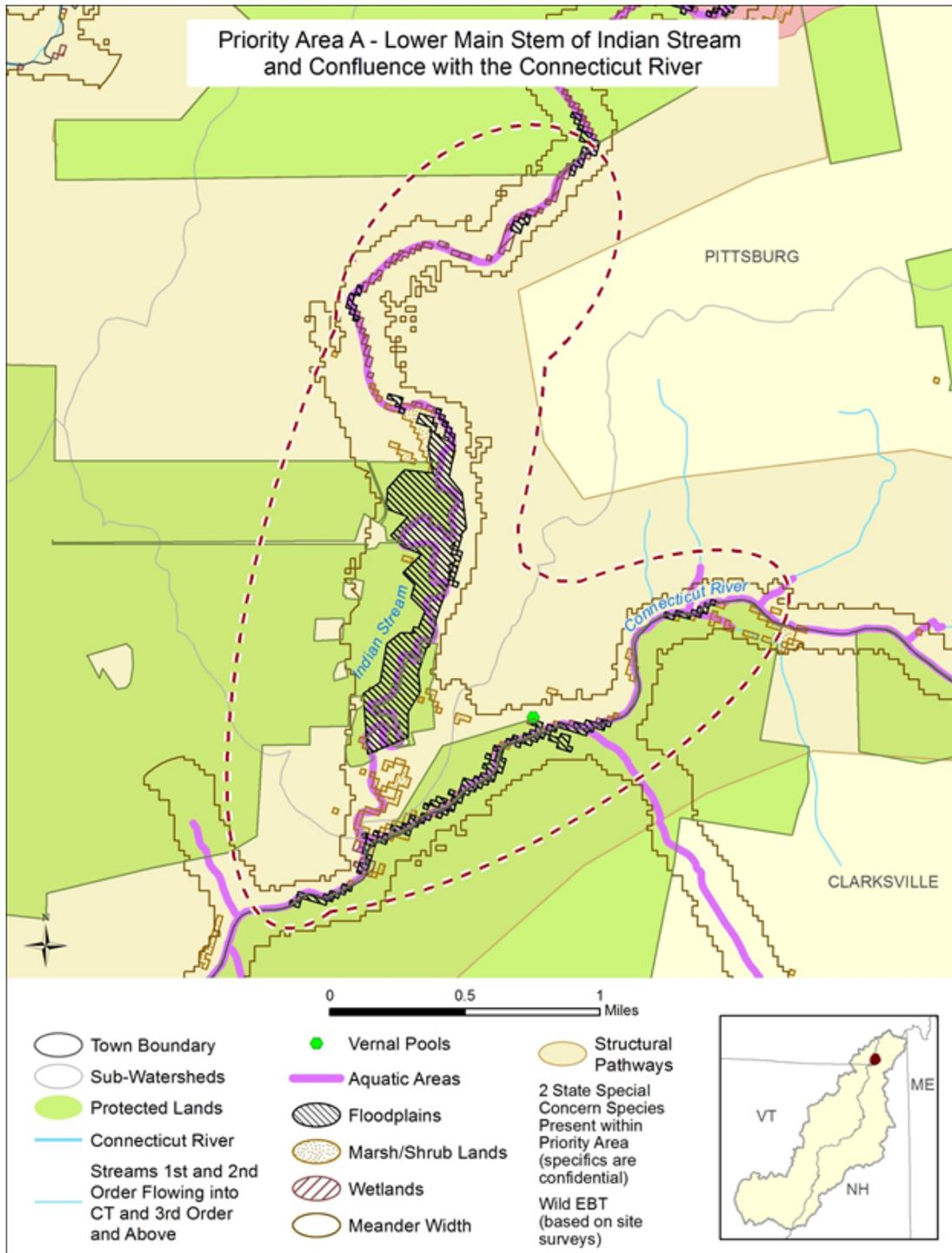
Each *Priority Area* contains a minimum of six in-stream/riparian resources. Three *Priority Areas* have the potential for connecting large blocks of protected land. Three *Priority Areas* contain the federal listed Dwarf Wedge Mussel.

Map 1 displays all eight priority areas in the MEF area. Following is an overview and map of each of the eight MEF *Priority Areas* and their underlying in-stream and riparian resources. The *Priority Areas* outline is a **general boundary line** used to identify multiple riparian/in-stream resources and connect protected lands that contains such resources. **Use the identified Priority Area boundaries as a guide, not a rigid boundary line** due to variability in the spatial resolution of some resource data. Emphasis is put on direct nexus with the river or stream and the qualifying aquatic and riparian related resources within this boundary.

Map 1: Selected Priority Sub-watershed and *Priority Areas* Map



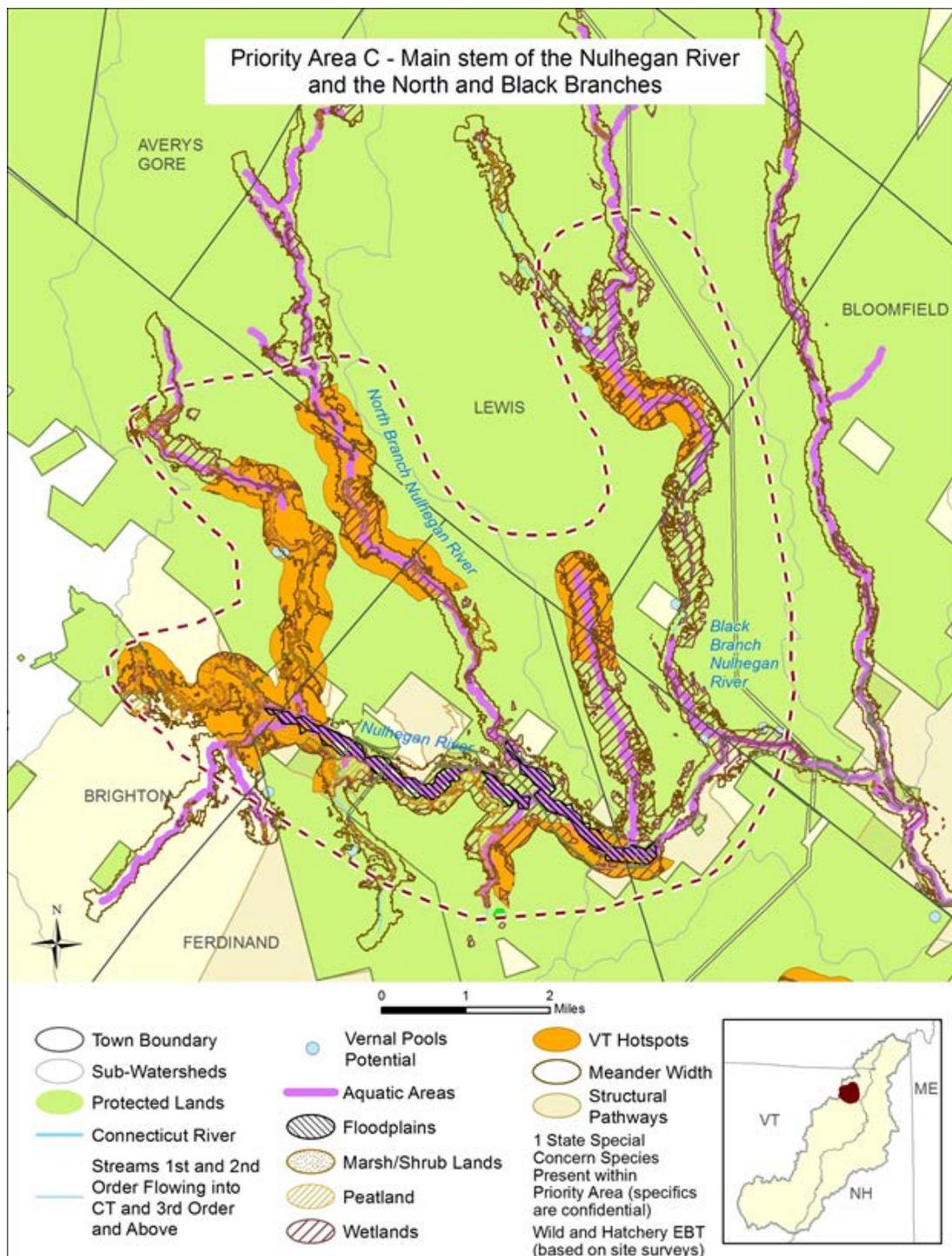
Priority Area A (dashed line) – Lower main stem of the Indian Stream and confluence with the Connecticut River. Identified In-stream and Riparian Resources include: *Aquatic Areas*, *Floodplains*, *Marsh/Shrub Lands*, *State Special Concern Species* (2 species), *Vernal Pools*, *Wetlands*, *Wild Eastern Brook Trout* (based on site surveys) and *Wildlife Connectivity Structural Pathways* (TNC). This area has the potential of connecting the protected lands in this region by creating a corridor between the Connecticut Lakes easement in the north with the protected lands in the southern section of this *Priority Area*, an added landscape-level ecological benefit.



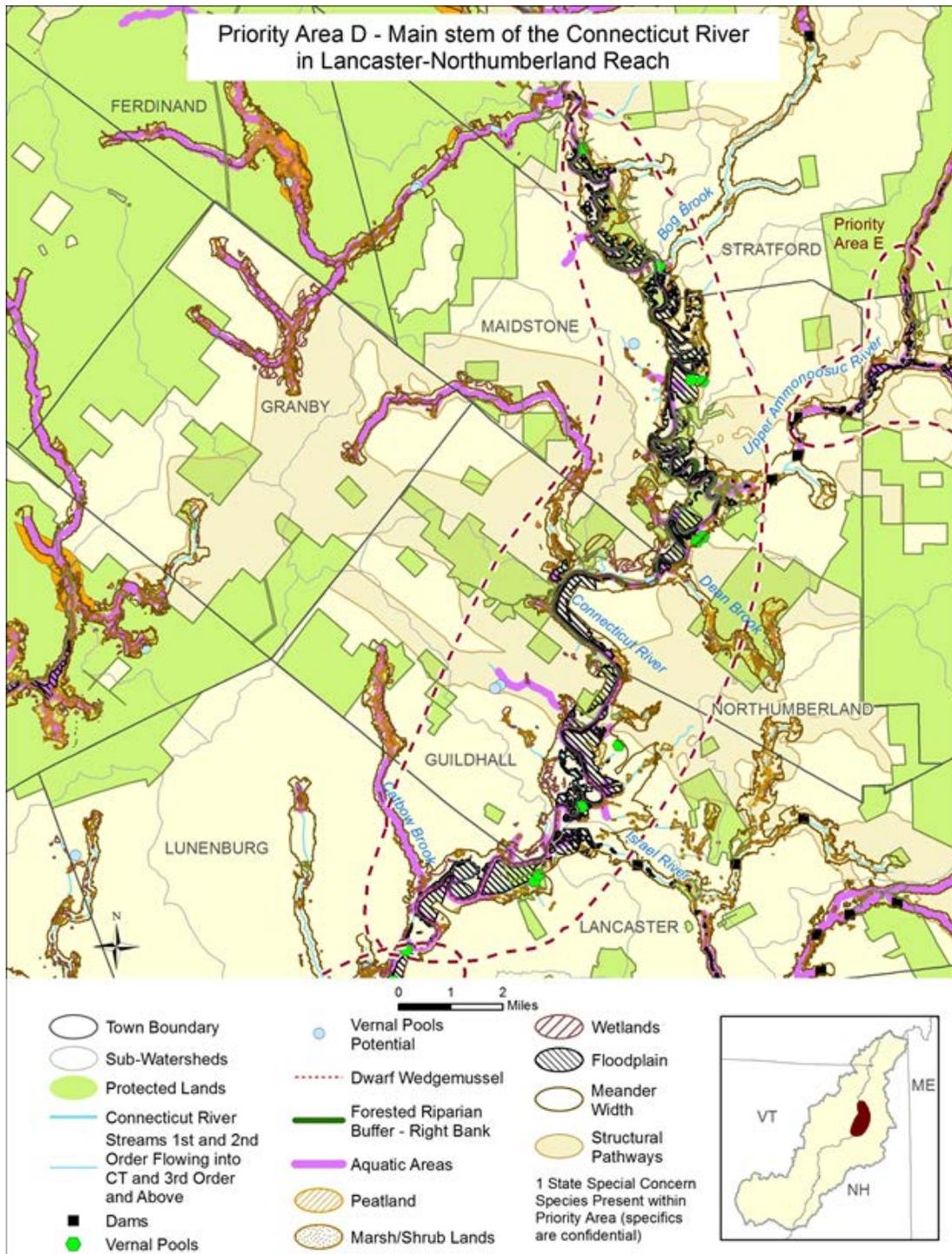
Priority Area B (dashed line) – Main stem of the Connecticut River in the Mohawk River – Stewartstown Tributaries Reach. Identified In-stream and Riparian Resources include: *Floodplains, Forested Riparian Buffer, Marsh/Shrub Lands, Vernal Pools, Wetlands and Wildlife Connectivity Structural Pathways (TNC).*



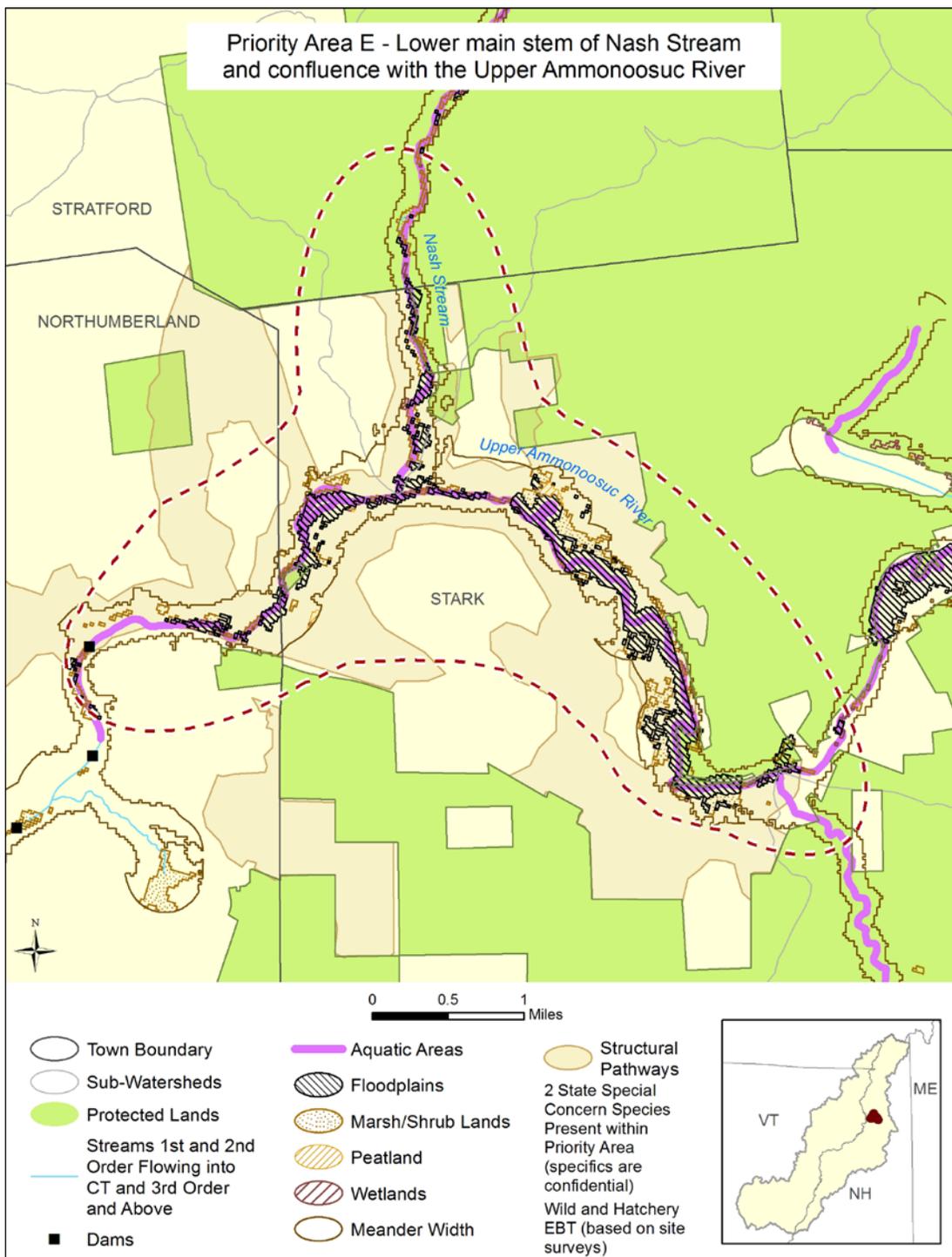
Priority Area C (dashed line) – Main stem of the Nulhegan River and the North and Black Branches. Identified In-stream and Riparian Resources include: *Aquatic Areas*, *Floodplains*, *Marsh/Shrub Lands*, *Peatland*, *State Special Concern Species* (1 species), *Vernal Pools*, *VT Hotspots*, *Wetlands*, *Wild Eastern Brook Trout* (based on site surveys), and *Wildlife Connectivity Structural Pathways* (TNC).



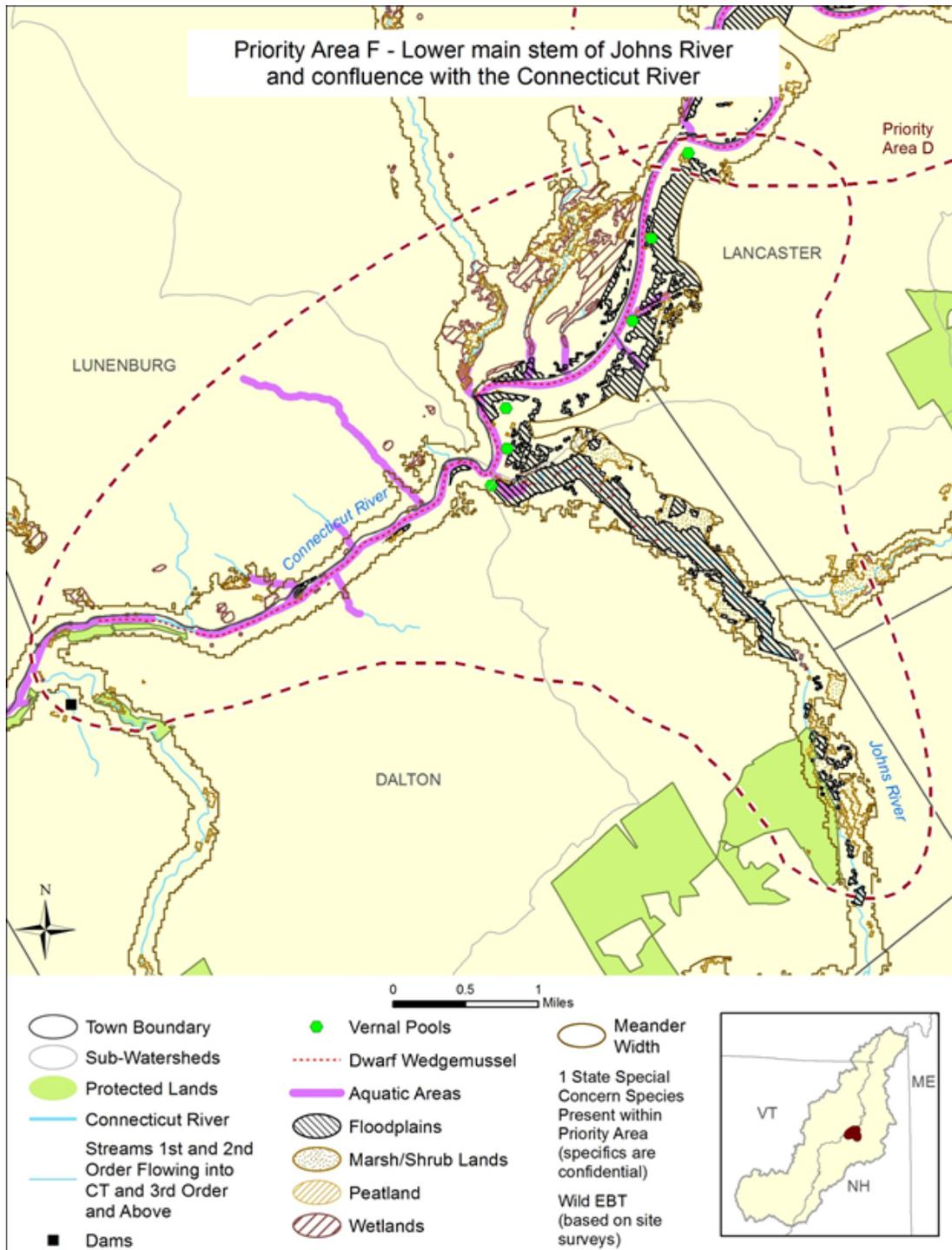
Priority Area D (dashed line) - Main stem of the Connecticut River in Lancaster-Northumberland Reach. Identified In-stream and Riparian Resources include: *Dwarf Wedge Mussel*, *Aquatic Areas*, *Floodplains*, *Forested Riparian Buffer*, *Marsh/Shrub Lands*, *Peatland*, *State Special Concern Species* (1 species), *Vernal Pools*, *Wetlands* and *Wildlife Connectivity Structural Pathways* (TNC).



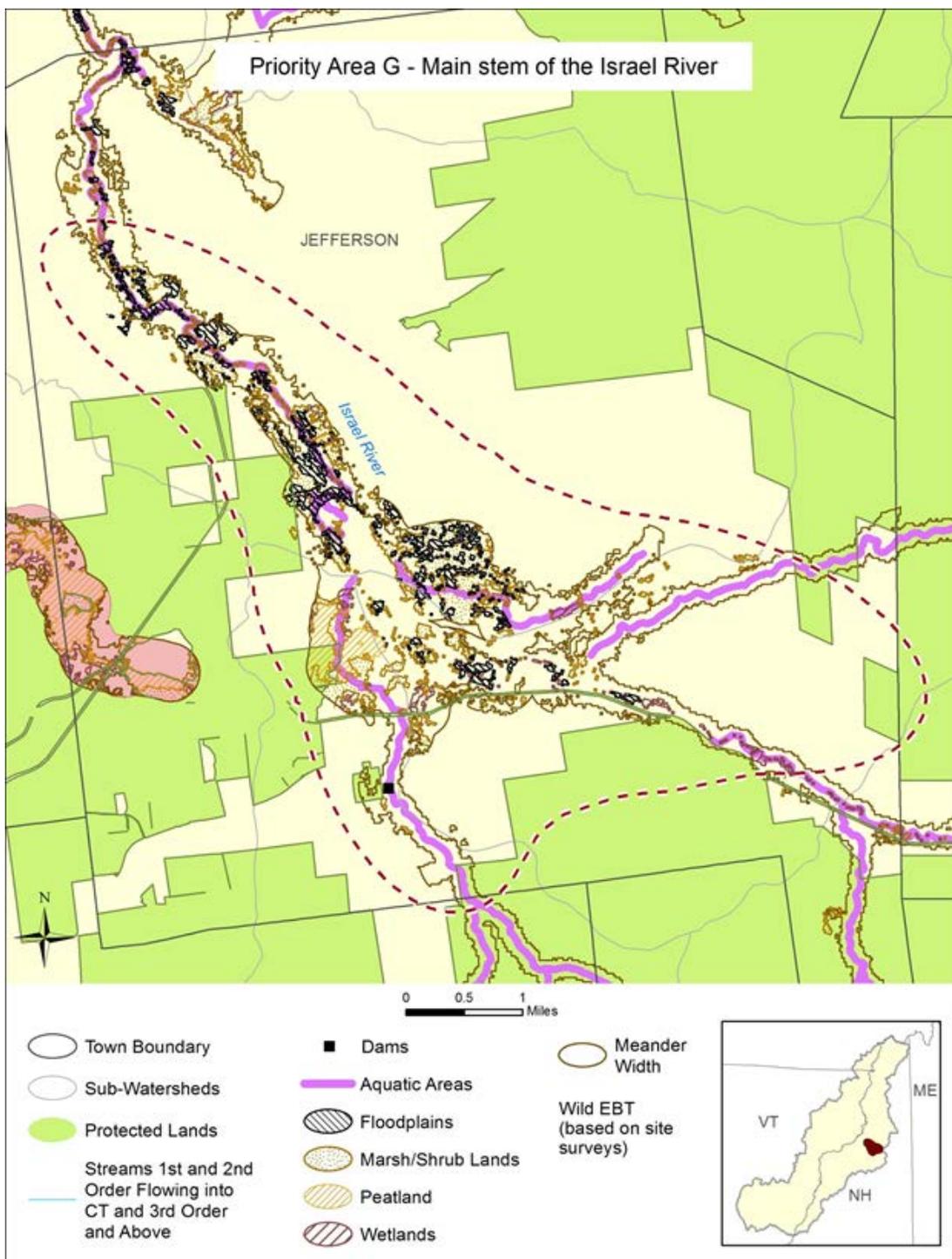
Priority Area E (dashed line) – Lower main stem of Nash Stream and confluence with the Upper Ammonoosuc River. Identified In-stream and Riparian Resources include: *Aquatic Areas*, *Floodplains*, *Marsh/Shrub Lands*, *Peatland*, *State Special Concern Species* (2 species), *Wetlands*, *Wild and Hatchery Eastern Brook Trout* (based on site surveys), and *Wildlife Connectivity Structural Pathways* (TNC). This area has the potential to connect the protected lands in this region by creating a corridor between the Nash Stream Forest in the north and the White Mountain National Forest in the southern section of this *Priority Area*, an added landscape-level ecological benefit.



