

# Action Plan for the Meadow River Wetlands Conservation Focus Area

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October 11, 2021

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## List of Acronyms Used

ACEP- Agricultural Conservation Easement Program

AFF- American Forest Foundation

AMJV- Appalachian Mountain Joint Venture

ATFS- American Tree Farm System

BMPs- Best Management Practices

B-Rank- Biodiversity Rank

CFA- Conservation Focus Area

CCV- Cave Conservancy of the Virginias

CCVI- Climate Change Vulnerability Index

CERW- Cerulean Winged Warbler

CREP- Conservation Reserve Enhancement Program

CRP- Conservation Reserve Program

CSP- Conservation Stewardship Program

EQIP- Environmental Quality Improvement Program

FSA- Farm Service Agency

FSC- Forest Stewardship Council

G Rank- Global Rank

GWWA- Golden-winged Warbler

HUC- Hydrologic Unit Code

NRCS- Natural Resources Conservation Service

NWTF- National Wild Turkey Foundation

OHCF- Outdoor Heritage Conservation Fund

RGS- Roughed Grouse Society

SGCN- Species of Greatest Conservation Need

SFI- Sustainable Forestry Initiative

S Rank- State Rank

SWAP- State Wildlife Action Plan

TCF- The Conservation Fund

TNC- The Nature Conservancy

TU- Trout Unlimited

USDA- United States Department of Agriculture

USFWS- United States Fish and Wildlife Service

WMA- Wildlife Management Area

WVACS- West Virginia Association for Cave Studies

WVCA- West Virginia Conservation Agency

WVCC- West Virginia Cave Conservancy

WVDA- West Virginia Department of Agriculture

WVDEP- West Virginia Department of Environmental Protection

WVDHHR- Department of Health and Human Resources

WVDNR- West Virginia Division of Natural Resources

WVDOF- West Virginia Division of Forestry

WVDOH- West Virginia Division of Highways

WVLT- West Virginia Last Trust

WVU- West Virginia University

## Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the first revision to the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species, and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups, cave interest groups and other non-profit conservation organizations working in the area to develop the Action Plan for the Meadow River Wetlands CFA. The plan addresses the eight essential elements required in the SWAP. It provides an overview of the landscape and major habitat types within this CFA, including forest and woodland habitats, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. It also identifies 50 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the plan lists the priority species, stresses and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. An implementation plan for each major habitat type lists partners and programs available to assist with each of the actions as well as metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience, and outlines next steps in plan implementation.

Local stakeholders can use this plan to identify priority species, the habitats and stresses within the CFA, as well as partners who can assist with planning, implementation and monitoring of conservation actions to conserve wildlife and enable climate adaptation. The information in this plan can also be used to inform conservation projects being planned by partners and provide justification for grant applications and other proposals seeking to conserve priority species and habitats. Local stakeholders can also work with relevant agencies to develop strategies to avoid, minimize and mitigate impacts to priority species, their habitats and the resilient and connected landscapes within the CFA.

Conserving wildlife species and their habitat within the CFA will rely upon the voluntary actions of local landowners, public agencies and partner organizations, with support from the WVDNR. WVDNR will convene a working group of local stakeholders on a regular basis to provide guidance, assistance and support; implement and monitor conservation actions; facilitate stakeholder collaboration; and update the plan every 10 years or sooner if needed.

## Introduction to the State Wildlife Action Plan & Conservation Focus Areas

The West Virginia Division of Natural Resources (WVDNR) manages the state's wildlife resources as part of the public trust. A goal of the WVDNR is to support and promote a sense of ownership in the conservation community and the public for the unique habitats and wildlife resources in West Virginia. The 2015 WV State Wildlife Action Plan (SWAP) was therefore developed to function as a blueprint for conservation for use by other natural resource agencies, local governments, non-governmental organizations and the general public (WVDNR 2015). The SWAP is intended to have a ten-year timeframe and will be updated by 2025.