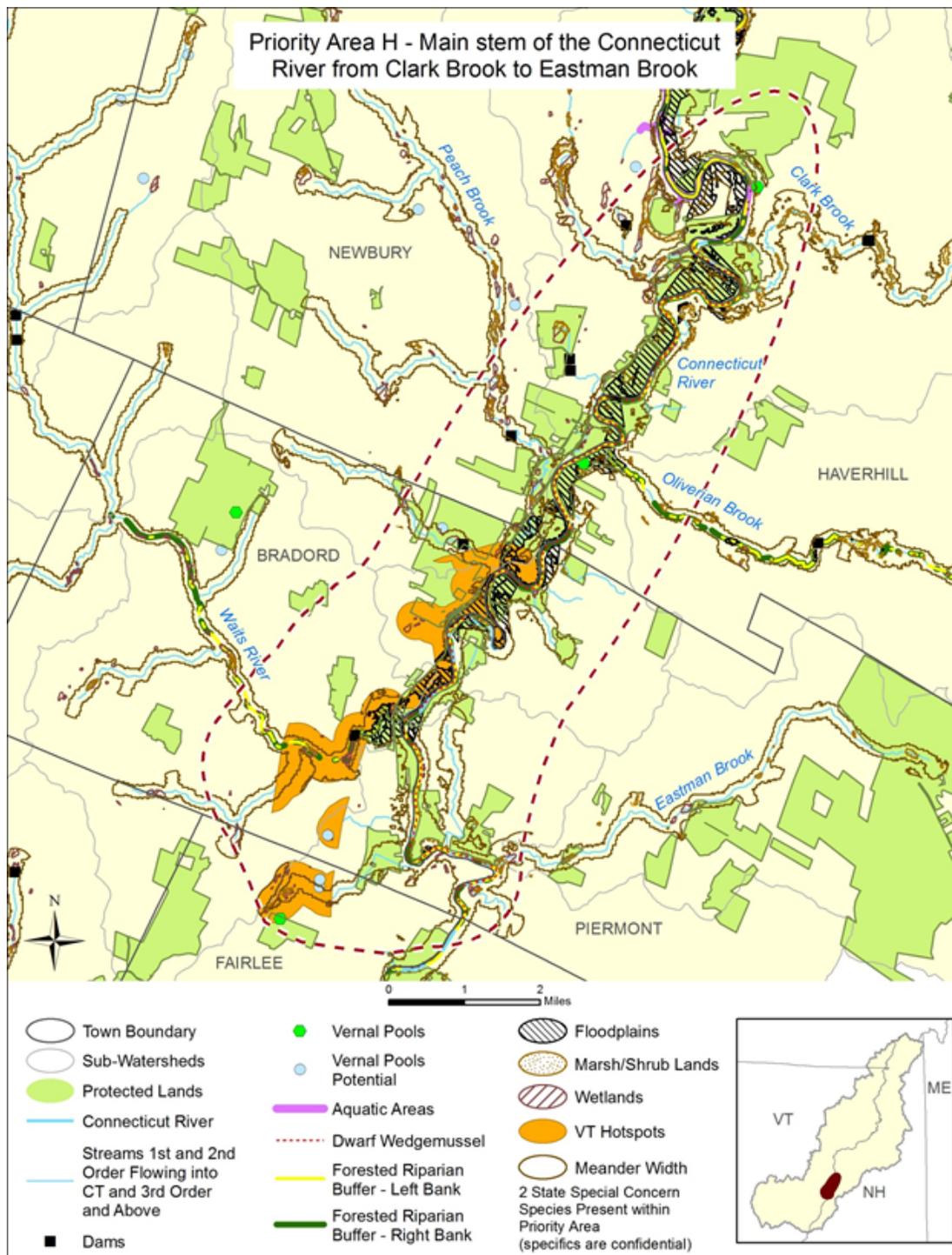
Priority Area F (dashed line) - Lower main stem of the Johns River and confluence with the Connecticut River. Identified In-stream and Riparian Resources include: *Dwarf Wedge Mussel*, *Aquatic Areas*, *Floodplains*, *Marsh/Shrub Lands*, *Peatland*, *State Special Concern Species (1 species)*, *Vernal Pools*, *Wetlands* and *Wild Eastern Brook Trout* (based on site surveys).



Priority Area G (dashed line) - Main stem of the Israel River. Identified In-stream and Riparian Resources include: *Aquatic Areas, Floodplains, Marsh/Shrub Lands, Peatland, Wetlands and Wild Eastern Brook Trout (based on site surveys)*. This area has the potential to connect the protected lands in this region by creating a corridor between the Pondicherry Unit of Silvio O Conte NFWR, the White Mountain National Forest, and Randolph Community Forest of this *Priority Area*, an added landscape-level ecological benefit.



Priority Area H (dashed line) - Main stem of the Connecticut River from Clark Brook to Eastman Brook. Identified In-stream and Riparian Resources include: *Dwarf Wedge Mussel*, *Aquatic Areas*, *Floodplains*, *Forested Riparian Buffer*, *Marsh/Shrub Land*, *State Special Concern Species (2 species)*, *Vernal Pools*, *VT Hotspots*, and *Wetlands*.



General Recommendations

1. Resolving bank stability may best require preserving an adequate boundary for the river to migrate (meander belt) and to allow riparian forests to reestablish themselves, rather than on-site fixes that re-focus river energy downstream to create new bank stability problem areas. Bank stability projects and their proposed remedies should include a provision for a permanently protected and adequate forested riparian buffer and (if possible) a “meander belt” based on the best available science, a cost the MEF Fund would entertain as part of a proposal.
2. Permanent riparian land protection efforts for river, wetland or shoreland protection should contain adequate forested riparian buffers or conditions in any proposed easements and management plans such that these features can evolve, function, and are maintained and protected long-term. Where reasonably possible, riparian land protection should also contain a sufficient corridor for a “meander belt” and the rights for the river to meander naturally, with the meander width to be determined based on the best available science. This may increase the cost of conservation easements as a landowner would be giving up additional “rights”, a cost the MEF Fund would entertain as part of a proposal.

Appendix A: Summary Sub-watershed Information and MEF Funded Projects

Table 1: Sub-watershed Information (Highlighted watersheds contain a *Priority Area*.)

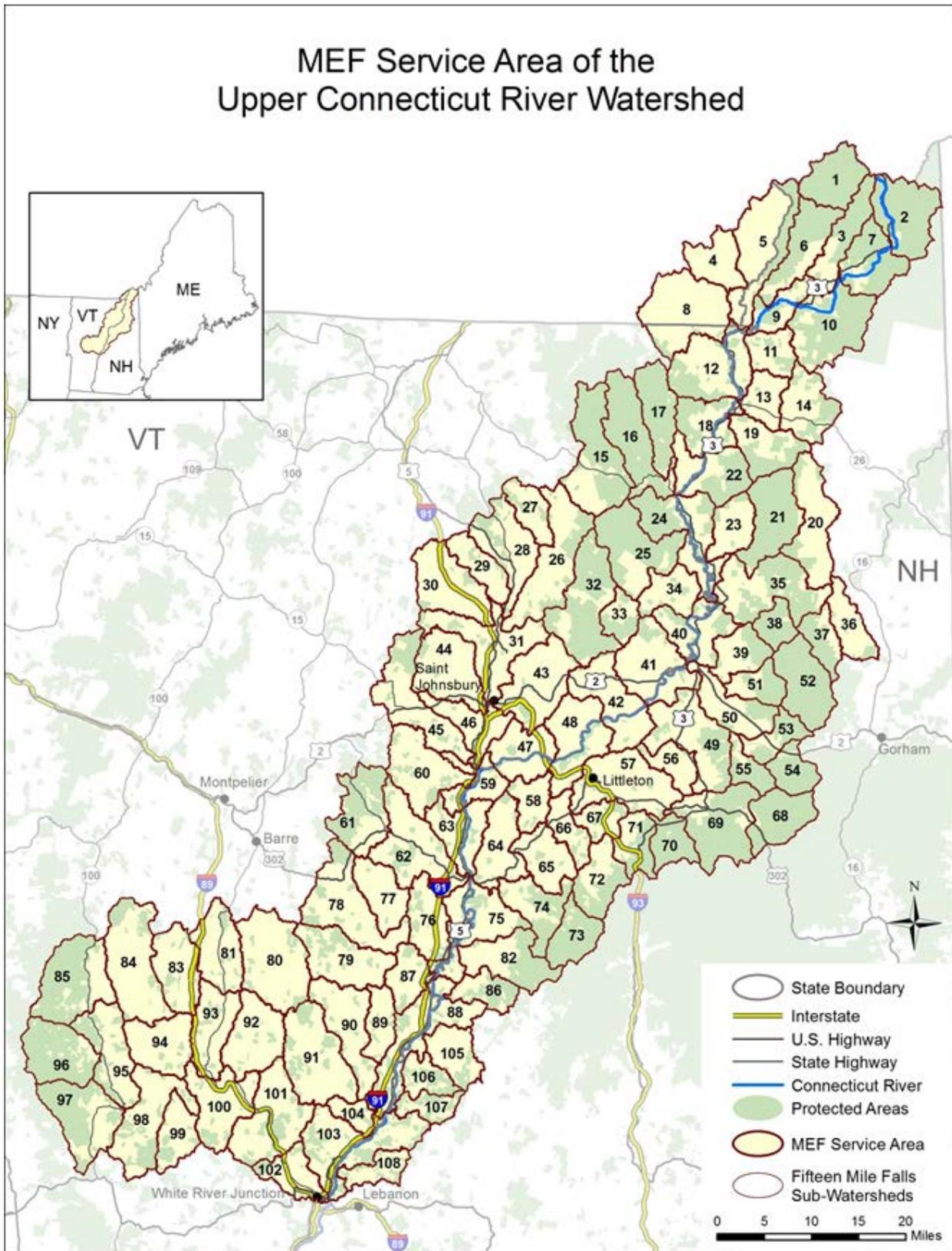
Watershed ID Number	Name	Acres	Square Miles	Miles of 1st Order and Above Streams	Miles of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams	Percentage of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams within Watershed
1	Middle Branch Indian Stream	20,813	33	45	14	31%
2	Second Connecticut Lake-Connecticut River	29,455	46	72	31	43%
3	Perry Stream	19,546	31	54	16	30%
4	Buck Creek	17,192	27	36	5	14%
5	Halls Stream	39,623	62	96	23	24%
6	Indian Stream	24,722	39	76	20	26%
7	First Connecticut Lake-Connecticut River	23,790	37	54	30	56%
8	Leach Creek	38,968	61	99	23	23%
9	Favreau Brook-Connecticut River	13,883	22	39	27	69%
10	Lake Francis-Connecticut River	36,355	57	98	34	35%
11	Bishop Brook	13,837	22	31	8	26%
12	Willard Stream-Connecticut River	34,582	54	117	46	39%
13	Lower Mohawk River	13,560	21	31	8	26%
14	Upper Mohawk River	22,574	35	58	12	21%
15	Headwaters Nulhegan River	38,549	60	164	47	29%
16	Nulhegan River	31,731	50	102	29	28%
17	East Branch Nulhegan River	22,229	35	70	18	26%
18	Clough Brook-Connecticut River	21,354	33	63	30	48%
19	Simms Stream	21,437	33	47	10	21%
20	Phillips Brook	30,294	47	54	18	33%
21	Nash Stream	28,336	44	72	18	25%
22	Lyman Brook-Connecticut River	25,568	40	51	21	41%
23	Bog Brook	16,091	25	37	9	24%
24	Dennis Pond Brook-Connecticut River	34,884	55	108	53	49%
25	Paul Stream	34,110	53	98	29	30%

Watershed ID Number	Name	Acres	Square Miles	Miles of 1st Order and Above Streams	Miles of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams	Percentage of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams within Watershed
26	East Branch Passumpsic River	38,074	59	174	36	21%
27	Bean Brook	13,577	21	52	14	27%
28	West Branch Passumpsic River	27,534	43	110	28	25%
29	Calendar Brook	14,827	23	52	11	21%
30	Millers Run	29,581	46	111	23	21%
31	South Wheelock Branch-Passumpsic River	33,812	53	124	33	27%
32	Headwaters Moose River	39,111	61	143	30	21%
33	Rogers Brook	10,757	17	38	7	18%
34	Cutler Mill Brook	16,018	25	48	12	25%
35	Upper Ammonoosuc River	37,352	58	94	30	32%
36	North Branch Upper Ammonoosuc River	15,622	24	33	8	24%
37	Higgins Brook-Upper Ammonoosuc River	12,757	20	23	9	39%
38	Mill Brook	10,207	16	26	5	19%
39	Otter Brook	16,024	25	59	11	19%
40	Dean Brook-Connecticut River	23,359	36	57	39	68%
41	Mink Brook-Connecticut River	32,745	51	112	31	28%
42	Miles Stream-Connecticut River	29,532	46	93	32	34%
43	Moose River	33,078	52	115	29	25%
44	Sleepers River	29,776	47	105	24	23%
45	Joes Brook	33,871	53	118	31	26%
46	Water Andric-Passumpsic River	18,814	29	65	17	26%
47	Comerford Station Dam-Connecticut River	21,434	33	65	25	38%
48	Moore Reservoir-Connecticut River	30,162	47	64	27	42%
49	Johns River	35,958	56	147	30	20%
50	Israel River	21,596	34	88	21	24%
51	Garland Brook	12,650	20	81	12	15%
52	Headwaters Upper Ammonoosuc River	27,007	42	80	16	20%

Watershed ID Number	Name	Acres	Square Miles	Miles of 1st Order and Above Streams	Miles of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams	Percentage of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams within Watershed
53	Stag Hollow Brook-Israel River	12,679	20	55	12	22%
54	Headwaters Israel River	12,941	20	66	9	14%
55	Appleby Road Brook-Mill Brook	10,275	16	56	8	14%
56	Forest Lake-Bog Brook	11,982	19	39	8	21%
57	Baker Brook-Ammonoosuc River	35,521	56	144	29	20%
58	Ogontz Brook	12,694	20	42	8	19%
59	McIndoe Falls-Connecticut River	15,055	24	52	21	40%
60	Stevens River	29,661	46	96	24	25%
61	Headwaters Wells River	27,366	43	81	17	21%
62	Wells River	36,826	58	144	38	26%
63	Manchester Brook-Connecticut River	21,199	33	76	31	41%
64	Ammonoosuc River	23,569	37	80	18	23%
65	Pearl Lake Brook-Ammonoosuc River	19,258	30	57	16	28%
66	Salmon Hole Brook-Ammonoosuc River	12,815	20	39	10	26%
67	Gale River	10,816	17	33	8	24%
68	Headwaters Ammonoosuc River	21,565	34	95	7	7%
69	Zealand River-Ammonoosuc River	34,893	55	158	32	20%
70	Headwaters Gale River	13,350	21	45	6	13%
71	Meadow Brook-Gale River	15,135	24	30	9	30%
72	Ham Branch	20,141	31	63	12	19%
73	Upper Wild Ammonoosuc River	17,029	27	58	7	12%
74	Lower Wild Ammonoosuc River	21,190	33	55	13	24%
75	Clark Brook-Connecticut River	31,429	49	110	50	45%
76	Halls Brook	19,633	31	72	21	29%
77	Tabor Branch	18,778	29	94	22	23%
78	Headwaters Waits River	37,497	59	156	35	22%
79	South Branch Waits River	28,815	45	119	31	26%

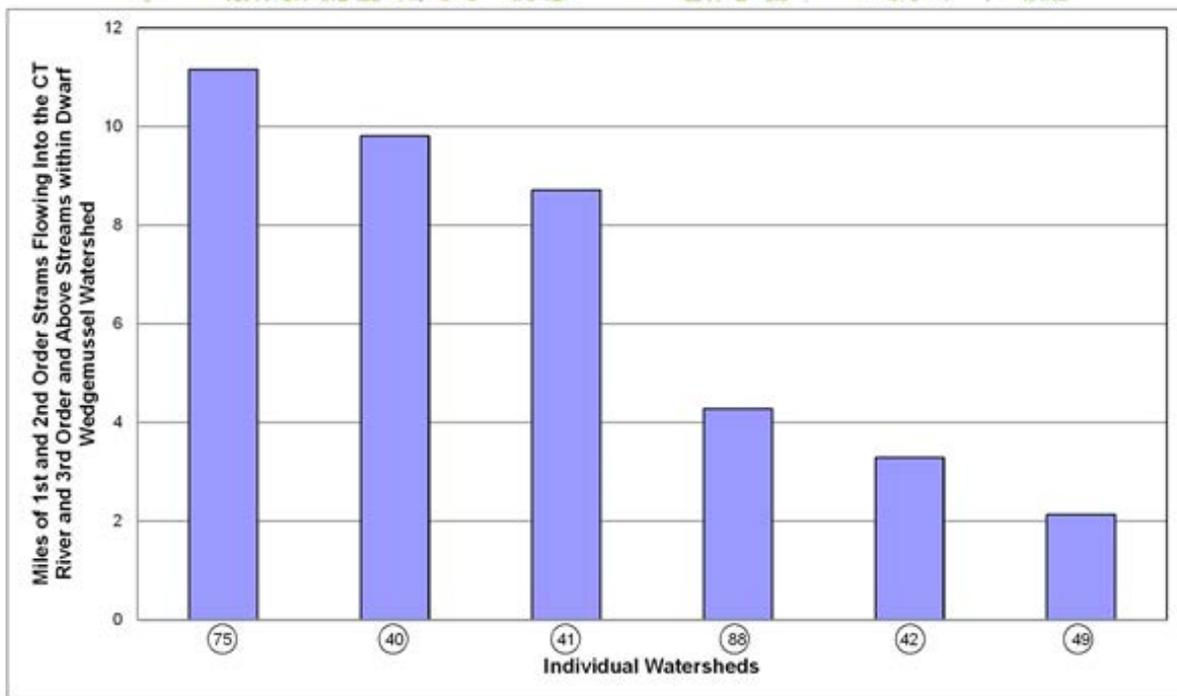
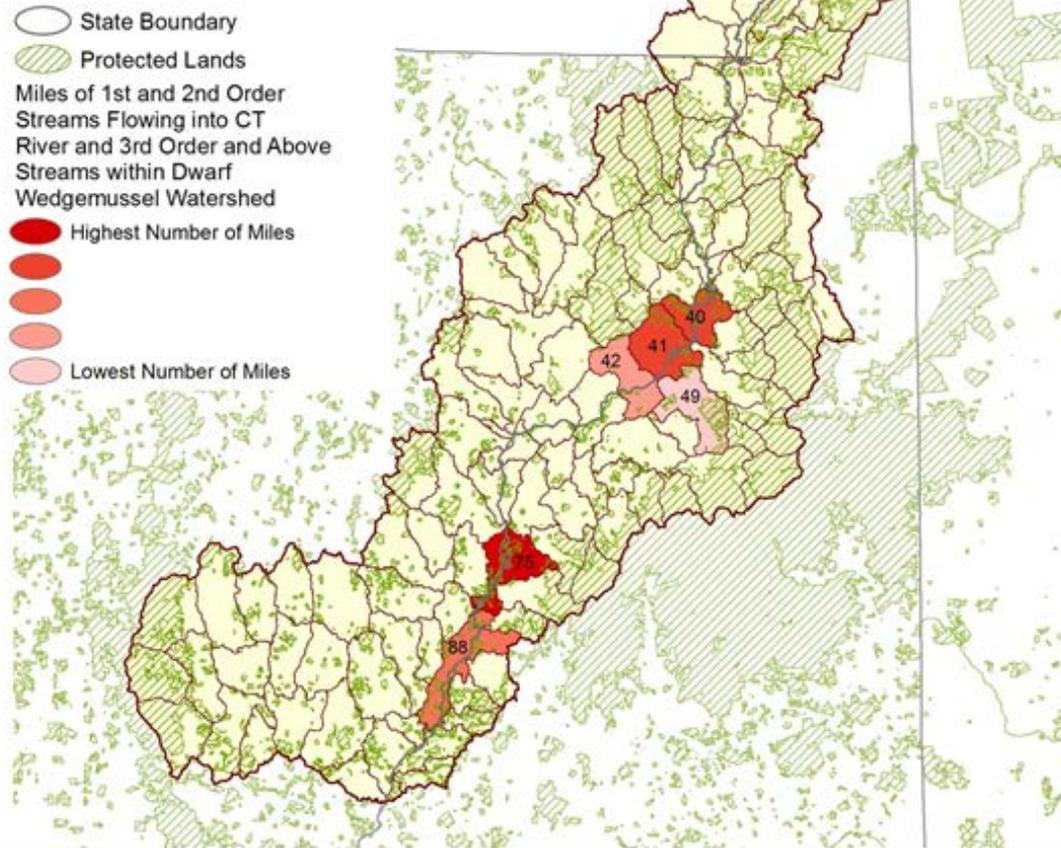
Watershed ID Number	Name	Acres	Square Miles	Miles of 1st Order and Above Streams	Miles of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams	Percentage of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams within Watershed
80	Headwaters First Branch White River	40,077	63	197	42	21%
81	Headwaters Second Branch White River	24,185	38	96	27	28%
82	Oliverian Brook	25,911	40	82	18	22%
83	Ayers Brook	23,828	37	111	29	26%
84	Headwaters Third Branch White River	40,154	63	191	47	25%
85	Headwaters White River	36,457	57	163	35	21%
86	Eastman Brook	13,350	21	29	7	24%
87	Waits River	14,631	23	58	15	26%
88	Lake Morey-Connecticut River	37,813	59	114	49	43%
89	Middle Brook	13,362	21	55	17	31%
90	Headwaters Ompompanoosuc River	28,246	44	130	31	24%
91	West Branch Ompompanoosuc River	38,253	60	192	49	26%
92	First Branch White River	26,931	42	119	31	26%
93	Second Branch White River	23,350	36	91	21	23%
94	Third Branch White River	23,786	37	88	26	30%
95	Broadneck Brook-White River	27,696	43	95	22	23%
96	West Branch White River	27,748	43	97	19	20%
97	Tweed River	32,622	51	124	28	23%
98	Stony Brook-White River	32,919	51	117	26	22%
99	Locust Creek	16,031	25	66	19	29%
100	Broad Brook-White River	27,915	44	113	27	24%
101	Mill Brook-White River	36,427	57	152	41	27%
102	White River	16,074	25	78	19	24%
103	Bloody Brook-Connecticut River	40,883	64	157	56	36%
104	Ompompanoosuc River	7,843	12	28	7	25%
105	Jacobs Brook	17,308	27	37	8	22%
106	Clay Brook	12,177	19	28	6	21%
107	Grant Brook	10,471	16	19	1	5%
108	Mink Brook	11,838	18	66	15	23%

Map 1: MEF Service Area Sub-Watersheds



Appendix B: River Restoration (In-stream Resources) Maps and Charts

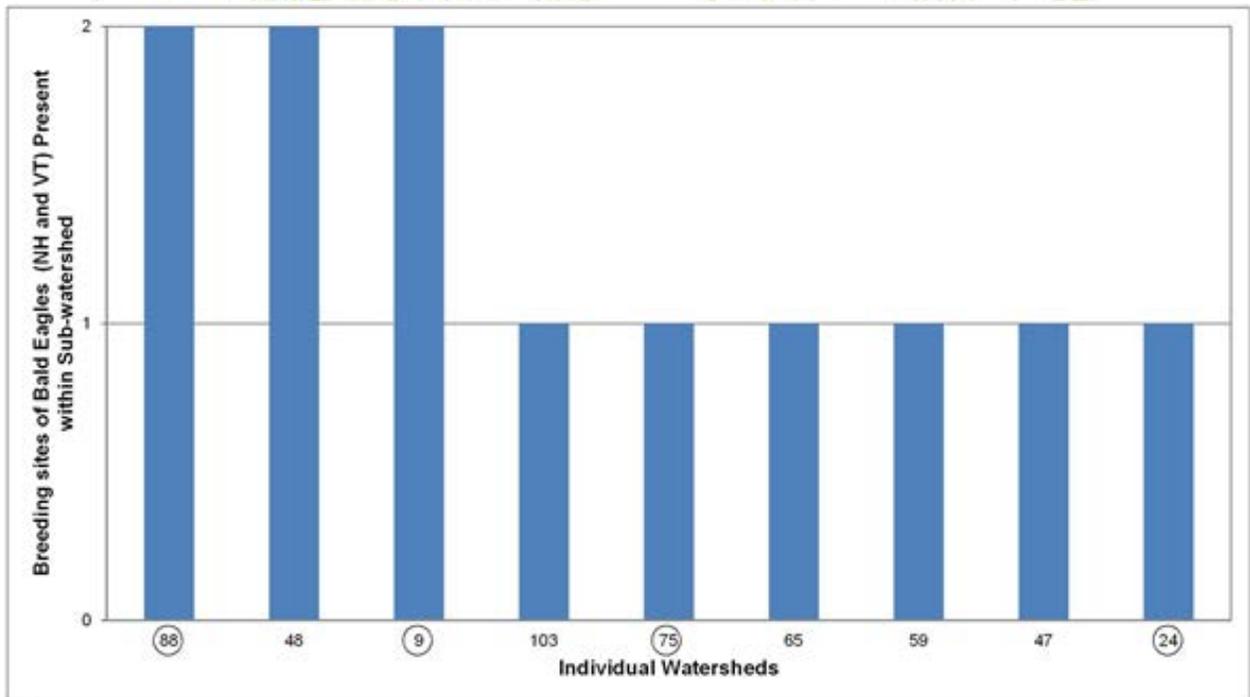
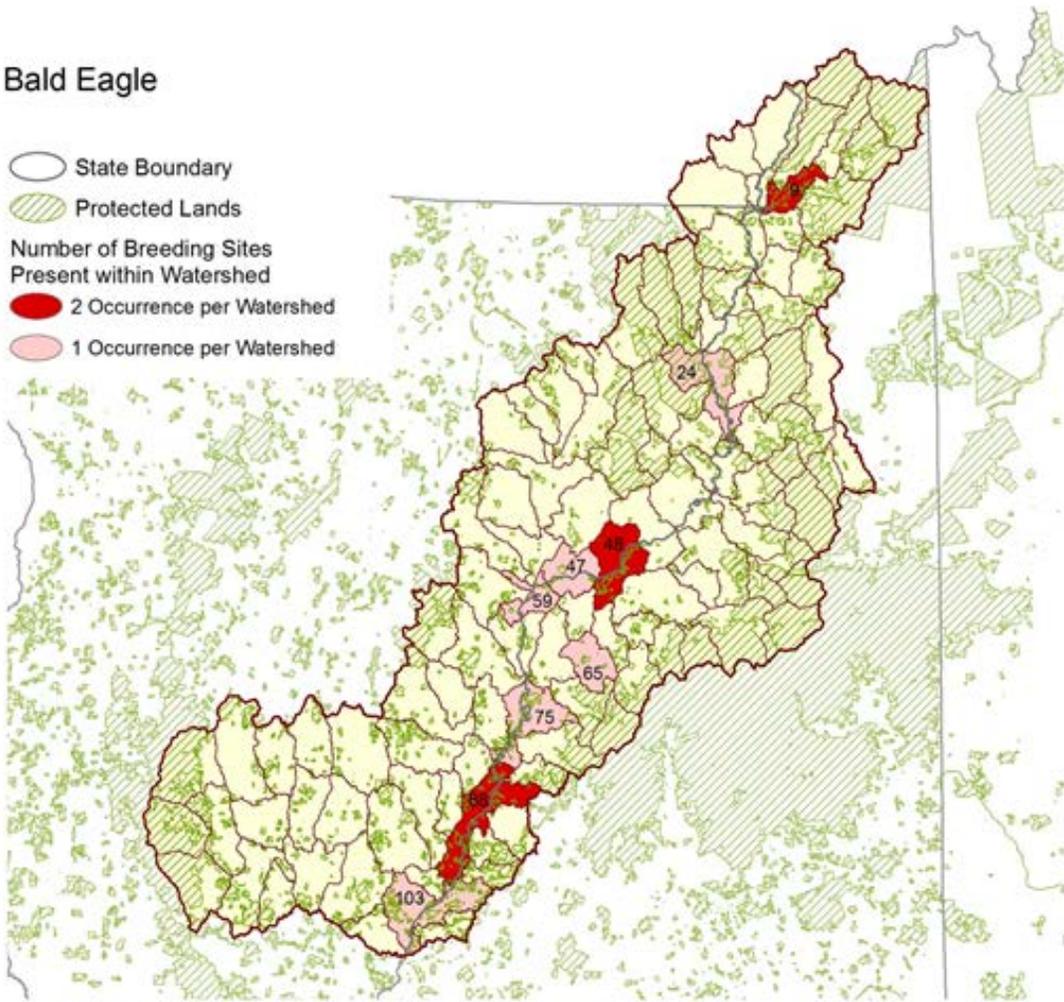
Dwarf Wedgemussel



○ - Selected Priority Sub-watershed

Bald Eagle

- State Boundary
- ▨ Protected Lands
- Number of Breeding Sites Present within Watershed
- 2 Occurrence per Watershed
- 1 Occurrence per Watershed

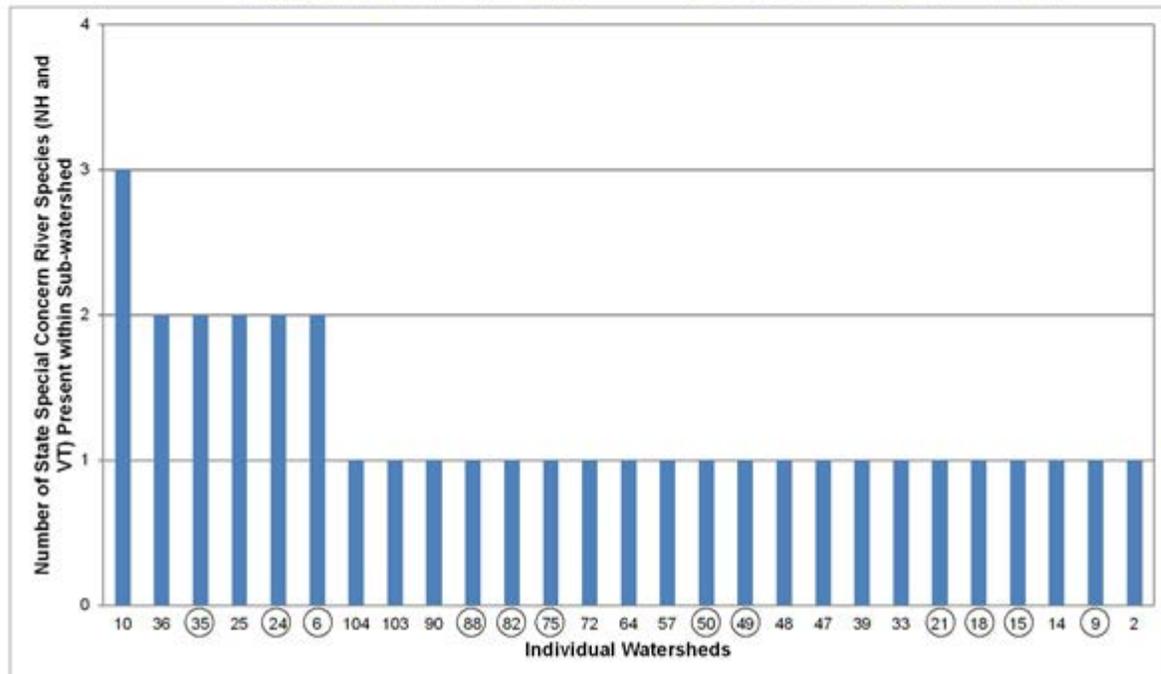
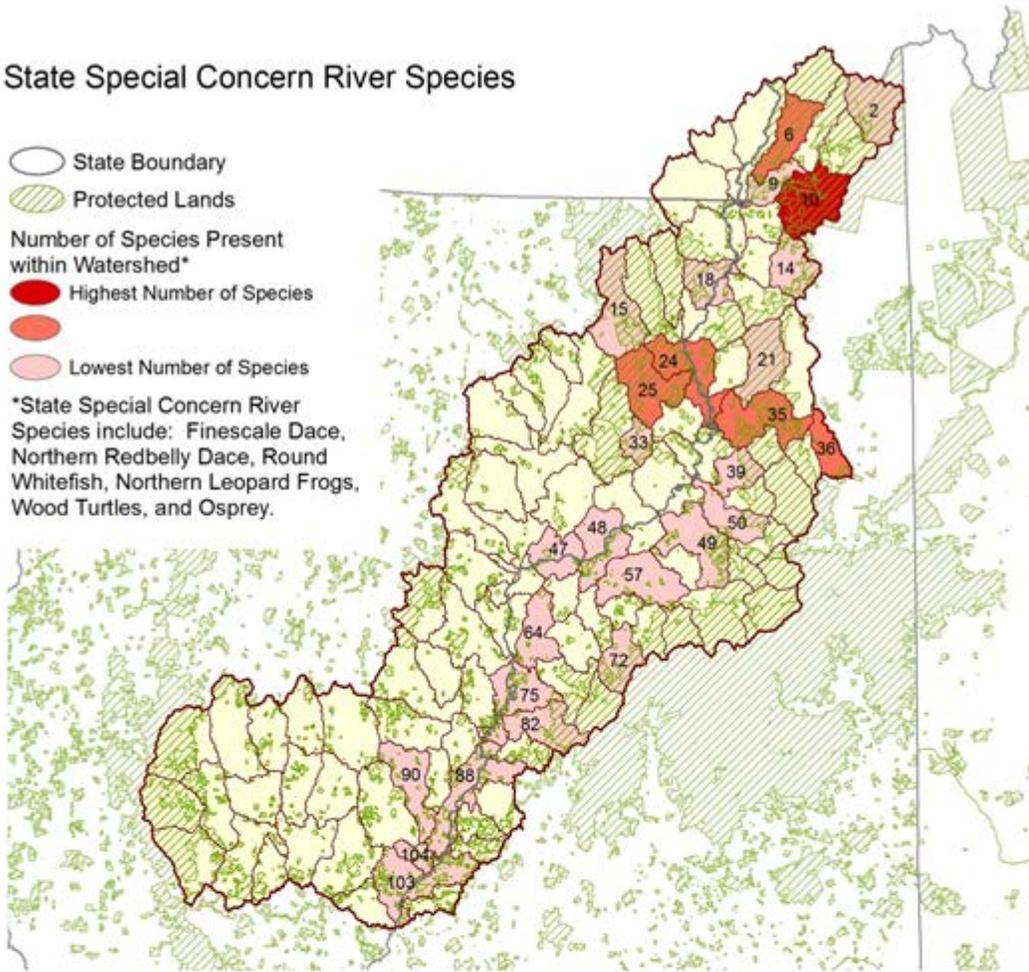


○ - Selected Priority Sub-watershed

State Special Concern River Species

- State Boundary
- ▨ Protected Lands
- Number of Species Present within Watershed*
- Highest Number of Species
- Lowest Number of Species

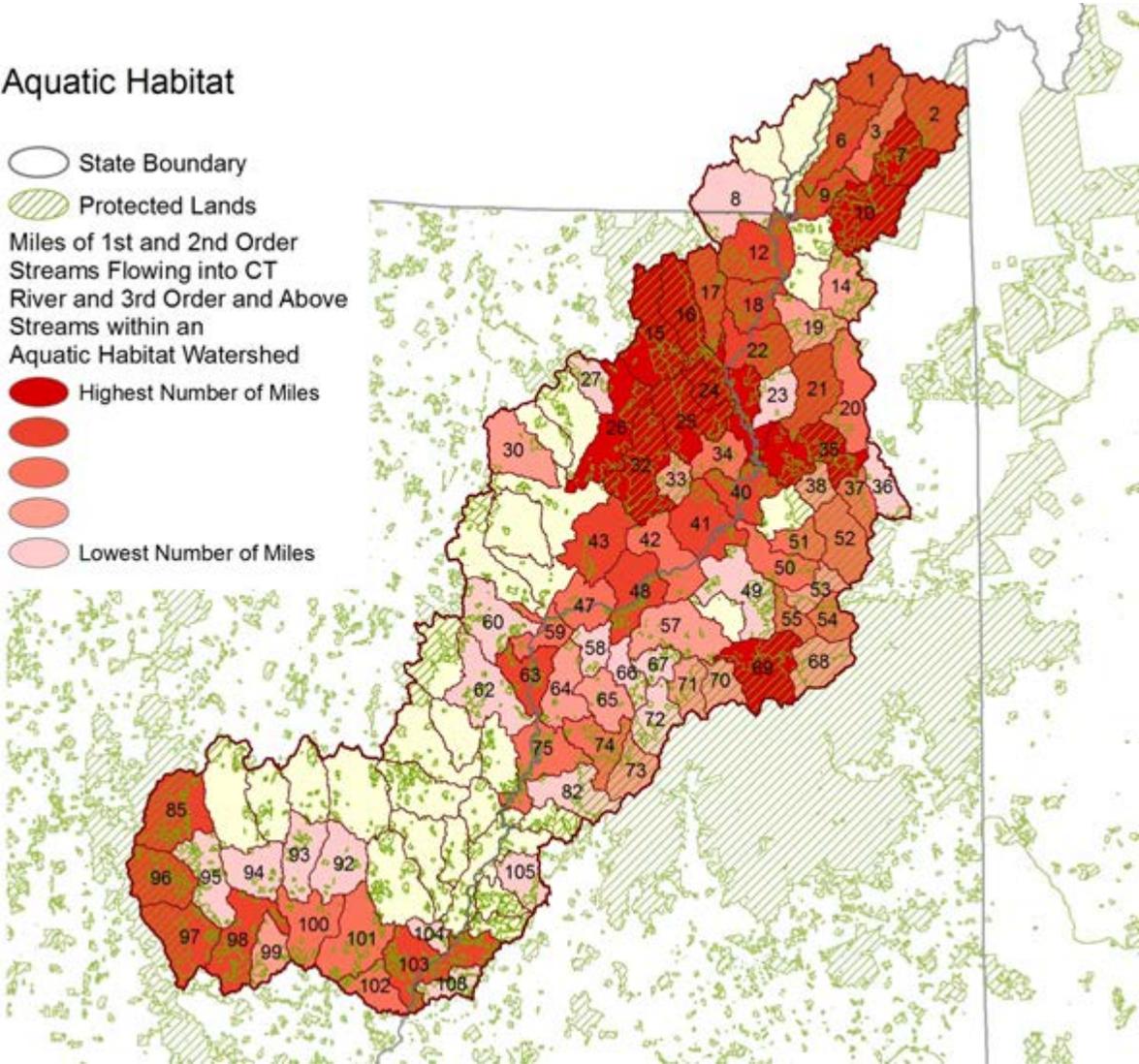
*State Special Concern River Species include: Finescale Dace, Northern Redbelly Dace, Round Whitefish, Northern Leopard Frogs, Wood Turtles, and Osprey.

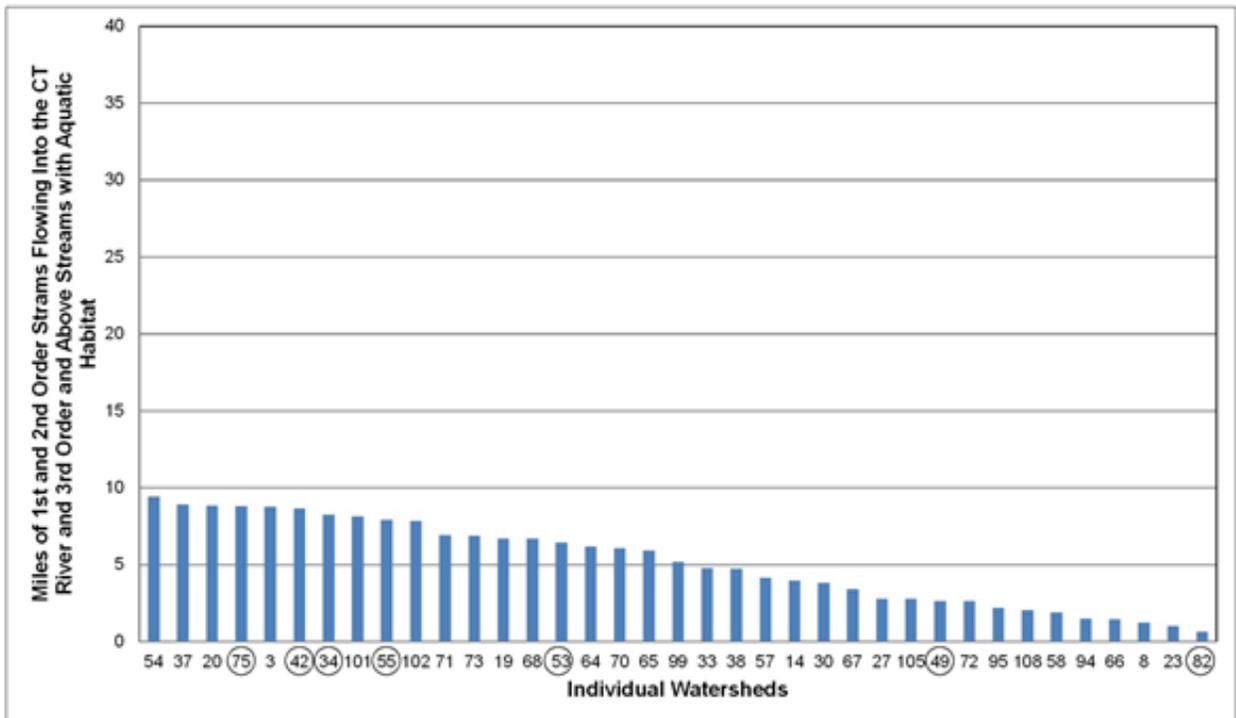
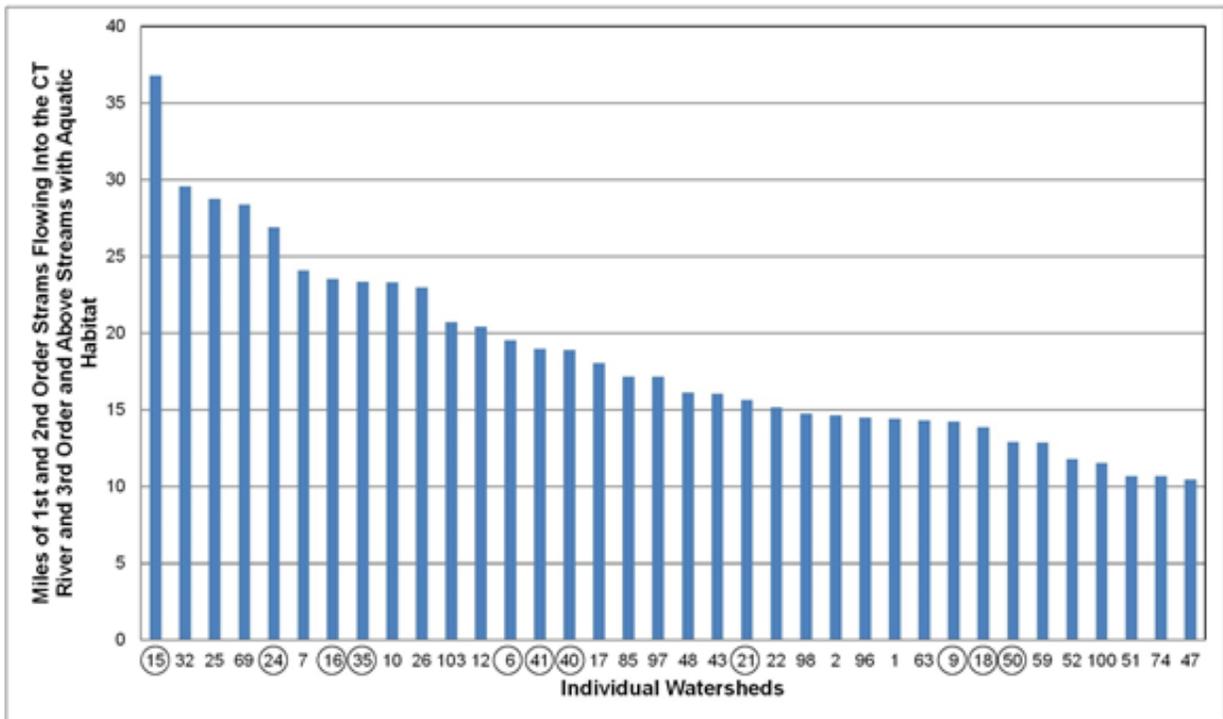


○ - Selected Priority Sub-watershed

Aquatic Habitat

- State Boundary
- ▨ Protected Lands
- Miles of 1st and 2nd Order Streams Flowing into CT River and 3rd Order and Above Streams within an Aquatic Habitat Watershed
- Highest Number of Miles
-
-
-
- Lowest Number of Miles