## Species of Greatest Conservation Need, Habitats and Stresses

The 2015 SWAP identified 681 wildlife Species of Greatest Conservation Need (SGCN) across the state. Because plants are a fundamental element of habitat for wildlife SGCN, a list of SGCN plants was also developed, including 482 plant species.

The SWAP classified and mapped 19 terrestrial habitats across the state. These include 16 natural or semi-natural habitats that are derived from NatureServe's Ecological Systems (Comer et al., 2003, Gawler 2008) and 3 anthropogenic habitats that represent map classes of the National Land Cover Database (Homer et al., 2004). In addition, the SWAP classifies and maps 18 aquatic habitat types. These are GIS-derived types based on a simplification for West Virginia of the Northeast Aquatic Habitat Classification System (Anderson et al., 2013). Stream size is considered the most influential variable on determining biological assemblages at the reach scale and is divided into four primary classes: headwaters and creeks, small rivers, medium rivers and large rivers. Stream slope, or gradient, affects aquatic communities at the reach scale due to its influence on stream bed morphology, water velocity and sediment dynamics. Three relative classes (low, moderate, high) of gradient are used to define West Virginia's streams. Water temperature in streams is a key physiological characteristic determining where different stream organisms may persist. Temperature affects seasonal migrations, growth rates, body condition and fecundity of biota. Three temperature classes (cold, cool, warm) based on continuously recorded data and modeled environmental variables were used to determine biological constraints on stream communities in the model. The characteristics, distribution, trends and threats associated with each of the terrestrial and aquatic habitats are described in the 2015 SWAP.

For those SGCN listed in the SWAP as priority species and their associated habitats, WVDNR staff developed a statewide stress assessment using the classification system of the International Union for Conservation of Nature. Terrestrial stresses were addressed at the habitat level within ecoregions. Aquatic stresses were addressed at the HUC 8 watershed level within ecoregions. The resulting analysis identified 21 major statewide stresses affecting terrestrial SGCN and habitats and 21 major stresses that affect aquatic SGCN and habitats. Stresses exerted on SGCN populations and habitats can reduce species populations either directly, by causes such as disease, or indirectly, by affecting the quality or quantity of available habitat.

## Conservation Actions

The purpose of stress assessment and prioritization in the 2015 SWAP is to identify statewide conservation actions that can reduce stress on SGCN populations and their habitats. Most stresses are the result of the lawful activities of people, corporations and public agencies. Rather than seeking a regulatory approach to

restrict lawful activities, the intent of the SWAP is to promote collaboration with landowners, corporations and other partner organizations and agencies to reduce stresses on wildlife species and their habitats.