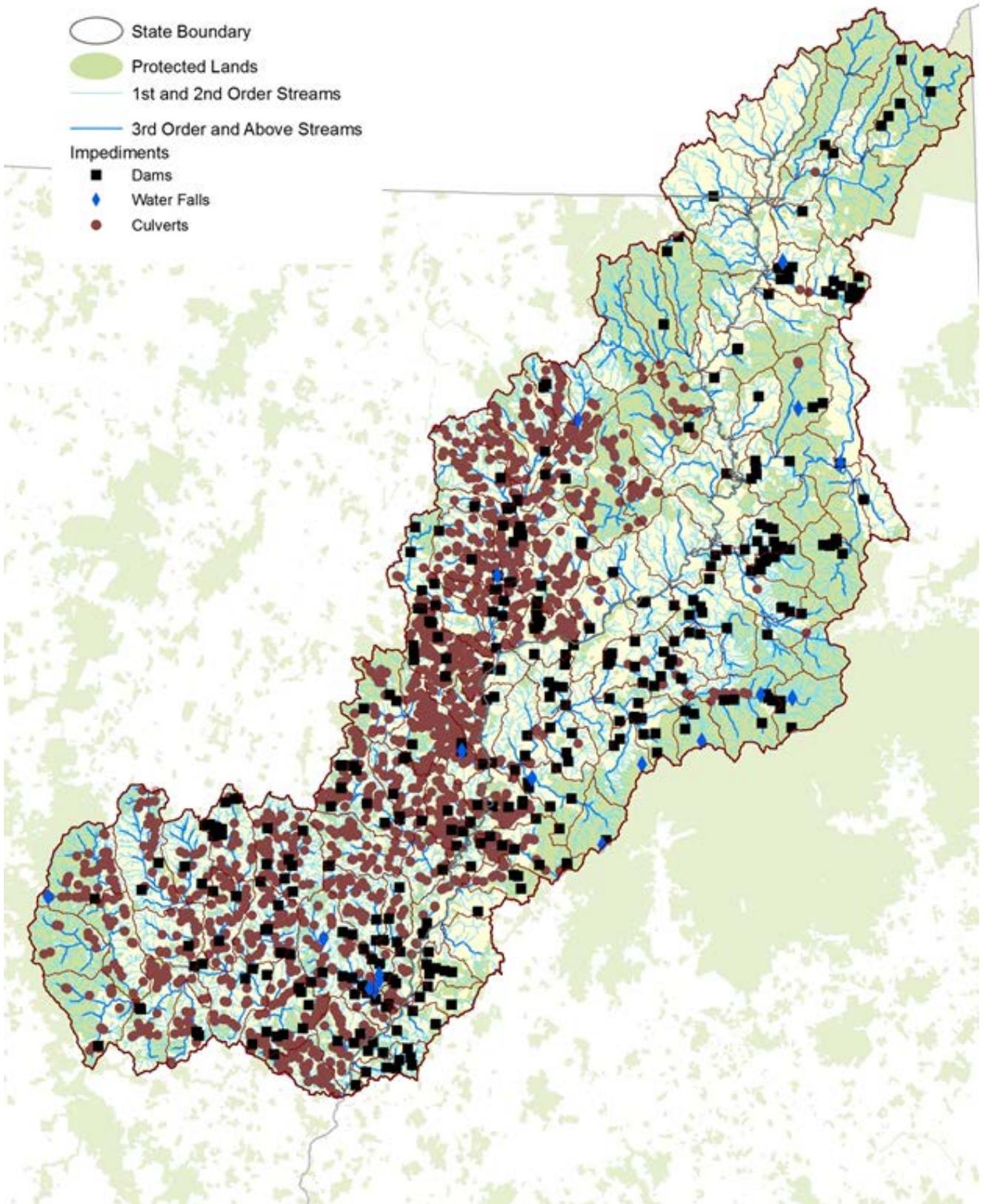




○ - Selected Priority Sub-watershed

River/Stream Connectivity Impediments

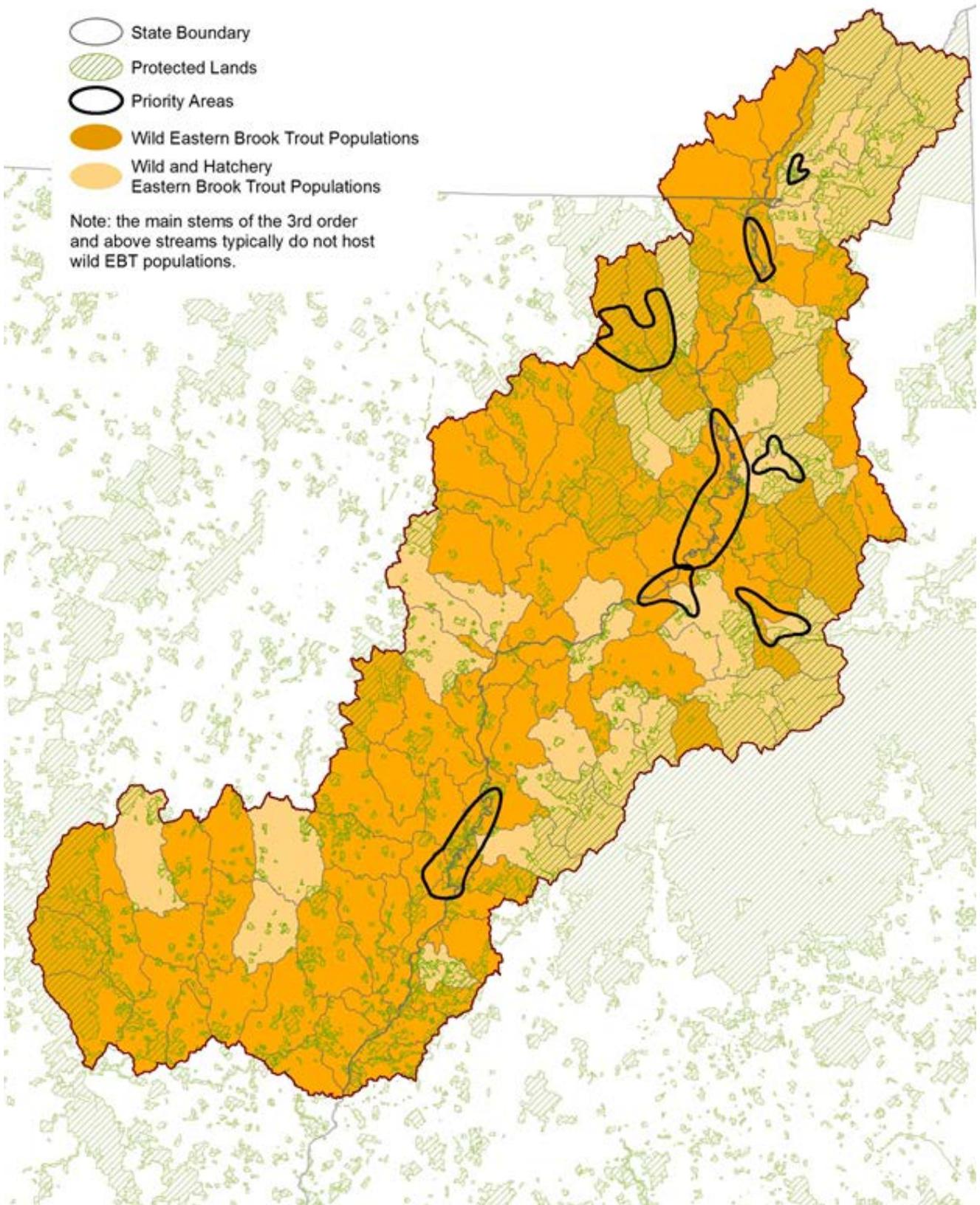
-  State Boundary
-  Protected Lands
-  1st and 2nd Order Streams
-  3rd Order and Above Streams
- Impediments**
 -  Dams
 -  Water Falls
 -  Culverts



Eastern Brook Trout

-  State Boundary
-  Protected Lands
-  Priority Areas
-  Wild Eastern Brook Trout Populations
-  Wild and Hatchery Eastern Brook Trout Populations

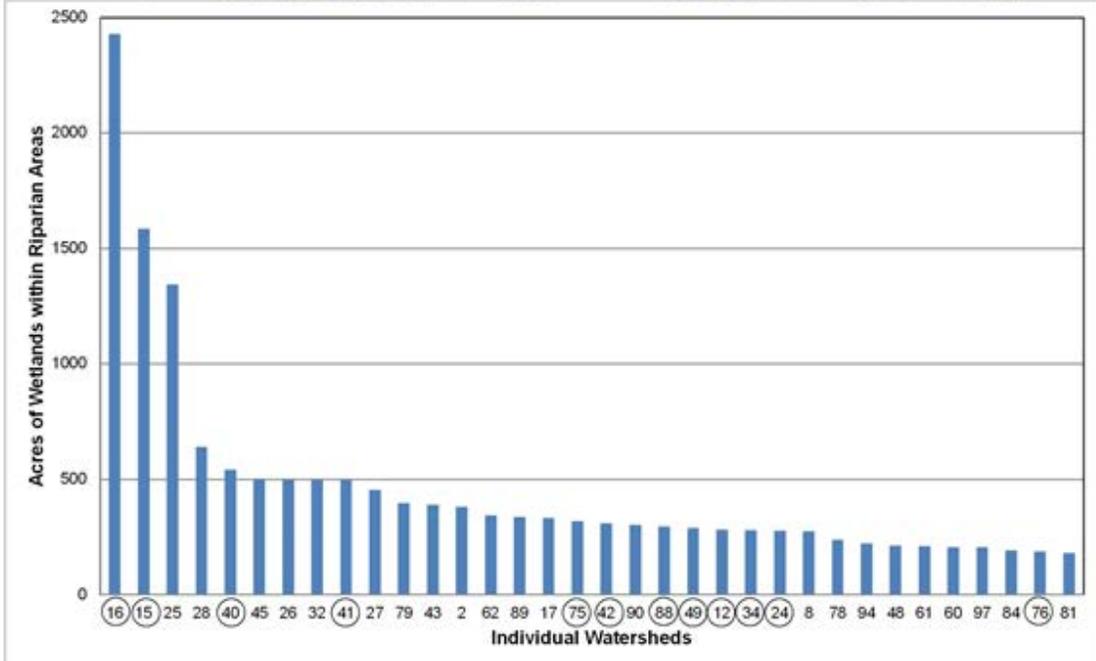
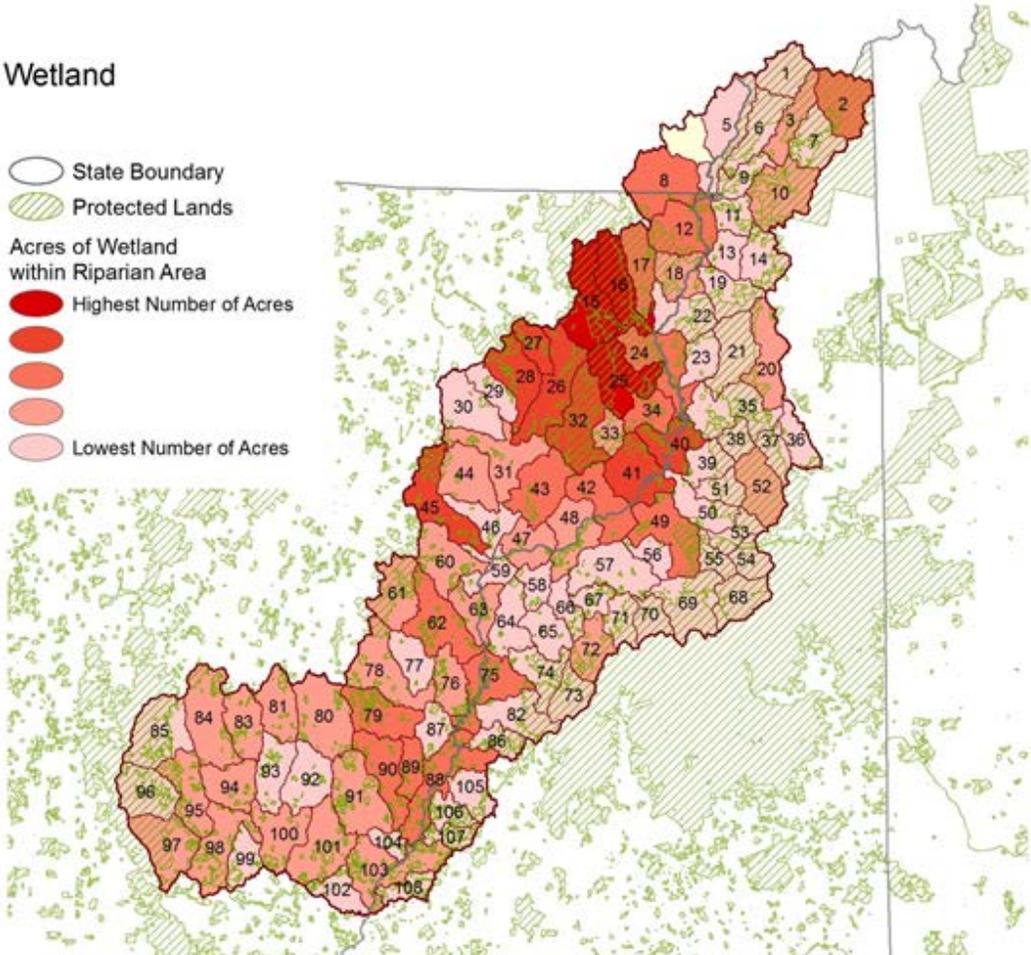
Note: the main stems of the 3rd order and above streams typically do not host wild EBT populations.



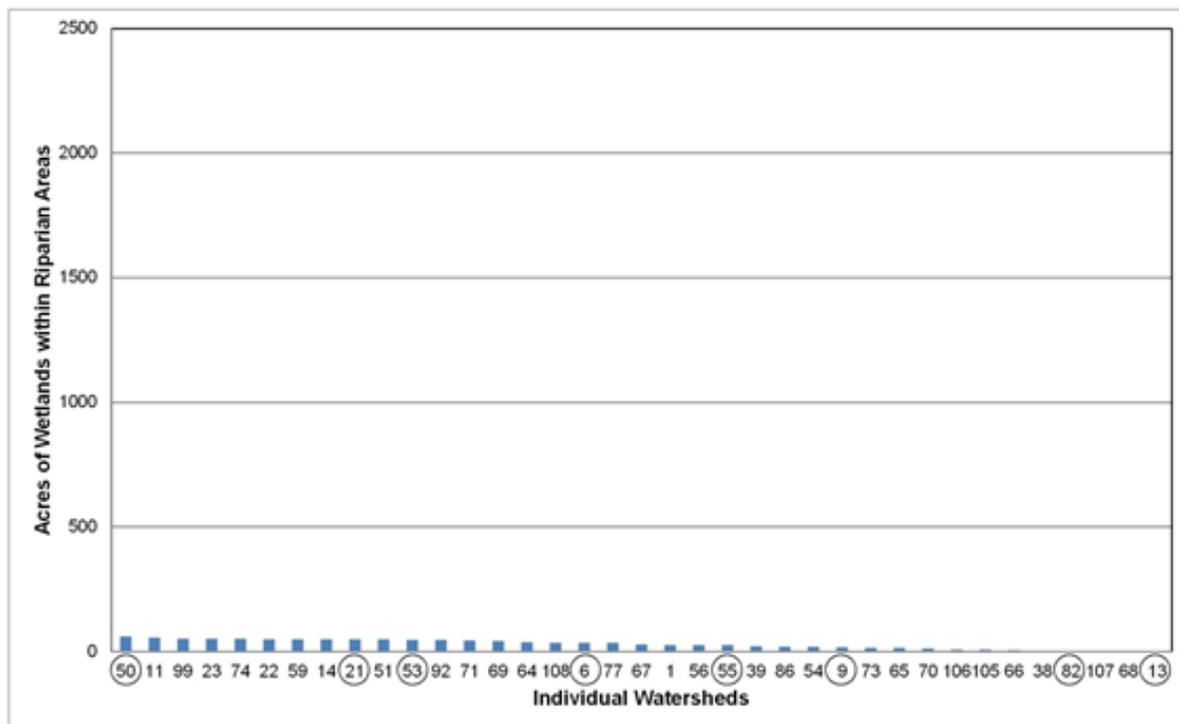
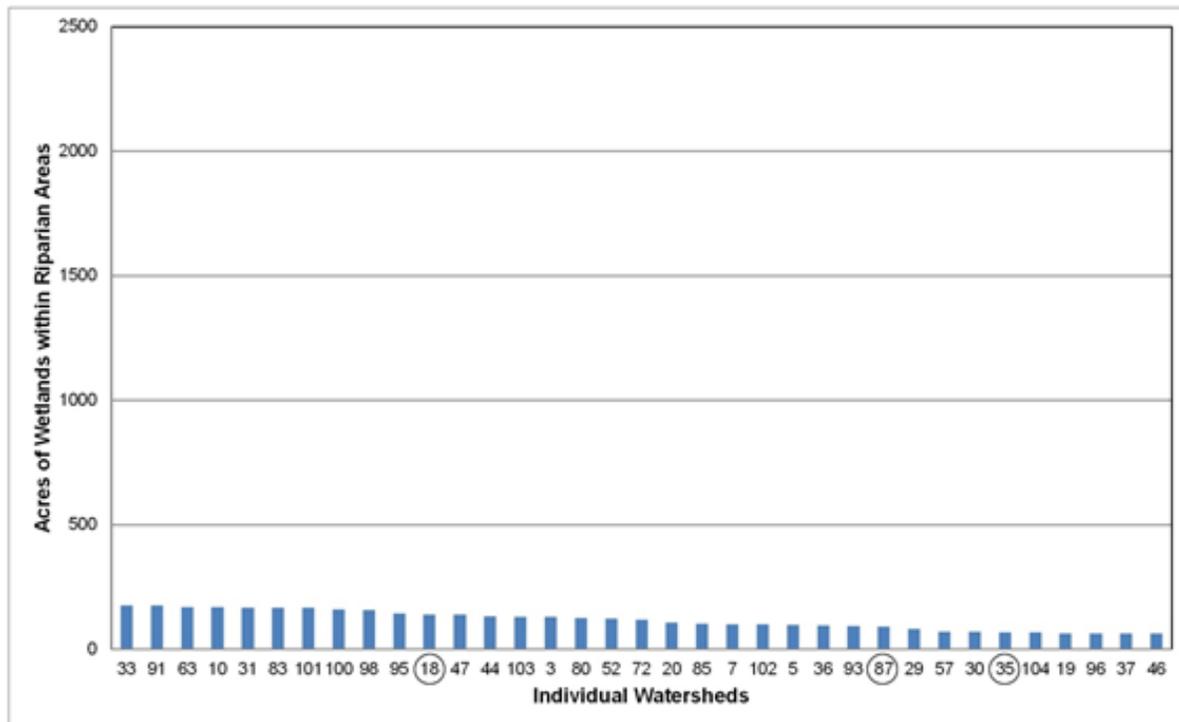
Appendix C: Wetlands (Riparian Resources) Maps and Charts

Wetland

-  State Boundary
-  Protected Lands
- Acres of Wetland within Riparian Area
-  Highest Number of Acres
-  Lowest Number of Acres



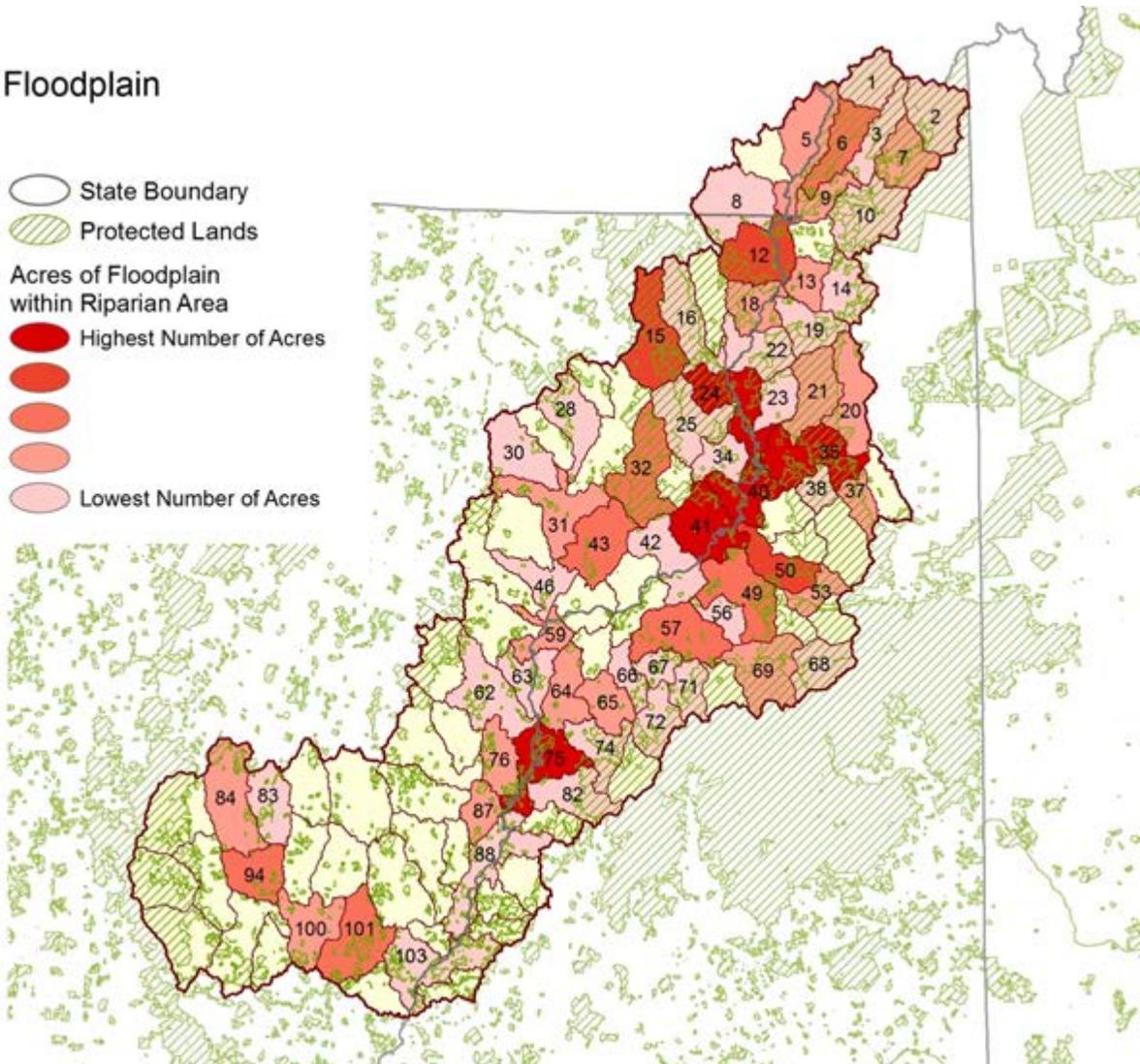
○ - Selected Priority Sub-watershed

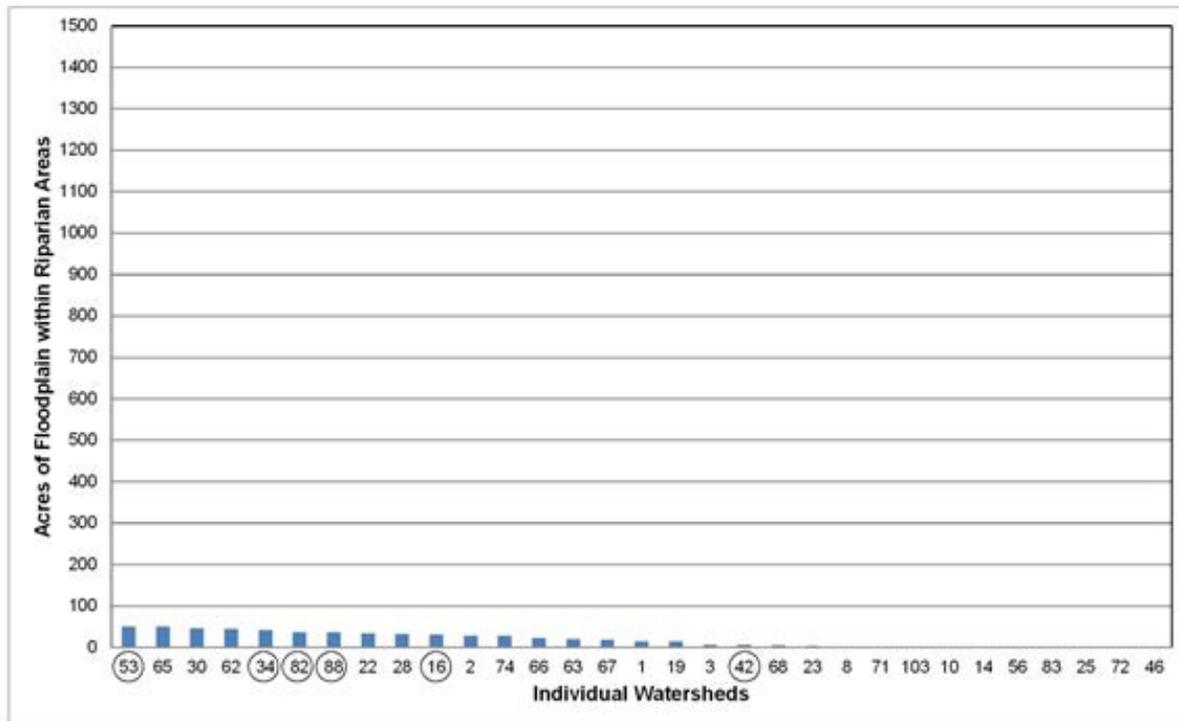
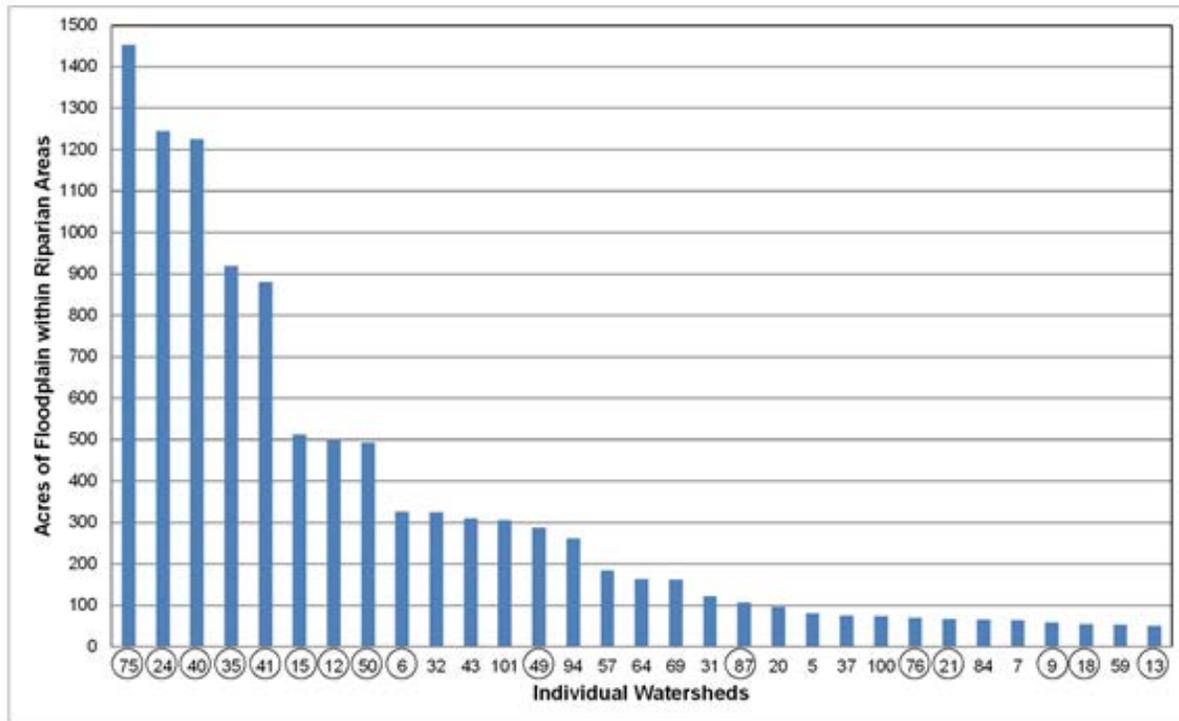


○ - Selected Priority Sub-watershed

Floodplain

- State Boundary
- ▨ Protected Lands
- Acres of Floodplain within Riparian Area
- Highest Number of Acres
-
-
-
- Lowest Number of Acres

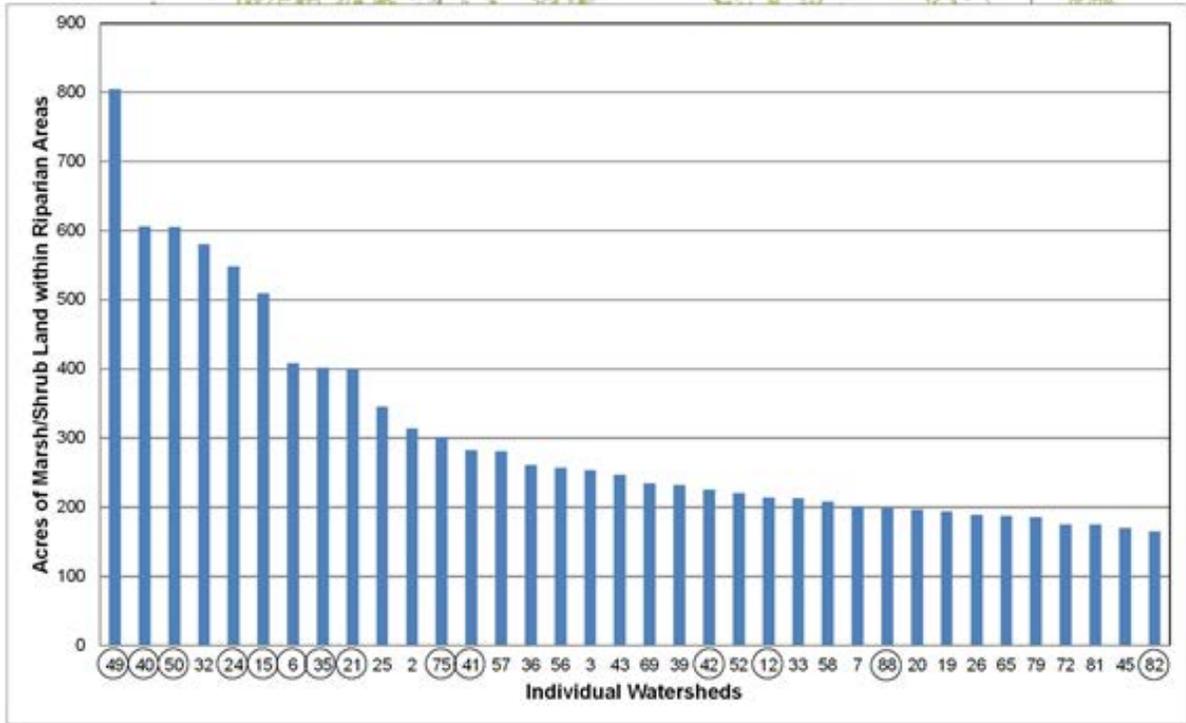
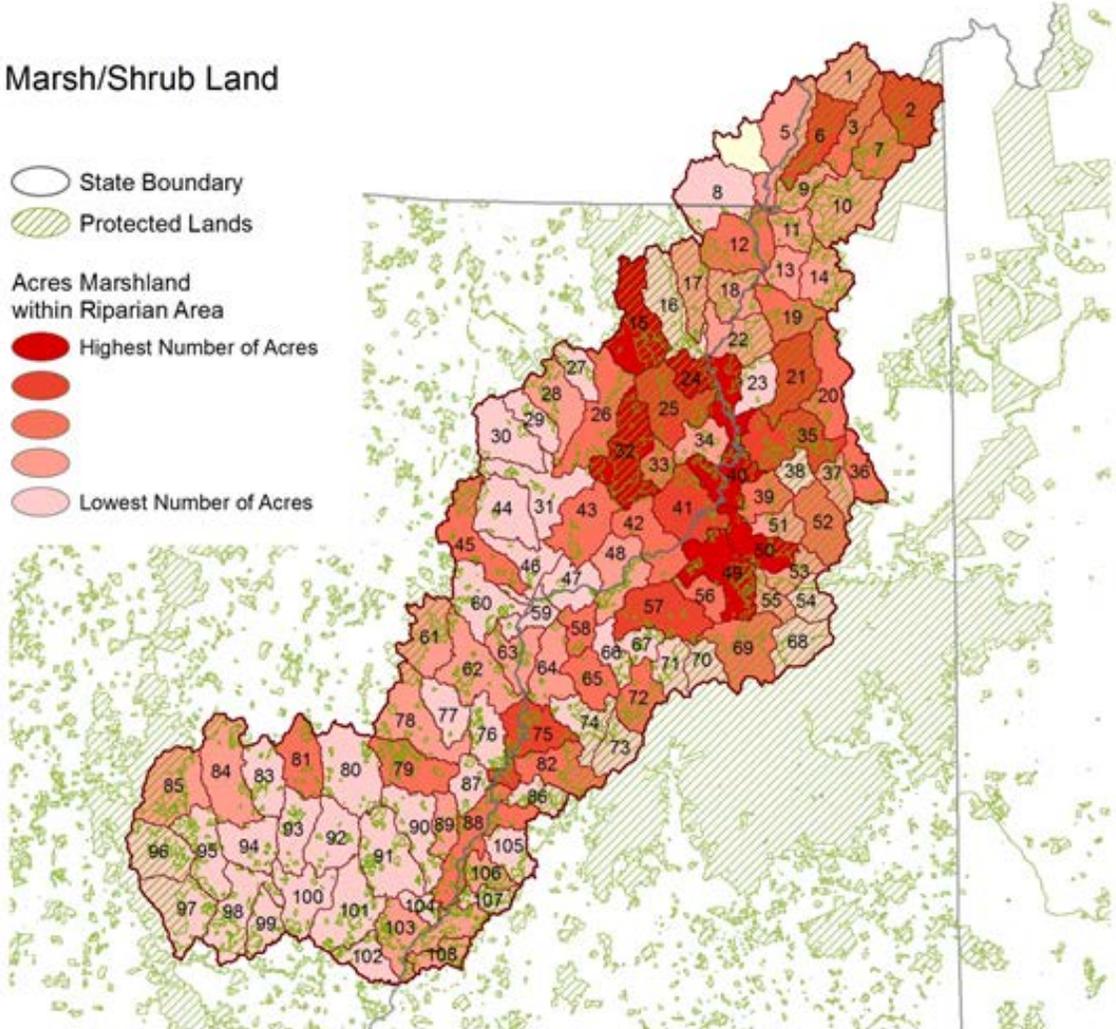




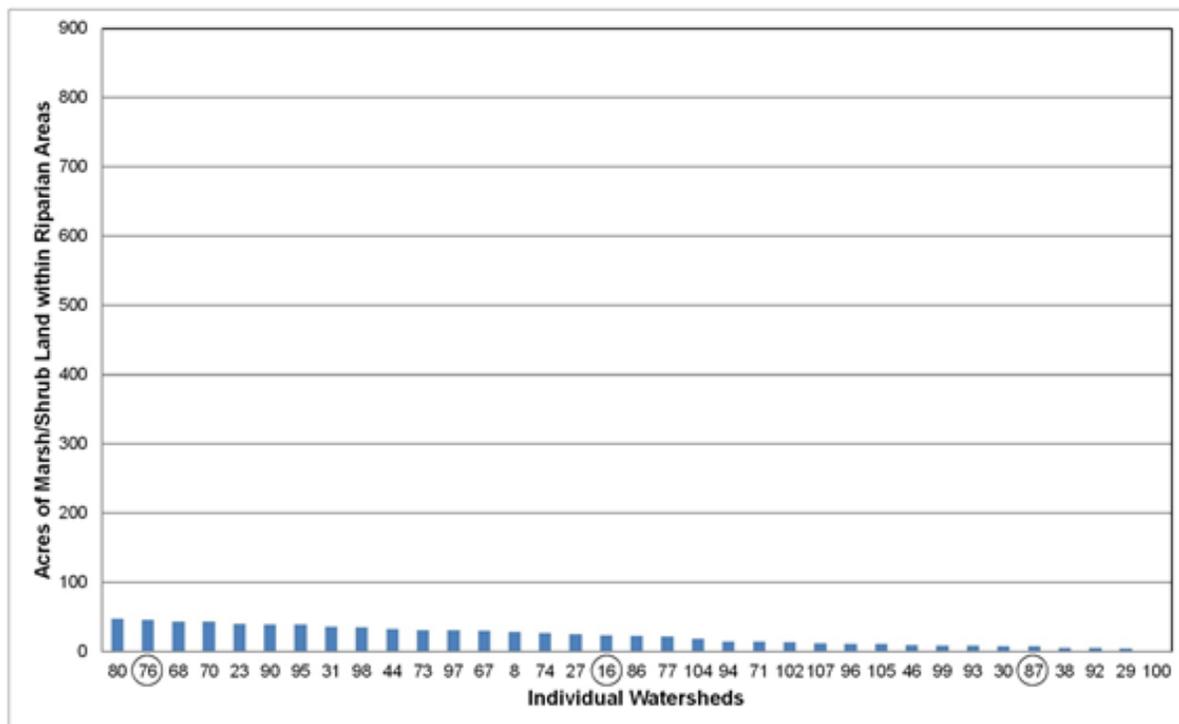
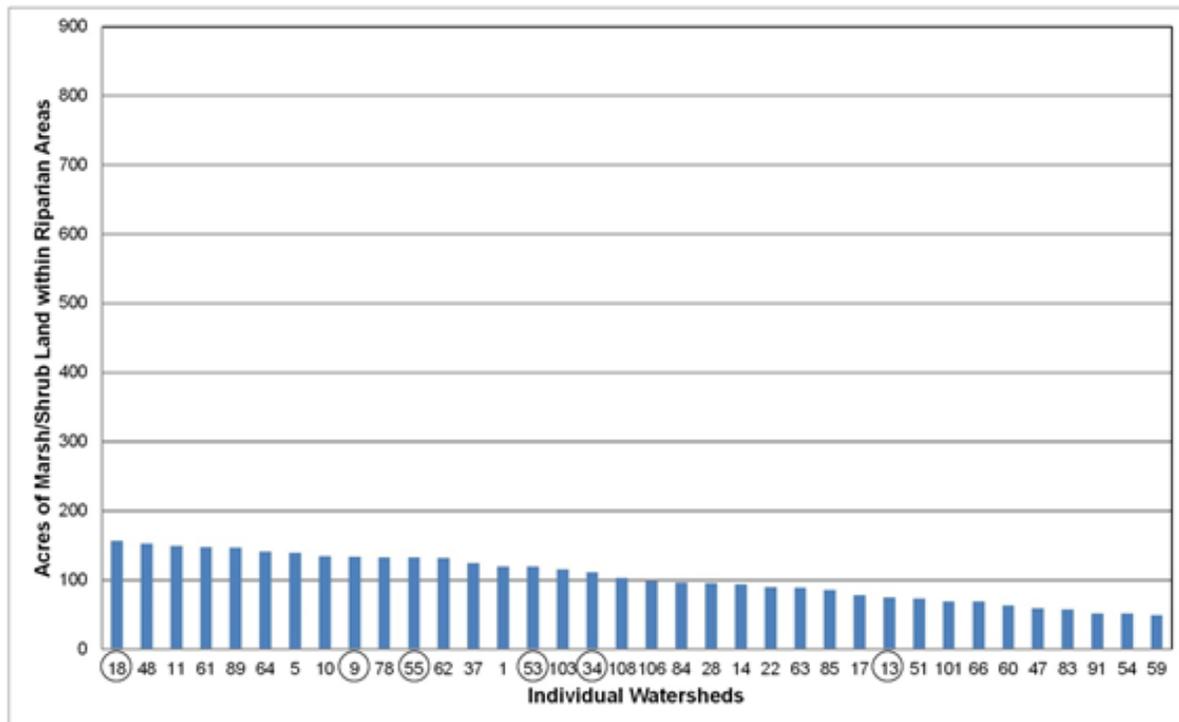
○ - Selected Priority Sub-watershed

Marsh/Shrub Land

-  State Boundary
-  Protected Lands
- Acres Marshland within Riparian Area
-  Highest Number of Acres
- 
- 
-  Lowest Number of Acres



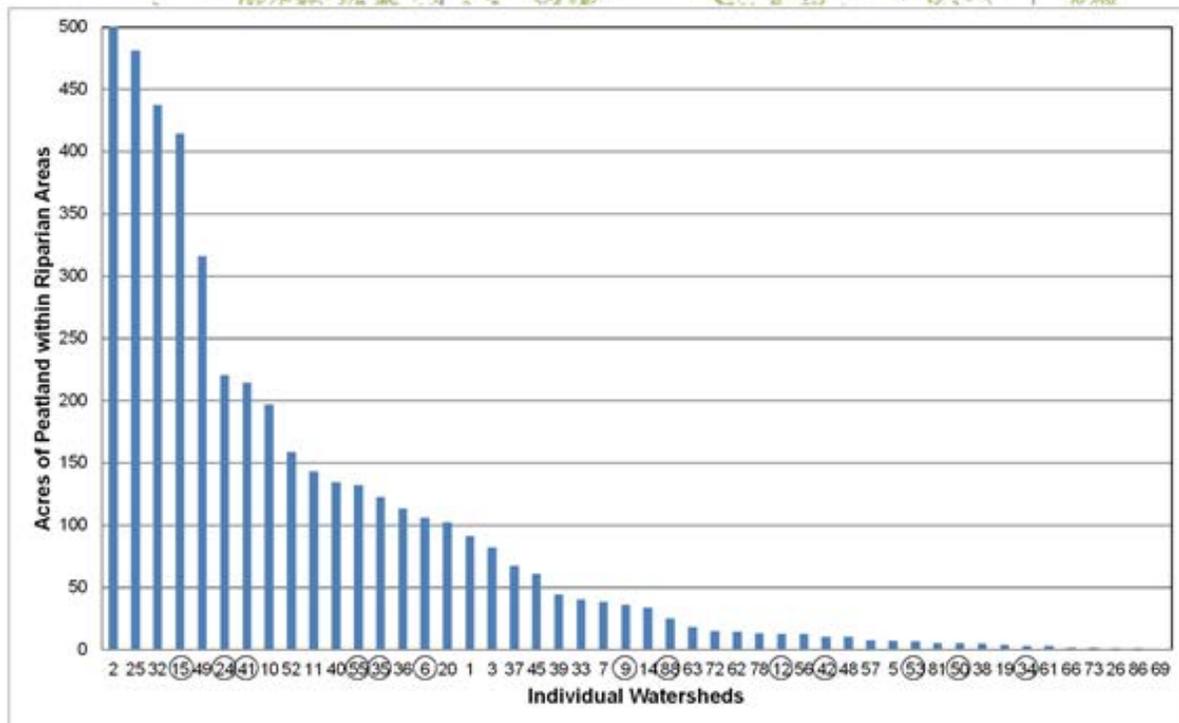
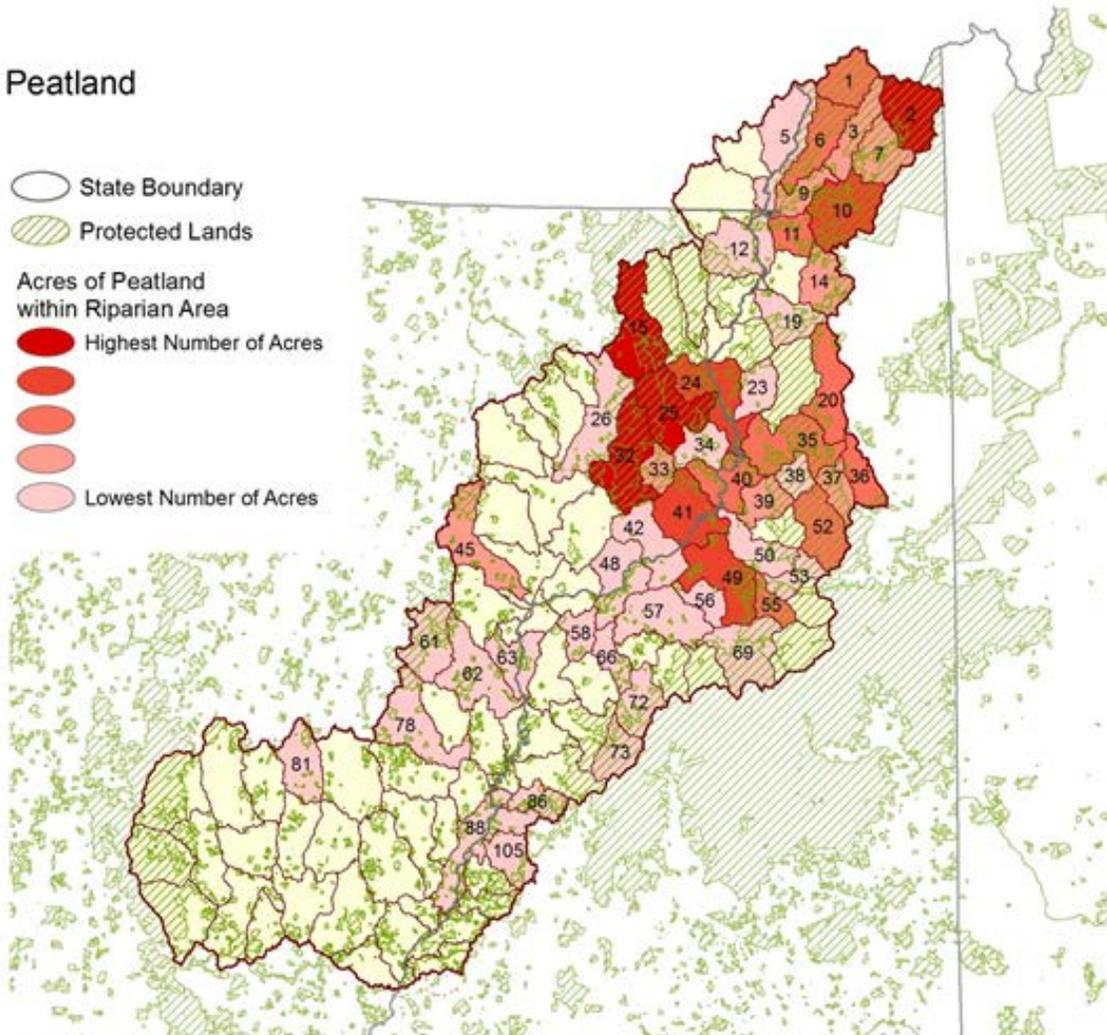
○ - Selected Priority Sub-watershed