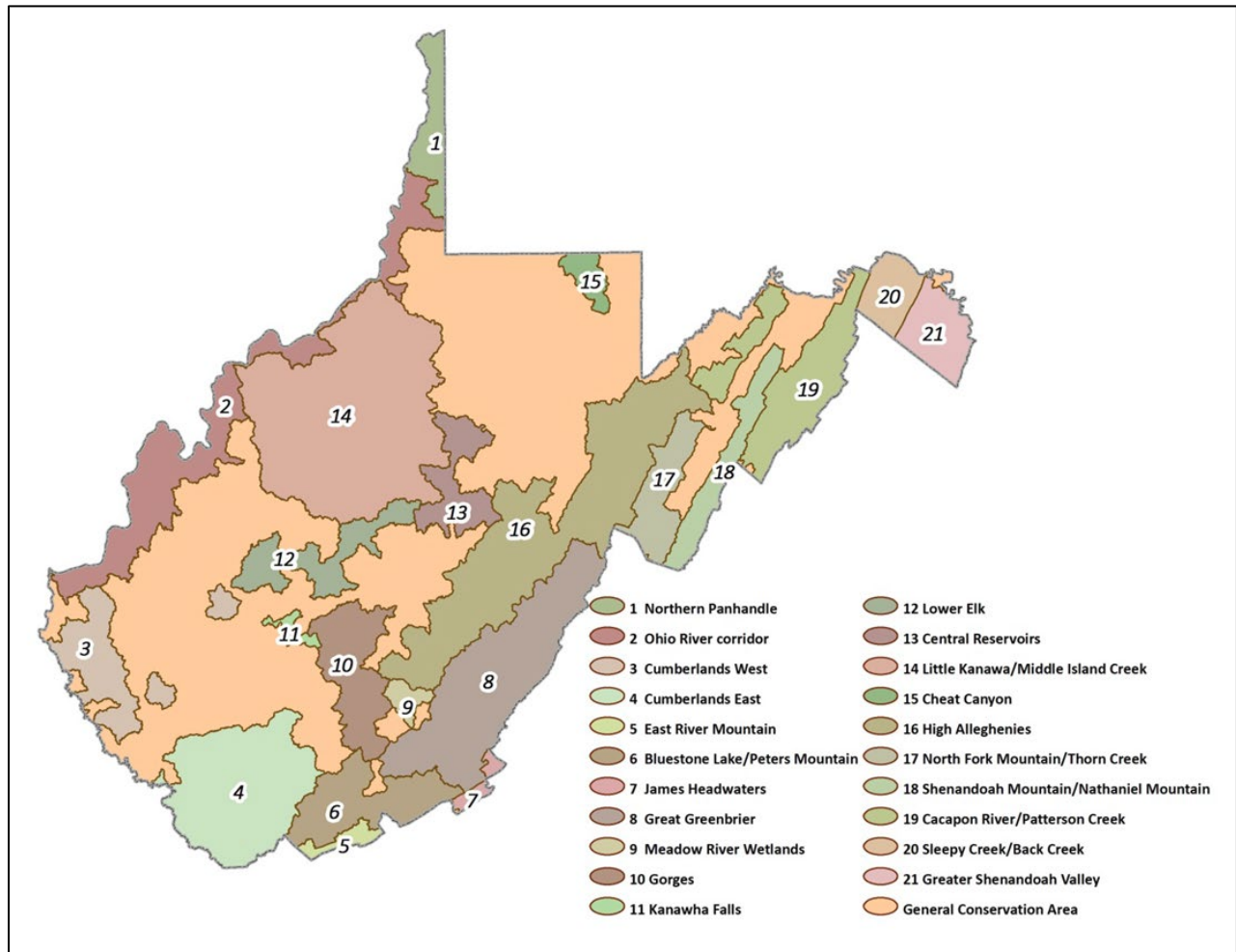
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve directly protecting or restoring habitats or even restoring populations. Conservation easements are a form of habitat protection that preserves habitat in its current state or can include land management plans that benefit wildlife. It is likely that a suite of actions is required depending on the identified stress and the opportunities available. Ideally, actions are designed to address the source of the stress (AFWA 2011). Conservation actions must also address habitat integrity and ecosystem processes. This includes conserving or preserving intact and functional habitats, protecting or restoring aquatic resources and maintaining and restoring connectivity between habitats (AFWA 2012, Byers and Norris, 2011).

### Conservation Focus Areas and Action Plans

The SWAP provides a broad framework for conservation across West Virginia. However, wildlife species are concentrated in different parts of the state and exposed to multiple stresses at state, regional and local scales. Conservation Focus Areas (CFAs) are specific regions in the state where SGCNs are concentrated, addressable threats are identified and where feasible opportunities exist for focused actions that will achieve success. In completing the 2015 SWAP, WVDNR defined 21 CFAs across the state based on these factors. Map 1 on the following page illustrates the CFAs in West Virginia.