○ - Selected Priority Sub-watershed

Peatland

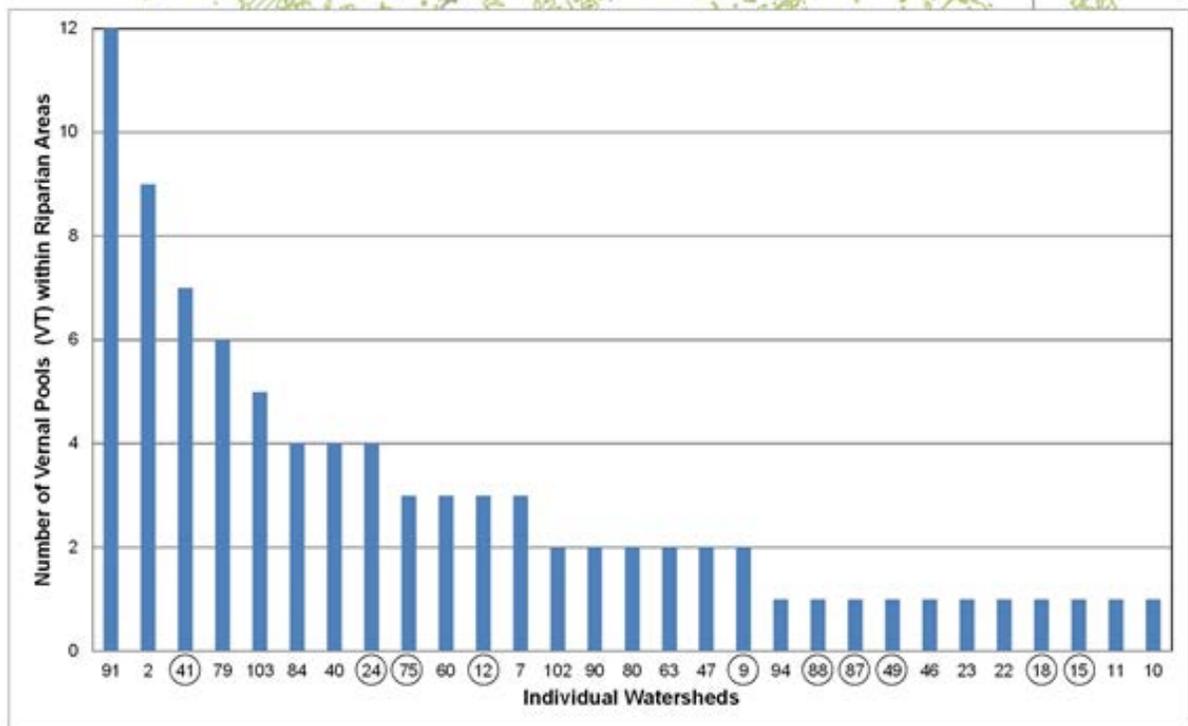
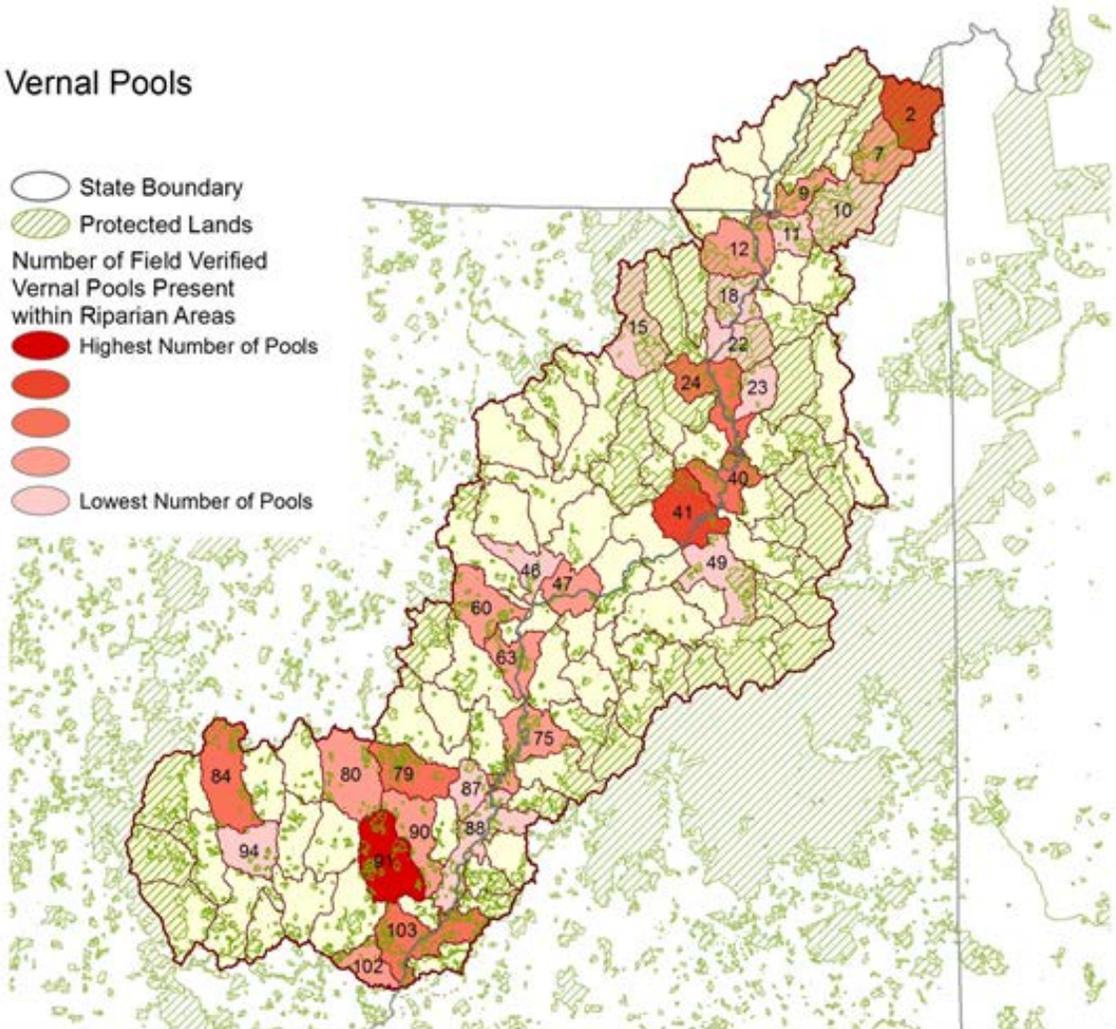
-  State Boundary
-  Protected Lands
- Acres of Peatland within Riparian Area
-  Highest Number of Acres
- 
- 
-  Lowest Number of Acres



○ - Selected Priority Sub-watershed

Vernal Pools

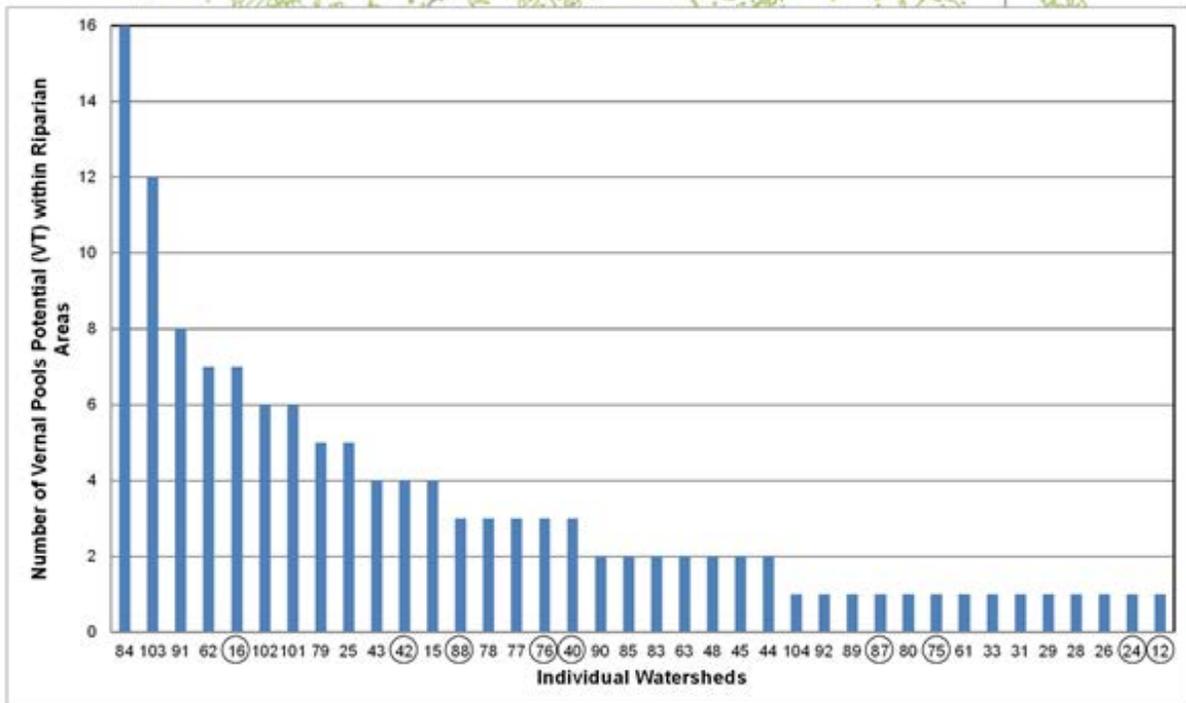
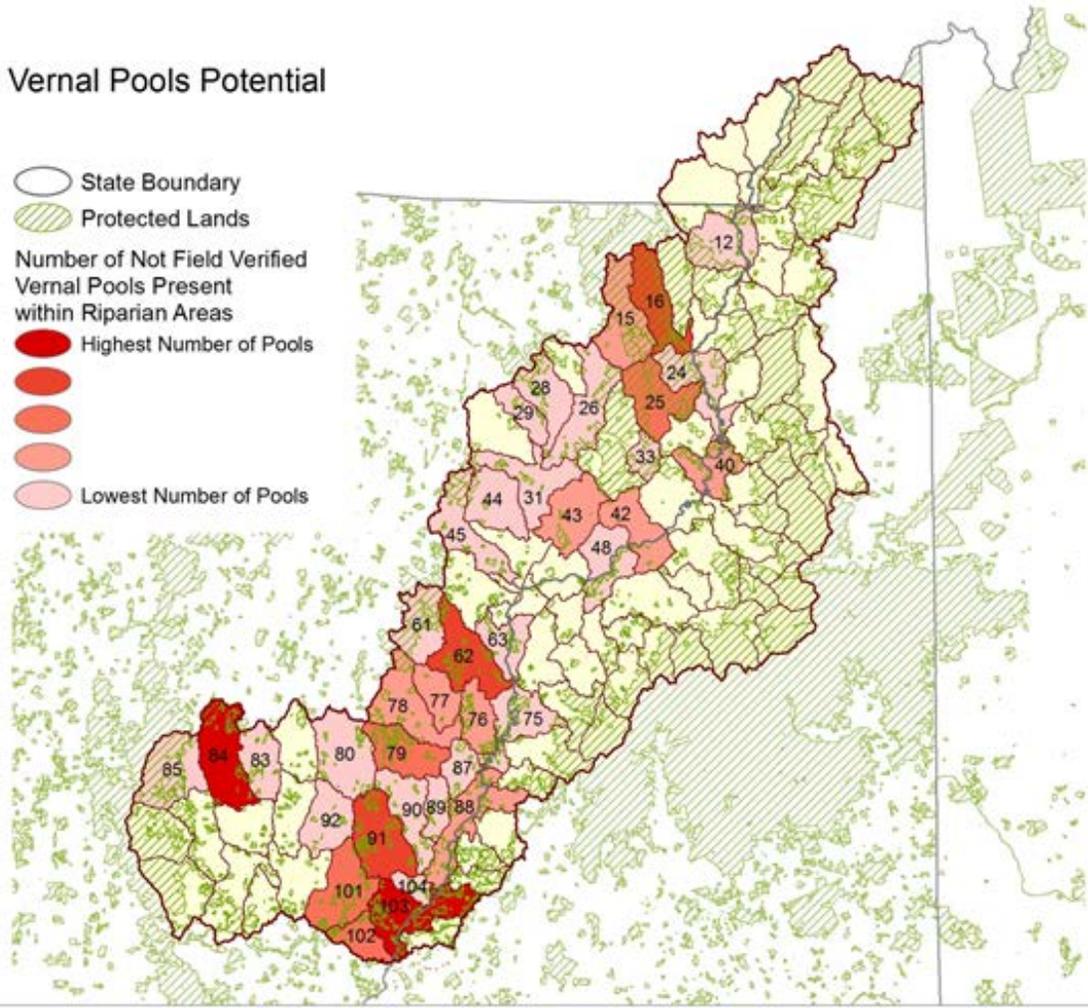
-  State Boundary
-  Protected Lands
- Number of Field Verified Vernal Pools Present within Riparian Areas
-  Highest Number of Pools
- 
- 
-  Lowest Number of Pools



○ - Selected Priority Sub-watershed

Vernal Pools Potential

-  State Boundary
-  Protected Lands
- Number of Not Field Verified Vernal Pools Present within Riparian Areas
-  Highest Number of Pools
- 
- 
-  Lowest Number of Pools

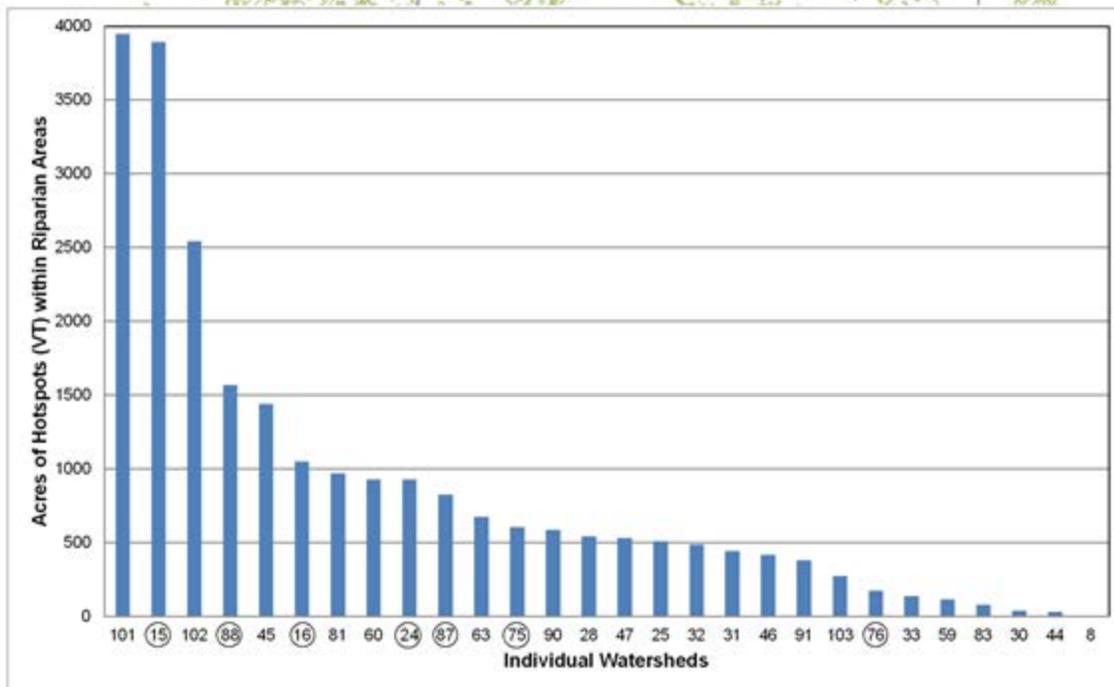
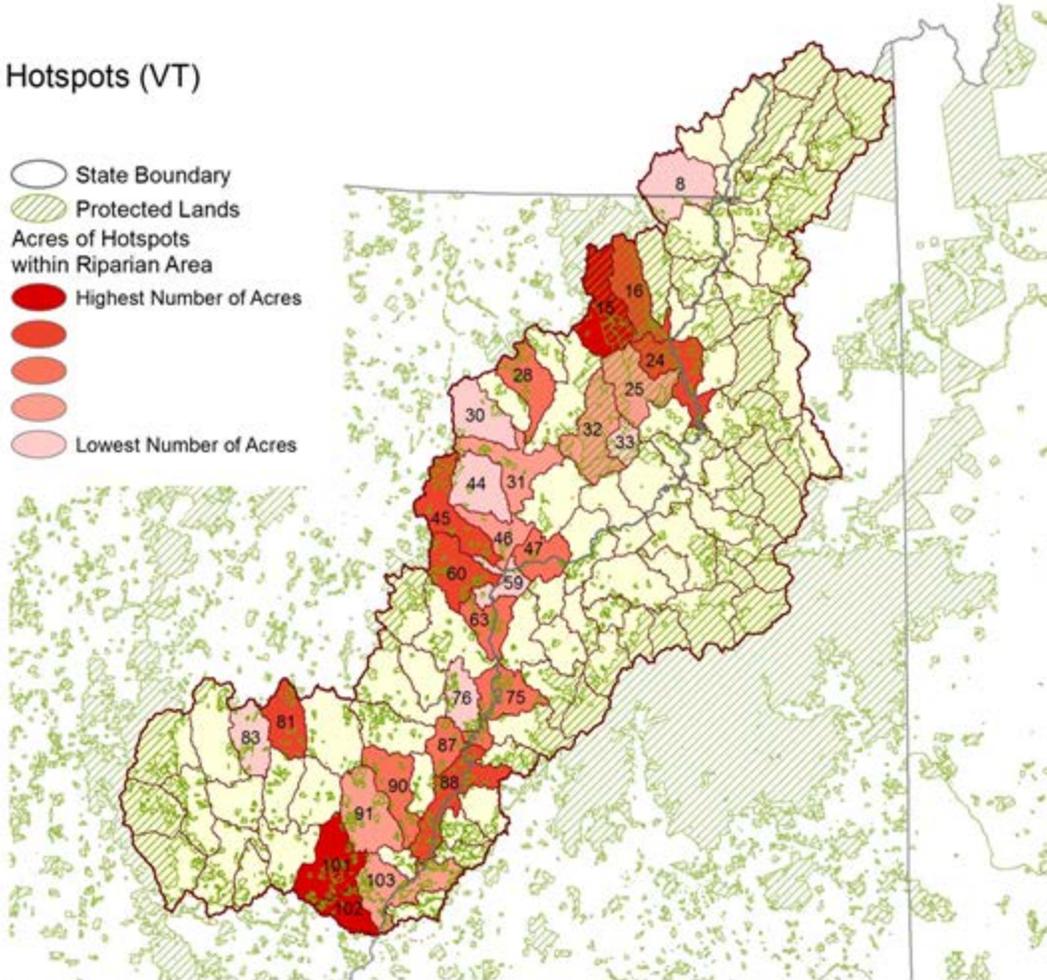


○ - Selected Priority Sub-watershed

Appendix D: Shoreland Protection (Riparian Resources) Maps and Charts

Hotspots (VT)

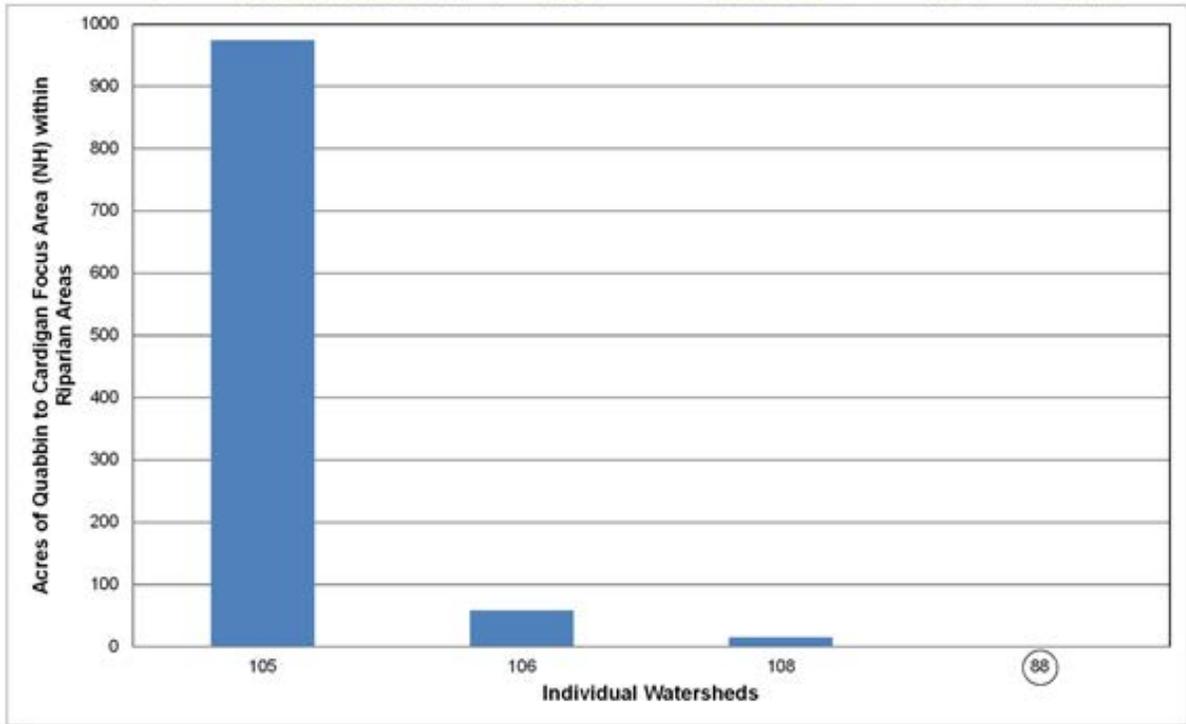
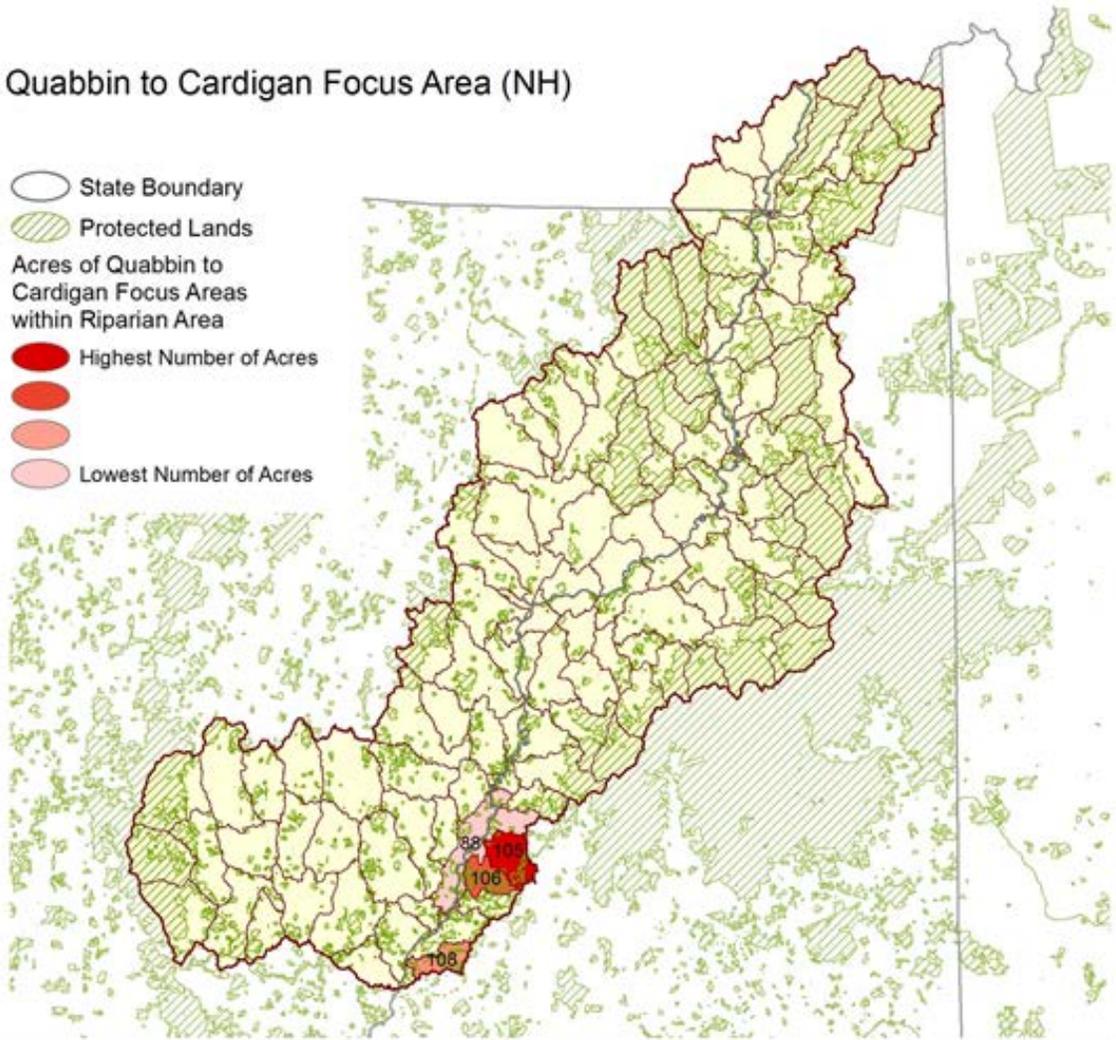
-  State Boundary
-  Protected Lands
- Acres of Hotspots within Riparian Area
-  Highest Number of Acres
-  Medium-High Acres
-  Medium-Low Acres
-  Lowest Number of Acres



○ - Selected Priority Sub-watershed

Quabbin to Cardigan Focus Area (NH)