In addition to conservation actions at the statewide level, the 2015 SWAP envisioned that planning at the CFA level would be necessary to fully implement successful conservation and to further define conservation actions and measurable outcomes for most SWAP-based activities. The SWAP also notes that investing conservation resources in the CFAs could increase the potential for collaboration with partners and landowners, as well as the efficiency and effectiveness of conservation on the ground. CFA Action Plans have been developed to identify priority SGCN from each taxa group in each major habitat type, key stresses in those habitats and actions that will effectively secure or protect priority species and their habitats within the CFA. The Plans also identify public lands that can provide opportunities for conservation in collaboration with public land managers. Because many SGCN and their habitats occur on private property within CFAs, conservation actions will require collaboration with private landowners, as well as partner organizations and stakeholder groups. Many local partners have relations with landowners as well as the expertise, capacity, resources and funding to plan and implement the actions listed in CFA Action Plans. CFA planning engages local partners and stakeholders at a scale where collaboration can increase resources (funding, capacity) available for conservation action. WVDNR has engaged a working group of local partners in developing each CFA Action Plan and intends to facilitate, guide and support partner efforts in planning, implementation and evaluation of conservation actions to implement the plans.

*Map 1. Conservation Focus Areas in West Virginia.*



The 2015 SWAP lists climate change as a substantial threat to wildlife and plant populations, noting several recent studies. For example, an assessment of the relative vulnerability to climate change of 185 animal and plant species in West Virginia (Byers and Norris, 2011) identified natural and anthropogenic barriers to movement and dispersal and physiological thermal and hydrological niches occupied by some species as risk factors correlated with vulnerability to climate change. Over half of the species assessed were determined to be vulnerable to climate change. Both this study and the SWAP identify climate change as a stressor particularly for cool and coldwater fish, mollusks, plants, terrestrial salamanders and many species associated with wetlands and high elevation ecosystems. The SWAP lists habitat shifts and alterations as statewide stresses for terrestrial SGCNs and it lists increasing frequency and severity of droughts, storms and flooding and temperature extremes as statewide stresses for aquatic SGCN and habitats. The SWAP notes that even within taxonomic and habitat groupings, species may respond differently to climate change based on their sensitivity to factors such as temperature, moisture and seasonal triggers. Because climate change acts in tandem with other stresses on wildlife and habitat, the SWAP suggests that actions to address those other stresses could decrease their vulnerability to climate change. Varying conditions among CFAs means actions to address climate impacts should be tailored to each CFA, emphasizing restoration and expansion of vulnerable habitat types in some areas, or reducing habitat fragmentation in

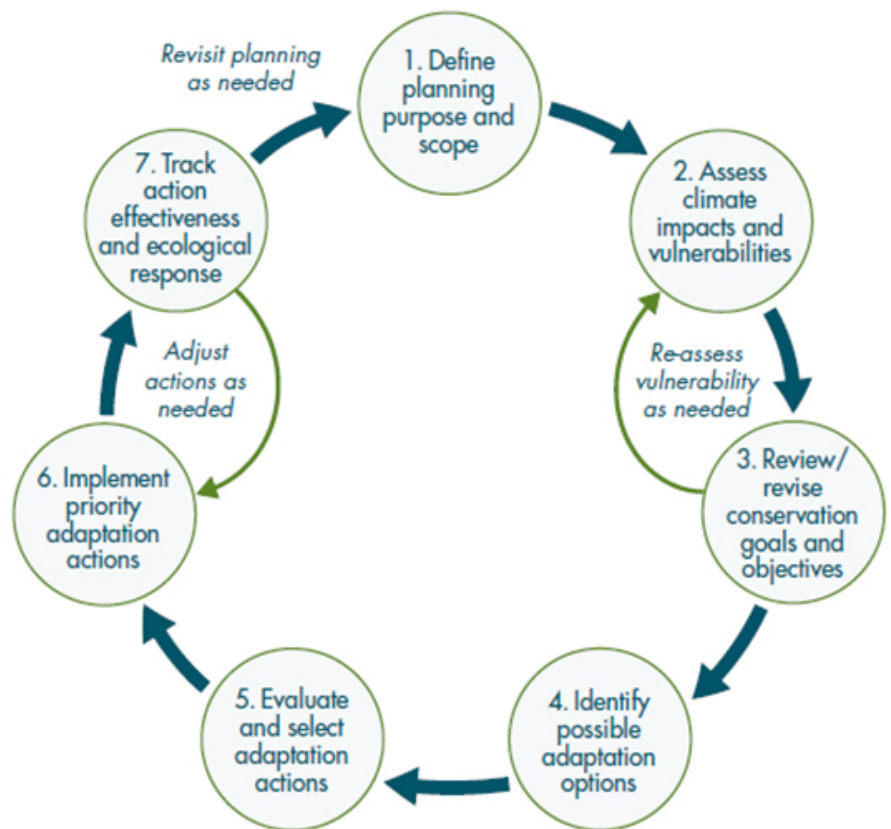
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, the SWAP therefore seeks to address climate change broadly through additional vulnerability assessments for select species, statewide actions to reduce additional stresses on SGCNs and their habitats and more geographically focused actions in Conservation Focus Areas (CFAs). CFAs are an appropriate scale to promote climate resilience by identifying local actions to relieve stresses on SGCN, restore or expand vulnerably habitats and maintain ecosystems process, landscape resilience and habitat connectivity.

### Monitoring and Adaptive Management

Monitoring of SGCNs and their habitat is essential to establish better baseline data about species distribution, abundance and population trends. The SWAP calls for monitoring of species and habitat trends across the state, along with more-intensive monitoring within CFAs through collaboration with local partners to gain more area-specific data and to address local threats with targeted conservation actions.

Beyond monitoring SGCNs and their habitat, successful wildlife conservation in CFAs will require monitoring the effectiveness of conservation actions and adapting those actions accordingly. The SWAP envisions monitoring the results of conservation actions at the CFA level and that CFA-level plans should incorporate measurement and monitoring protocols integrated with conservation actions themselves. Effectiveness measures indicate progress to date and whether the expected results are being realized. Conservation actions should be designed with enough specificity that project impacts and performance can be measured but broadly enough to benefit multiple species and engage partners. Success may be measured by the amount of protected or restored habitat, by stability or increase in populations, or by the acquisition of the information required to make informed conservation decisions. Another measure of success is the amount of “buy-in” or participation by conservation partners in the public and private sectors. Conservation partners, especially those operating through grant funding or those following conservation agency protocols, may already have metrics for accomplishment/success that are used for their own reporting requirements. Furthermore, accountability and transparency to funding sources, partners and the public are essential for program success.

Adaptive management also requires monitoring of climate change impacts on species and their habitats, as well as the success of conservation actions. In common terms, climate adaptation may be thought of as preparing for, coping with, or adjusting to climatic changes and their associated impacts (Stein et al., 2014). Frameworks such as the Climate Smart Conservation Cycle illustrated below (from Stein et al., 2014) can be used to plan, implement and monitor conservation actions to enable wildlife to adapt to a changing climate. Planning conservation actions to implement this plan should consider climate impacts to species and habitats, WVDNR’s ongoing vulnerability assessments and field surveys to further document population trends, distribution and abundance of priority species and the options to build the resilience of each major habitat type listed in this Action Plan. Information on site conditions and project plans provided by partners and landowners should also be considered. This will require careful coordination among WVDNR and local stakeholders.