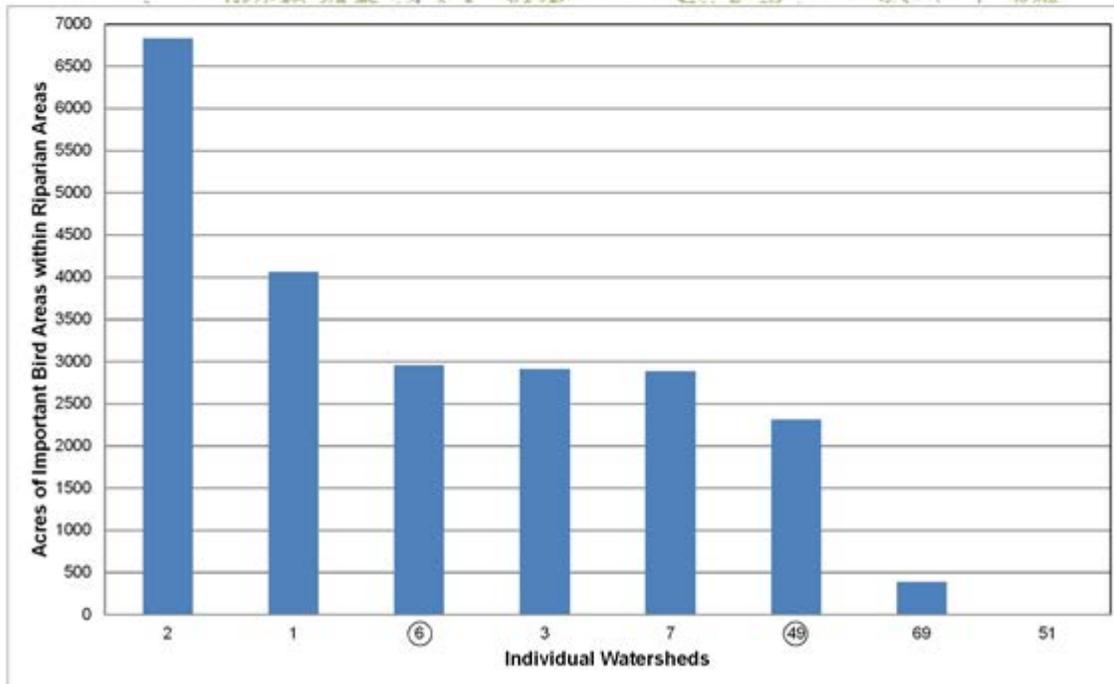
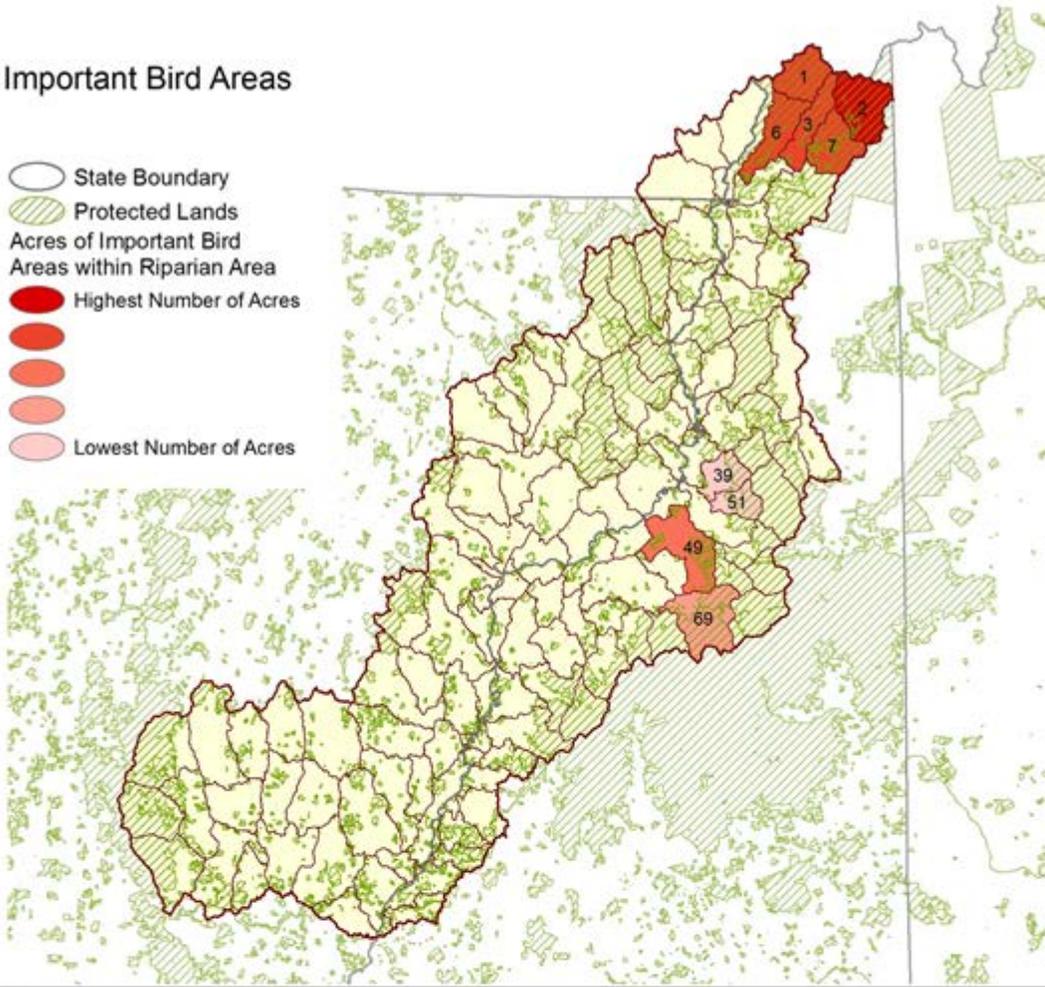
-  State Boundary
-  Protected Lands
- Acres of Quabbin to Cardigan Focus Areas within Riparian Area
-  Highest Number of Acres
-  Medium Number of Acres
-  Lowest Number of Acres



 - Selected Priority Sub-watershed

Important Bird Areas

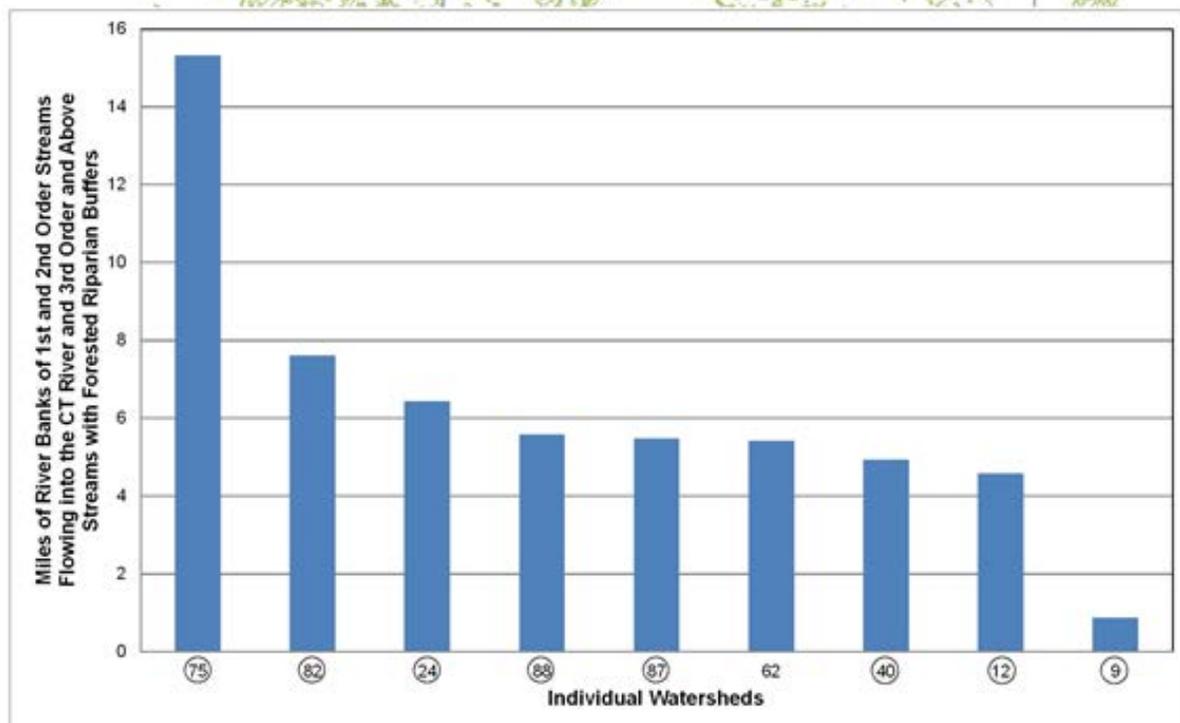
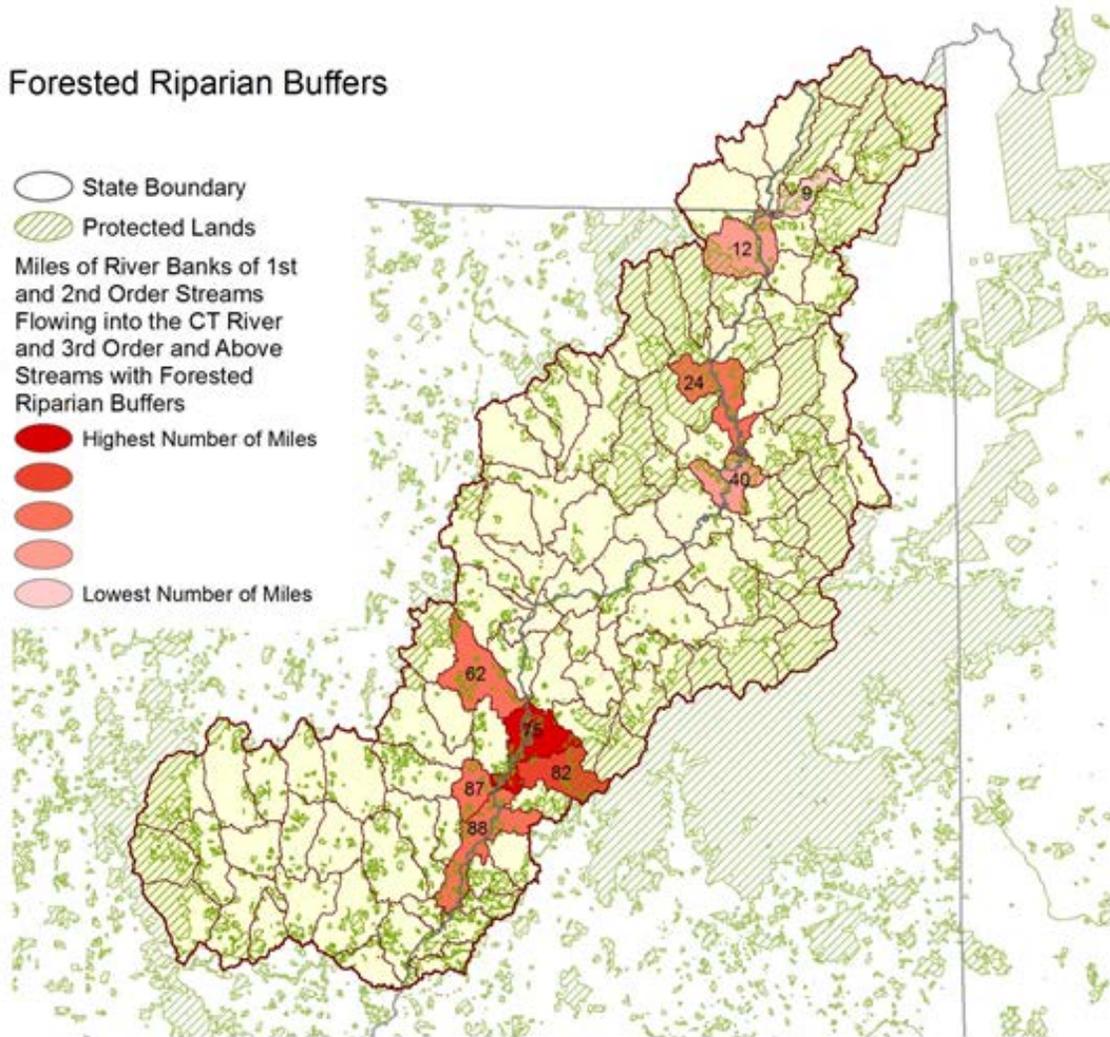
-  State Boundary
-  Protected Lands
- Acres of Important Bird Areas within Riparian Area
-  Highest Number of Acres
-  Medium-High Acres
-  Medium-Low Acres
-  Lowest Number of Acres



○ - Selected Priority Sub-watershed

Forested Riparian Buffers

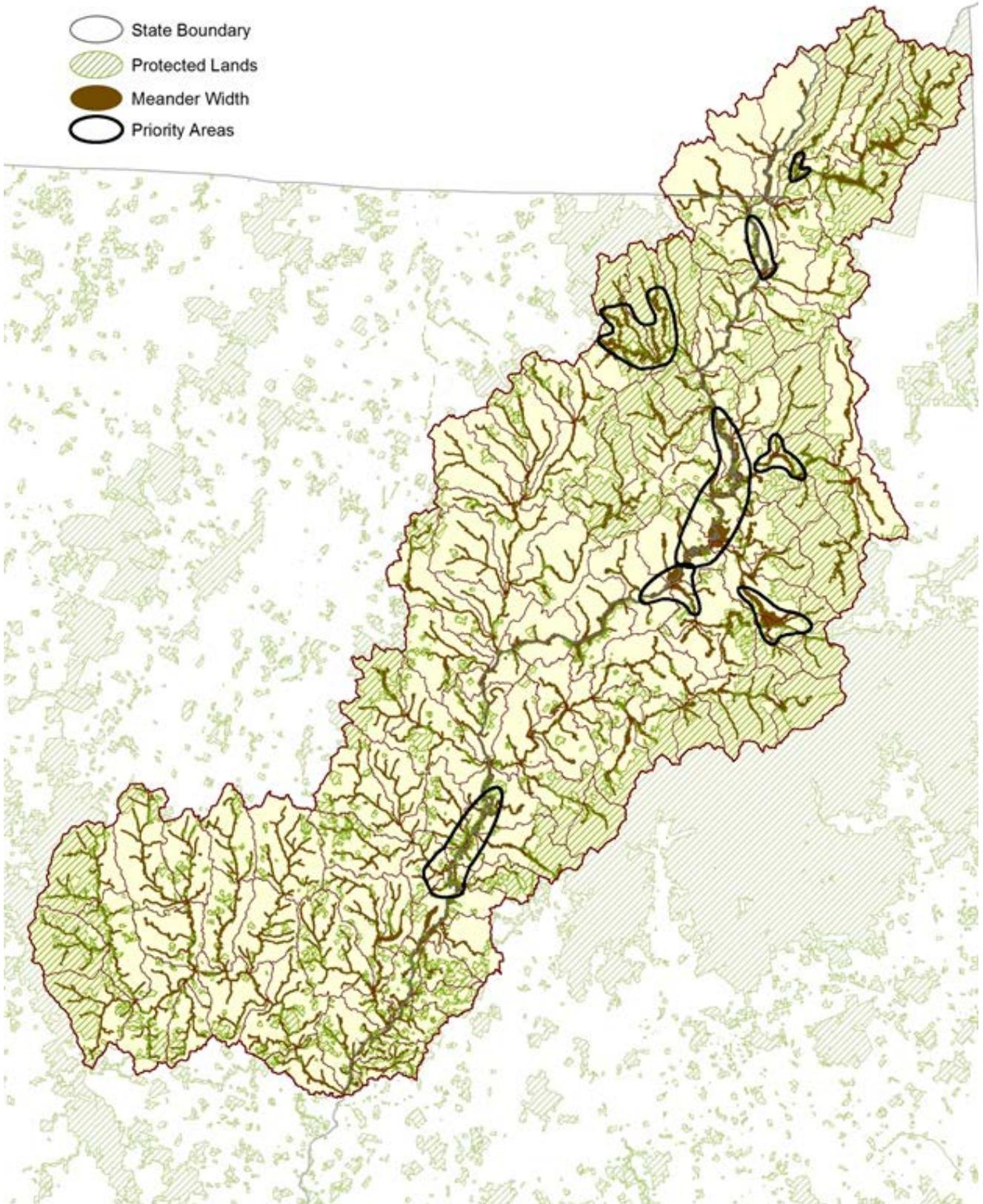
-  State Boundary
-  Protected Lands
- Miles of River Banks of 1st and 2nd Order Streams Flowing into the CT River and 3rd Order and Above Streams with Forested Riparian Buffers
-  Highest Number of Miles
-  Lowest Number of Miles



 - Selected Priority Sub-watershed

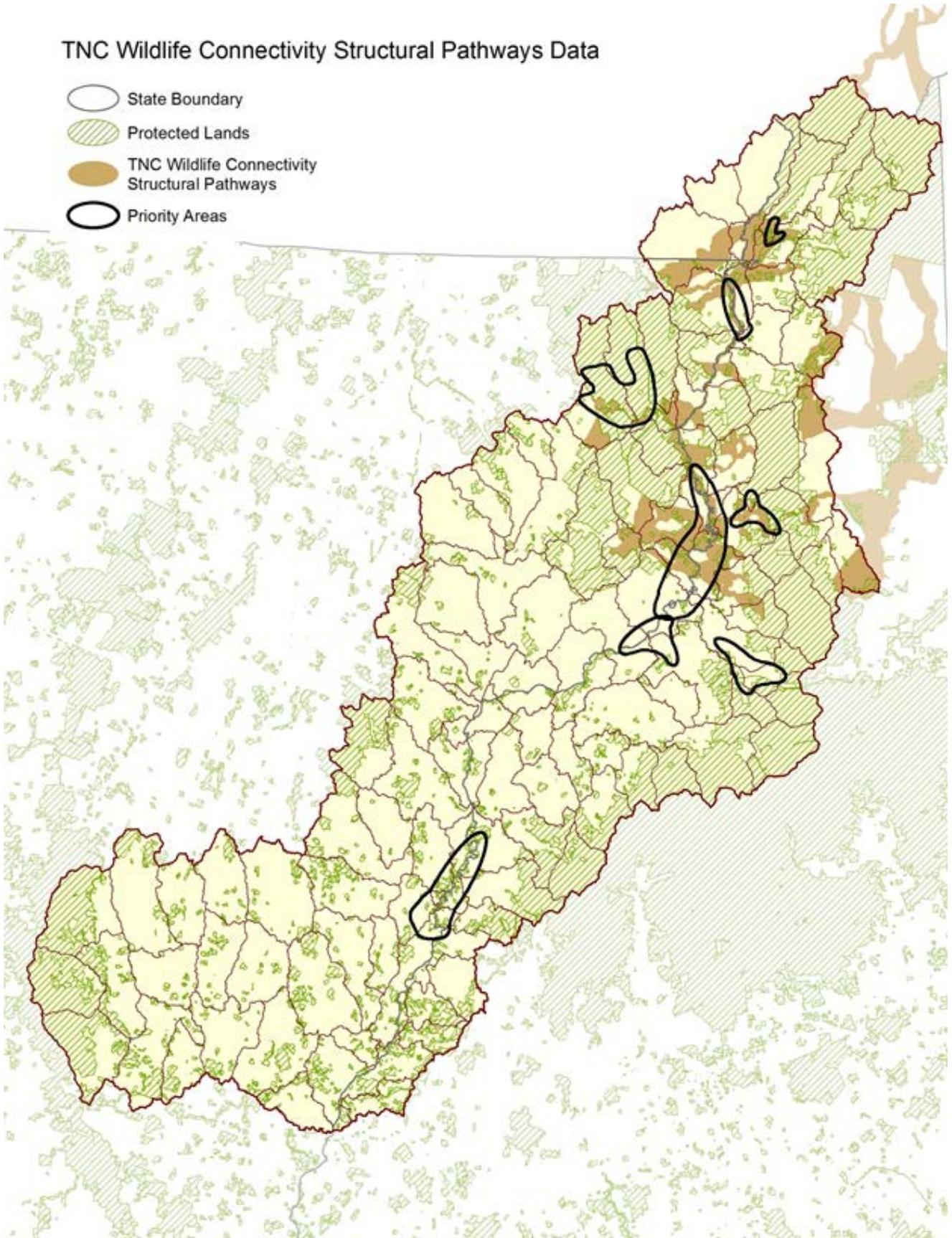
TNC Meander Width Data

- State Boundary
- ▨ Protected Lands
- Meander Width
- Priority Areas

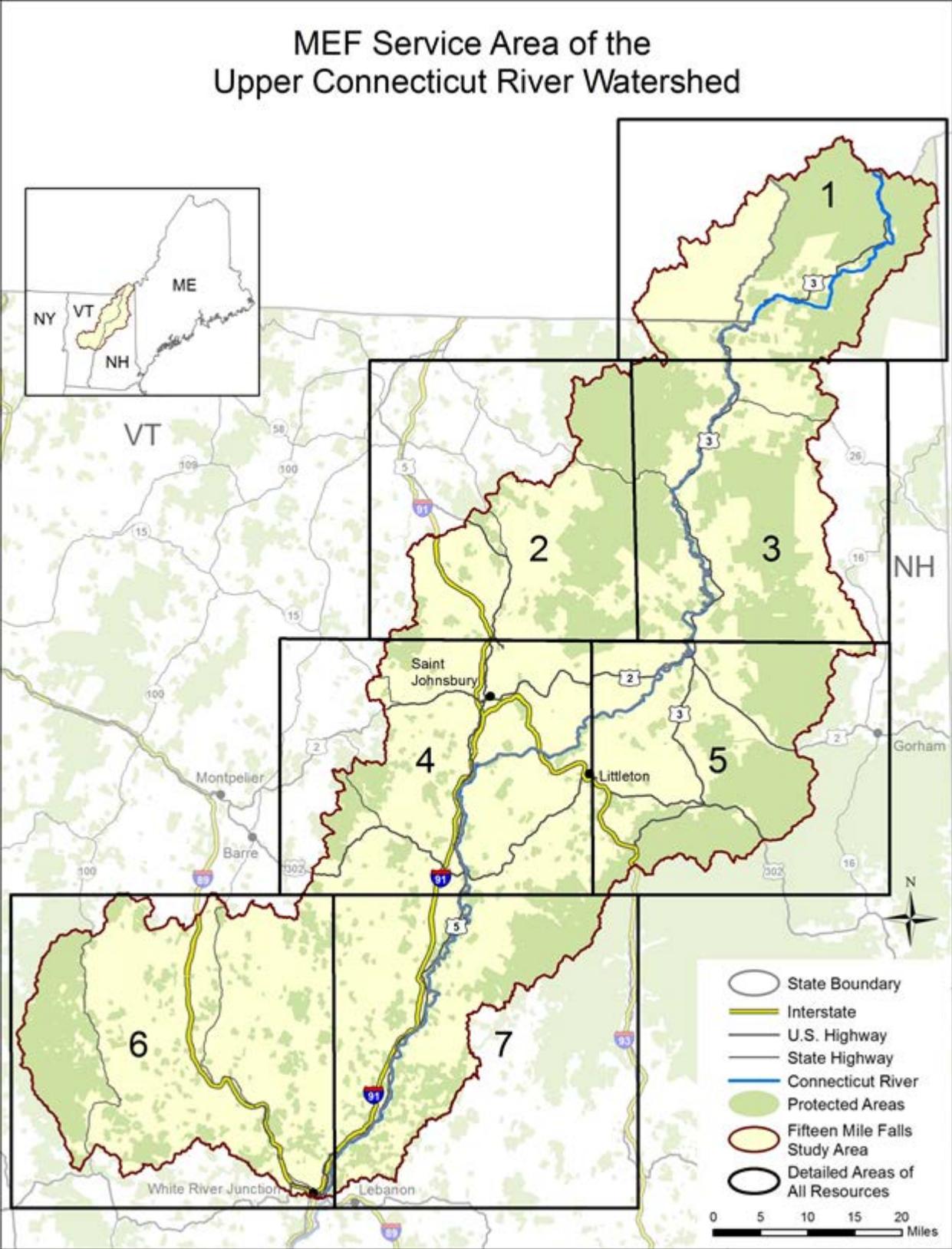


TNC Wildlife Connectivity Structural Pathways Data

- State Boundary
- ▨ Protected Lands
- TNC Wildlife Connectivity Structural Pathways
- Priority Areas