**Climate-Smart Conservation Cycle**  
 A General Framework for Adaptation Planning and Implementation  
 Stein et. al, 2014

### Organization of this Action Plan

This CFA Action Plan will begin by introducing the CFA, including an overview of the landscape, terrestrial and aquatic habitats, species of greatest conservation need, distinctive stresses and broad conservation actions, potential partners and lands protected by public ownership or conservation easements. The plan then reviews the conservation goals and lists priority species identified by WVDNR specialists based on factors such as their abundance, population trends and opportunities for conservation within the CFA. The plan is then divided by major habitat type, including forest and woodland habitats, rock outcrops, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. For each major habitat type the plan lists priority species, stresses effecting those species and actions to alleviate those stresses. The plan also identifies climate stresses impacting each major habitat type and lists potential actions to boost their resilience. The plan provides a roadmap for implementation and monitoring of conservation actions for each major habitat type and brief statements about other human benefits that may be generated by the proposed actions. The plan also describes a regional network of resilient and connected landscapes spanning multiple habitat types that enable wildlife species to adapt and shift to a changing climate and provides an implementation plan for landscape resilience and connectivity. The conclusion provides a summary of the priority habitats for conservation, describes the importance of integrating conservation for greater impact, connecting conservation actions for climate resilience and outlines next steps in plan implementation.

## How to use this plan

Implementation of this Action Plan will rely upon voluntary actions by local stakeholders including landowners, public agencies and partner organizations, and collaboration between them to conserve wildlife species and their habitat. The role of WVDNR in implementing this plan is to provide local stakeholders with information, guidance, assistance and support to develop, implement and monitor conservation actions, and facilitate stakeholder collaboration.

Local stakeholders can use this plan for many purposes, including the following:

- Identify priority wildlife species, rare plant communities and their habitats, and the resilient and connected landscapes that can enable species to shift in response to changing conditions.
- Work with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to priority species, their habitats and the resilient and connected landscapes.
- Identify stresses on priority species in specific habitats, conservation actions that can alleviate those stresses, monitoring protocols to evaluate success, and partners who can provide assistance.
- Understand climate impacts on wildlife habitat and actions to boost habitat resilience.
- Plan and implement conservation actions to boost habitat resilience and enable wildlife to adapt to climate change.
- Design and implement monitoring protocol to evaluate the success of conservation actions.
- Inform and provide rationale for activities being proposed in grant or permit applications.
- Integrate priority species, habitat and climate resilience into other local project plans.

The information provided in this Action Plan is constantly evolving. Local stakeholders are encouraged to seek additional information and assistance from WVDNR to:

- Confirm whether specific priority wildlife species and habitats are present at specific sites
- Understand species and habitat vulnerability to climate change
- Further define or confirm stresses on wildlife species and habitats
- Tailor proposed wildlife conservation actions to alleviate stresses
- Consider adaptation options to boost habitat resilience to climate change
- Develop effective strategies to monitor and evaluate project success

## Meadow River Wetlands Conservation Focus Area

### Overview

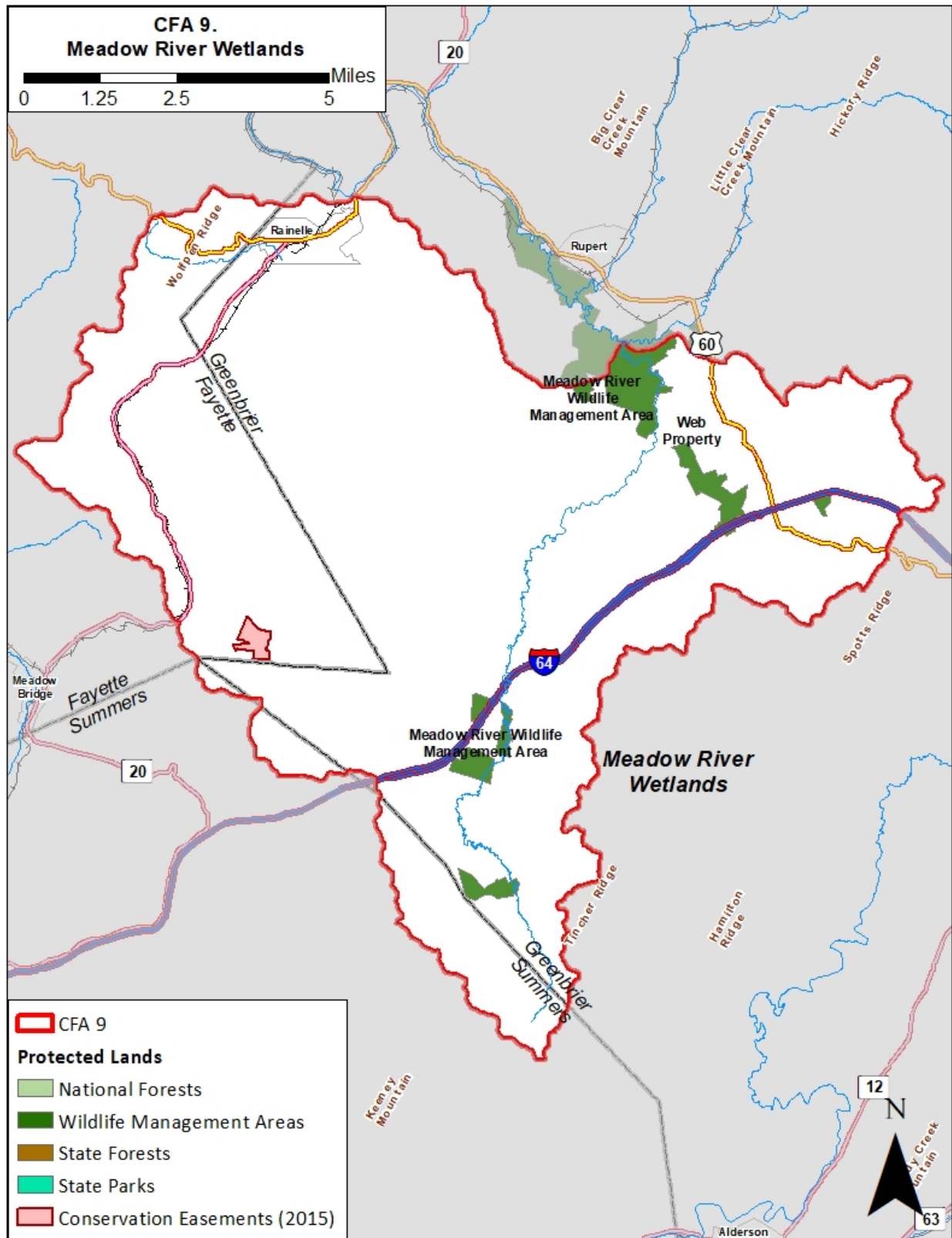
At the transition between the Allegheny Mountains and Cumberland Mountains ecoregions, the floodplain of the Meadow River includes the second largest wetland complex in the state. Covering over 3,000 acres, it is also one of the largest wetlands in the Central Appalachians. These wetlands include forested swamps dominated by Pin Oak and Black Ash as well as smaller areas of shrub swamps and marshes. Surrounding mid-elevation uplands are covered by deciduous forests with scattered farms used mostly for pasture and hay. Map 2 provides an overview of the CFA.

The Meadow River is a tributary of the Gauley River, the headwaters originating from the southern tip of the CFA in Summers County. The CFA is bordered by Meadow Mountain on the east, Red Spring Mountain on the southern and western boundary and Little Sewell Mountain on the northern boundary. Notable summits within Meadow River Wetlands CFA range in elevations from approximately 2700ft to 3600ft. Taller mountains, some rising above 3000 feet, include:

- Goddard Mtn.
- Fork Mtn.
- Sims Mtn.
- Turnip Hole Mtn

Public lands within the Meadow River Wetlands CFA consist primarily of several tracts that comprise the Meadow River Wildlife Management Area. Communities and towns present in the CFA include Rainelle, Spring Dale, Smoot, Sam Black Church, Bellwood and others.

Map 2. Overview



## Habitats

The Meadow River Wetlands CFA includes a variety of terrestrial and aquatic habitat types.