Appendix E: In-stream and Riparian Resources Zone Maps



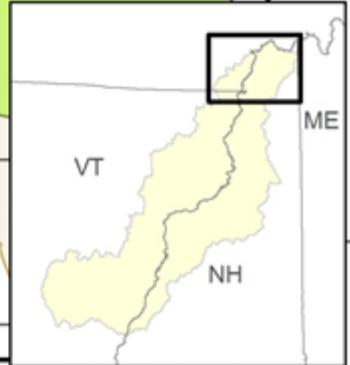
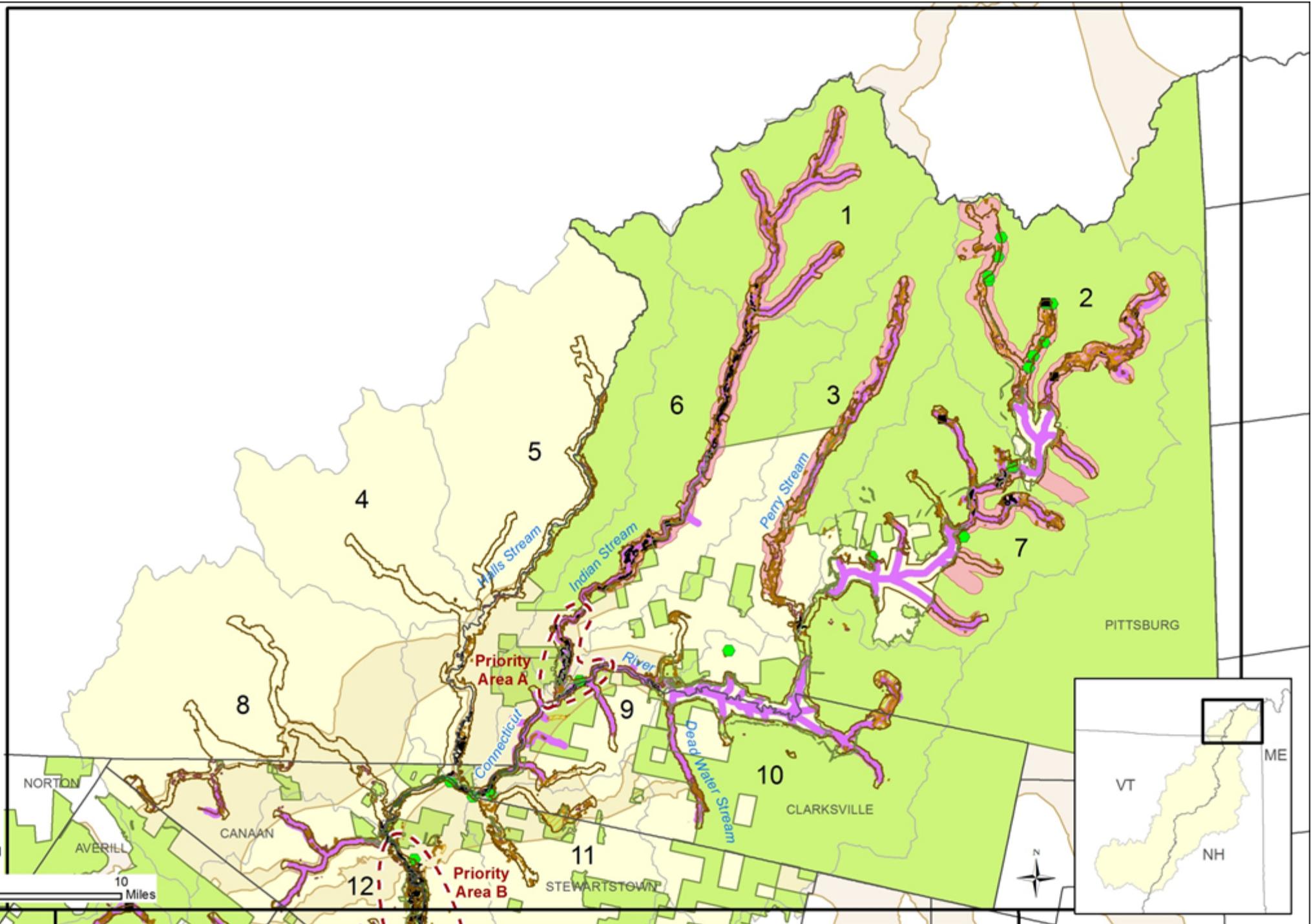
Zone 1

- Town Boundary
- Priority Areas
- Detail Areas
- Protected Lands
- HUC 12 Watershed with Project Id No
- Connecticut River
- Streams 1st and 2nd Order Flowing into CT and 3rd Order and Above
- Dams
- Vernal Pools
- Vernal Pools Potential
- Forested Riparian Buffer - Right Bank
- Aquatic Areas
- Peatland
- Marsh/Shrub Lands
- Floodplains
- Wetlands
- Important Bird Areas
- Meander Width
- Structural Pathways

- State Special Concern Species Occurrence*
- | |
|-------------------|
| Species A - 9 |
| Species B - 10 |
| Species C - 6, 10 |
| Species D - 9, 10 |
| Species E - 6 |
| Species F - 2 |

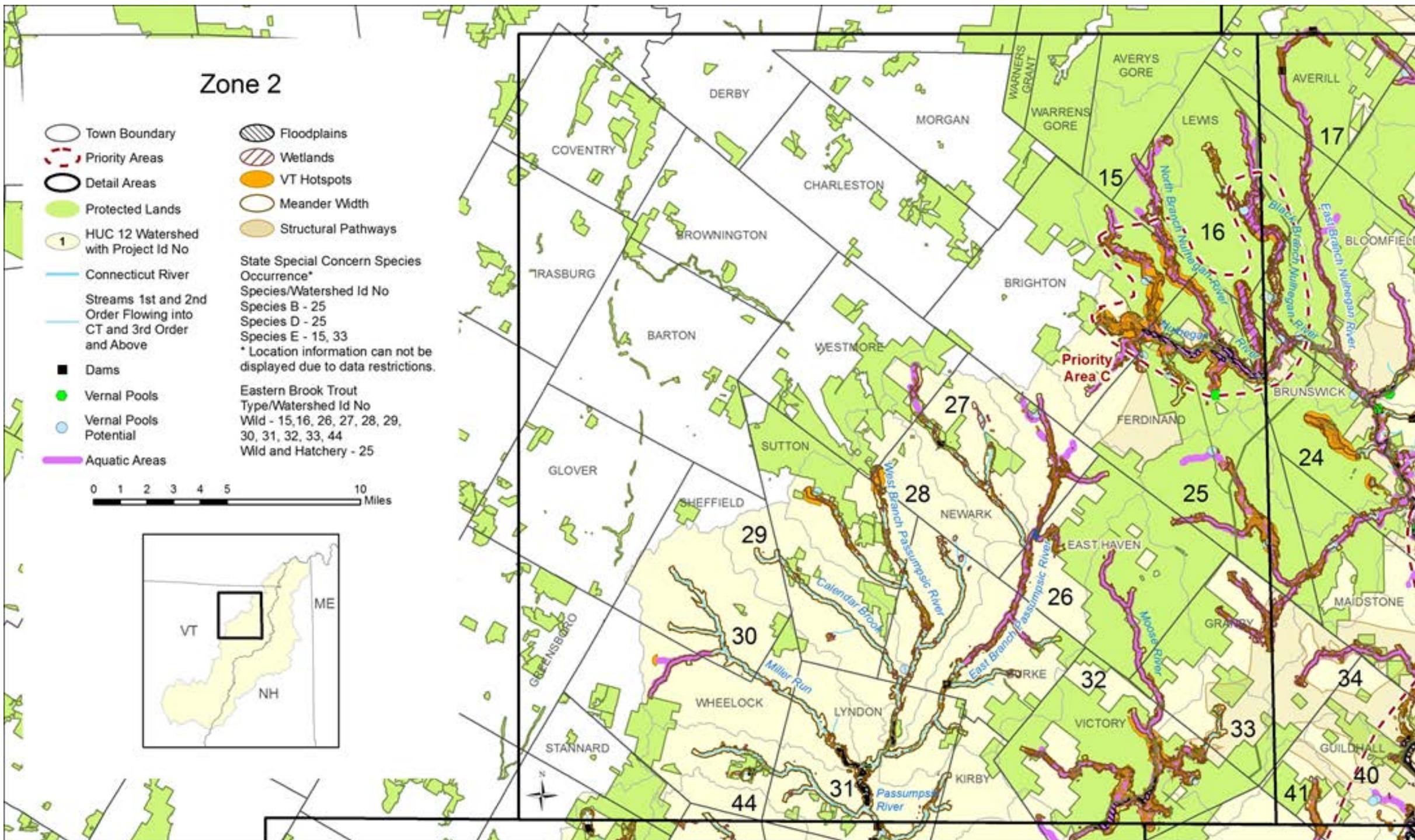
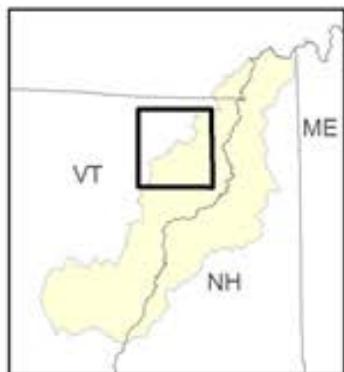
* Location information can not be displayed due to data restrictions.

- Eastern Brook Trout Type/Watershed Id No
- | |
|----------------------------------------------|
| Wild - 4, 5, 8, 12 |
| Wild and Hatchery - 1, 2, 3, 6, 7, 9, 10, 11 |



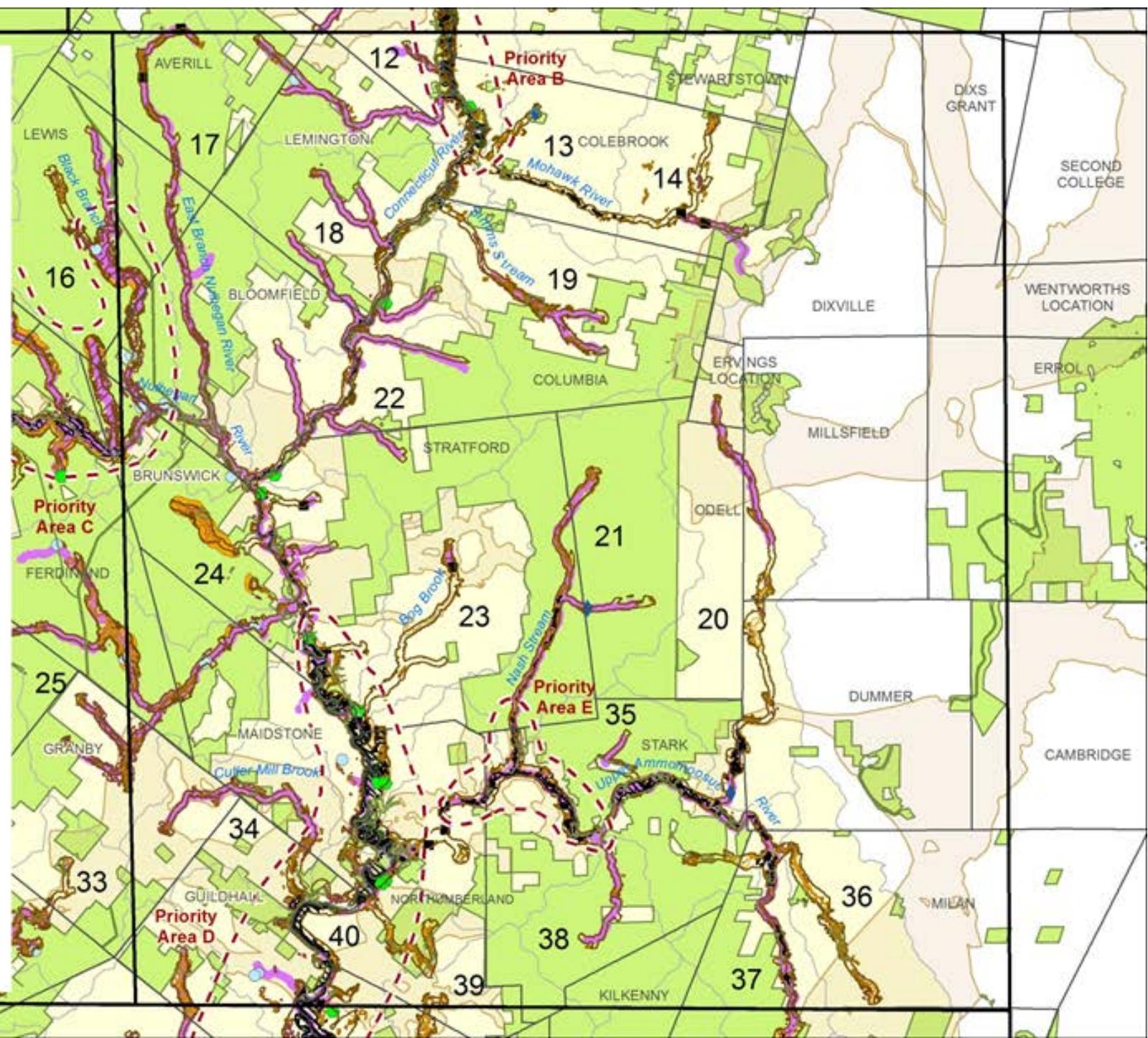
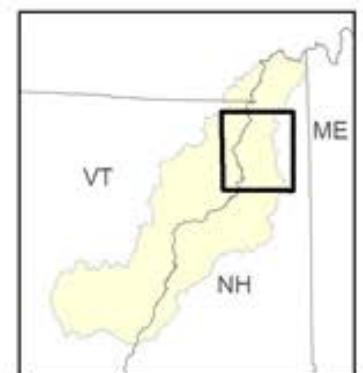
Zone 2

- Town Boundary
 - Priority Areas
 - Detail Areas
 - Protected Lands
 - HUC 12 Watershed with Project Id No
 - Connecticut River
 - Streams 1st and 2nd Order Flowing into CT and 3rd Order and Above
 - Dams
 - Vernal Pools
 - Vernal Pools Potential
 - Aquatic Areas
 - Floodplains
 - Wetlands
 - VT Hotspots
 - Meander Width
 - Structural Pathways
- State Special Concern Species Occurrence*
- Species B - 25
 - Species D - 25
 - Species E - 15, 33
- * Location information can not be displayed due to data restrictions.
- Eastern Brook Trout Type/Watershed Id No
- Wild - 15, 16, 26, 27, 28, 29, 30, 31, 32, 33, 44
 - Wild and Hatchery - 25



Zone 3

- Town Boundary
- Priority Areas
- Detail Areas
- Protected Lands
- HUC 12 Watershed with Project Id No
- Connecticut River
- Streams 1st and 2nd Order Flowing into CT and 3rd Order and Above
- Dams
- Vernal Pools
- Vernal Pools Potential
- Dwarf Wedgemussel
- Forested Riparian Buffer - Right Bank
- Aquatic Areas
- Peatland
- Marsh/Shrub Lands
- Floodplains
- Wetlands
- VT Hotspots
- Meander Width
- Structural Pathways
- State Special Concern Species Occurrence***
- Species/Watershed Id No**
- Dwarf Wedgemussel - 40
- Species A - 24
- Species B - 25
- Species C - 14, 21
- Species D - 24, 25, 35, 36
- Species E - 24, 33, 35, 36, 39
- Species G - 18
- * Location information can not be displayed due to data restrictions.
- Eastern Brook Trout Type/Watershed Id No**
- Wild - 13, 14, 18, 20, 22, 24, 34, 36, 37, 38, 39, 40
- Wild and Hatchery - 17, 19, 21, 23, 35

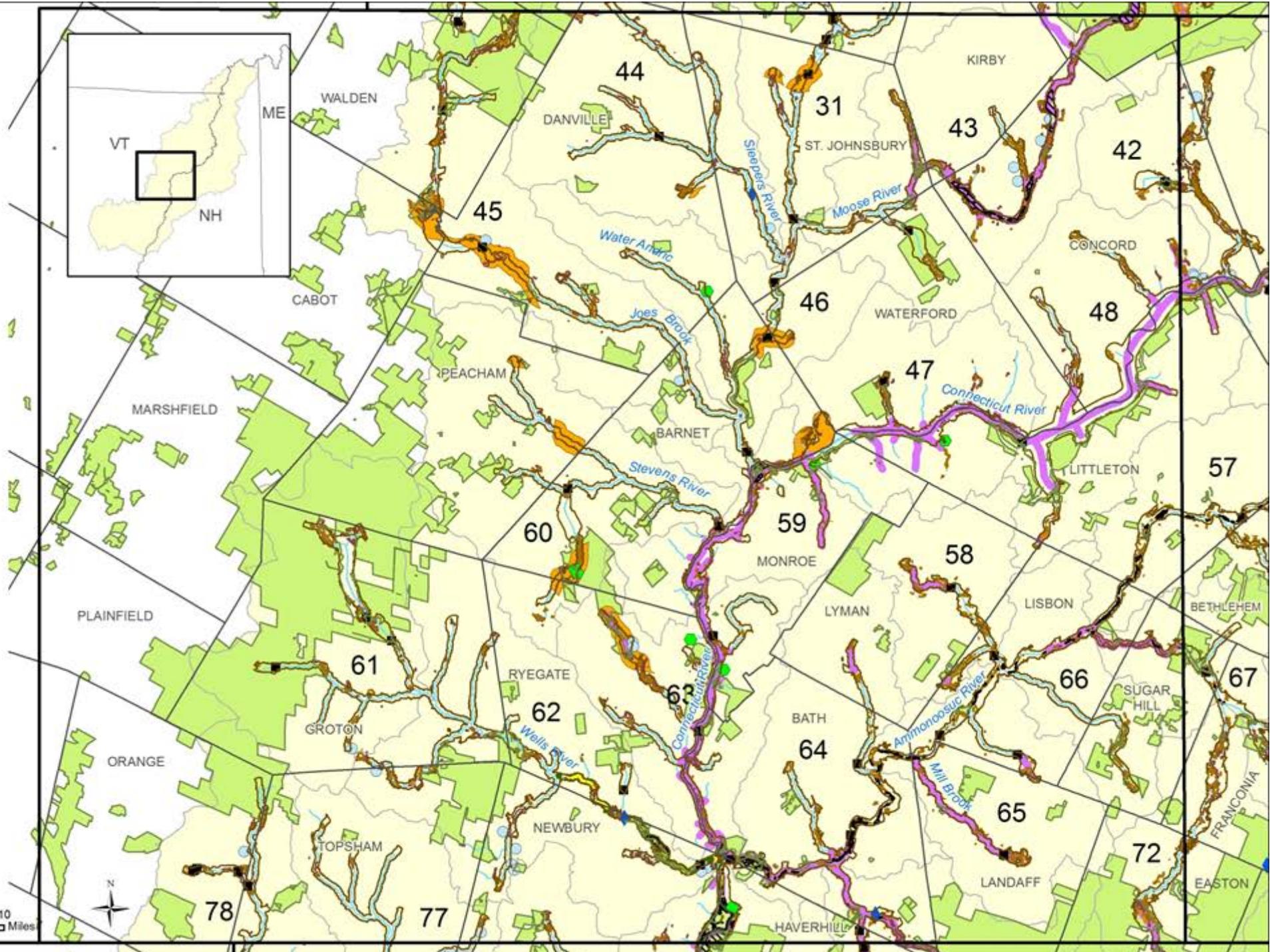


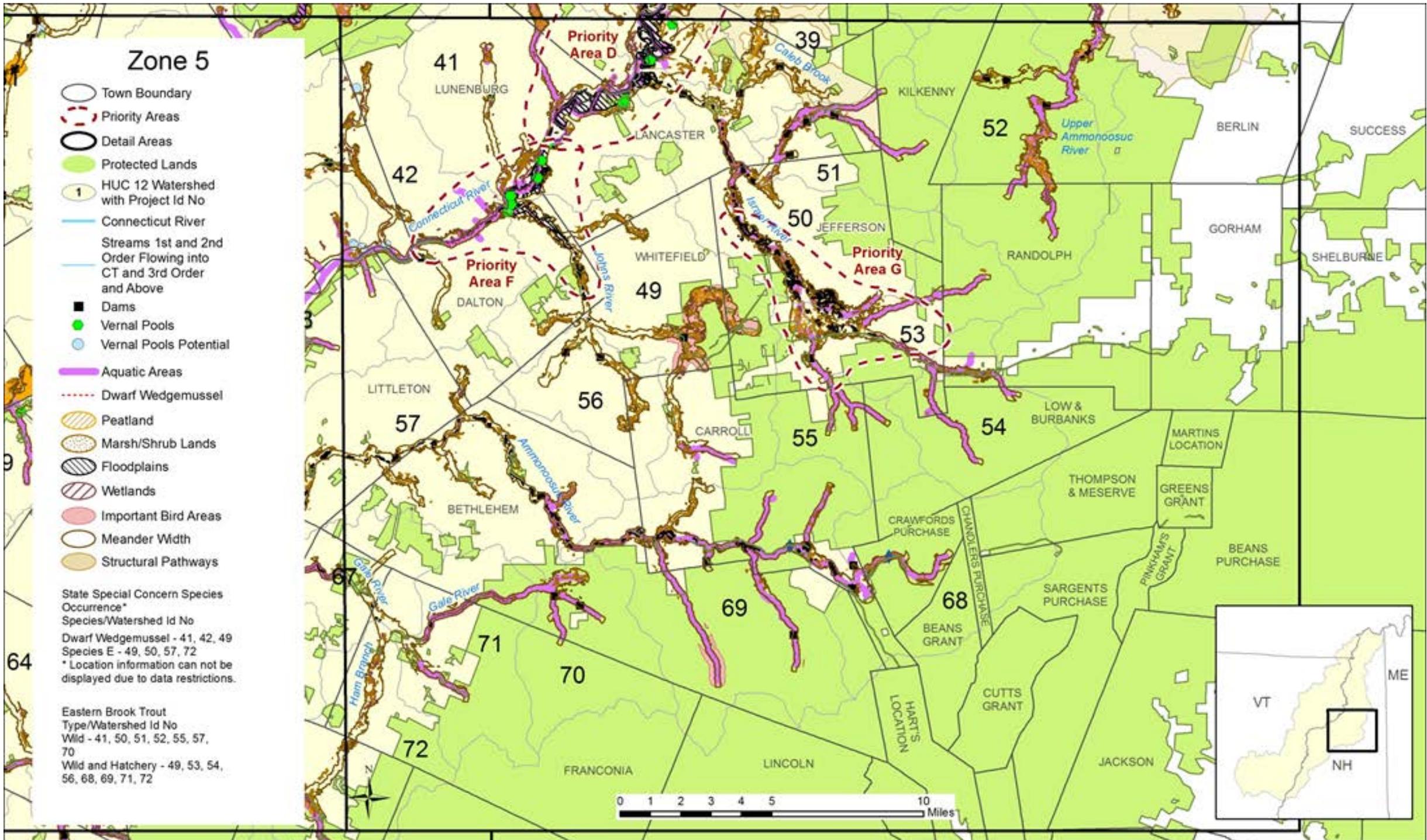
Zone 4

-  Town Boundary
-  Detail Areas
-  Protected Lands
-  HUC 12 Watershed with Project Id No
-  Connecticut River
-  Streams 1st and 2nd Order Flowing into CT and 3rd Order and Above
-  Dams
-  Vernal Pools
-  Vernal Pools Potential
-  Forested Riparian Buffer - Right Bank
-  Aquatic Areas
-  Peatland
-  Marsh/Shrub Lands
-  Floodplains
-  Wetlands
-  VT Hotspots
-  Meander Width

State Special Concern Species Occurrence*
 Species/Watershed Id No
 Species A - 47, 48, 59, 65
 Species D - 47, 48, 64
 Species F - 57
 * Location information can not be displayed due to data restrictions.

Eastern Brook Trout
 Type/Watershed Id No
 Wild - 42, 43, 44, 47, 57, 58, 59, 61, 62, 63, 64, 66, 77, 78
 Wild and Hatchery - 45, 46, 48, 60, 65, 67, 72





Zone 6

○ Town Boundary

○ Detail Areas

Protected Lands

1 HUC 12 Watershed with Project Id No

Connecticut River

Streams 1st and 2nd Order Flowing into CT and 3rd Order and Above

■ Dams

● Vernal Pools

● Vernal Pools Potential

■ Aquatic Areas

▨ Floodplains

▨ Marsh/Shrub Lands

▨ Peatland

▨ Wetlands

○ VT Hotspots

○ Meander Width

State Special Concern Species Occurrence*

Species A - 103

Species E - 103, 104

* Location information can not be displayed due to data restrictions.

Eastern Brook Trout

Type/Watershed Id No

Wild - 78, 79, 81, 83, 85, 90, 91, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104

Wild and Hatchery - 80, 84, 92