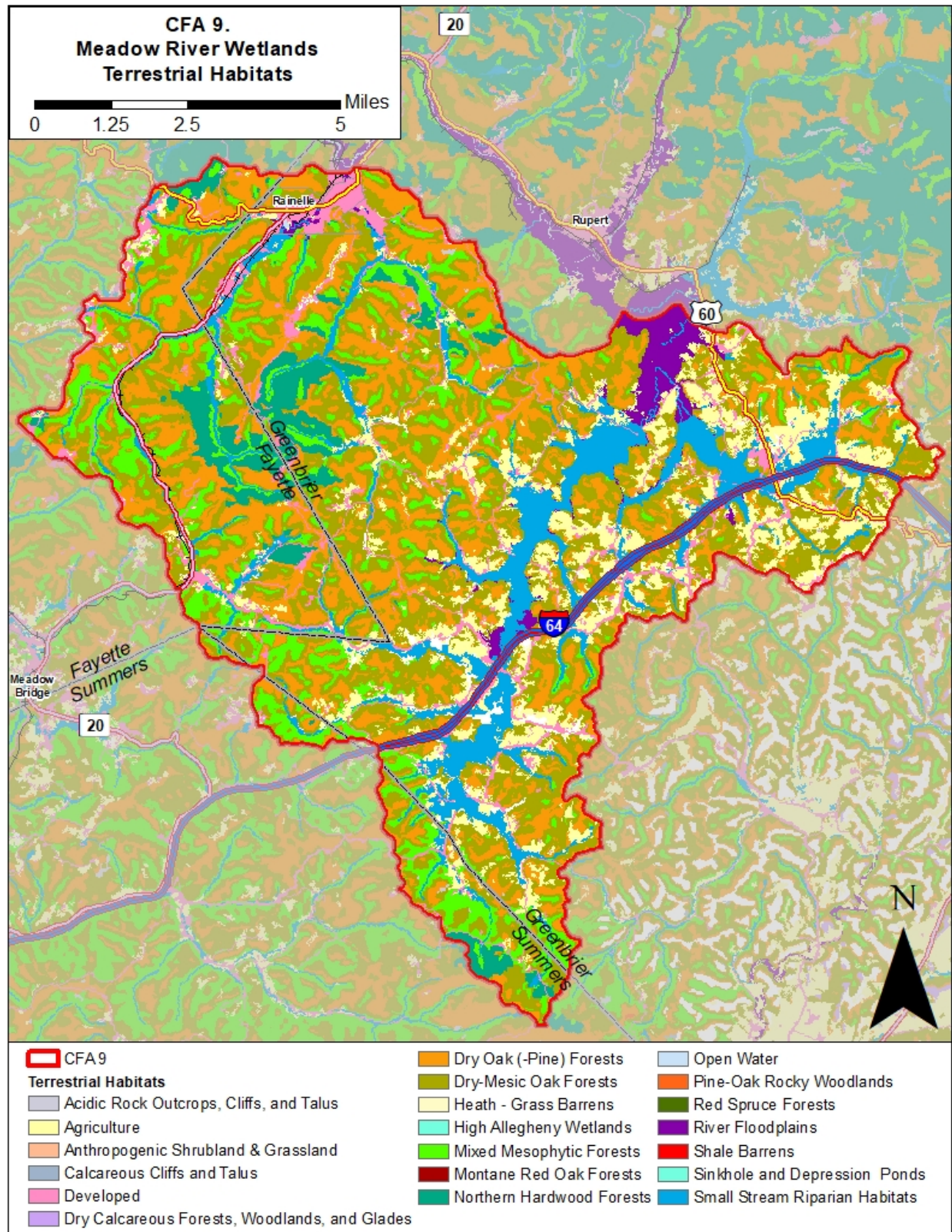
### Terrestrial Habitats

Nine of the habitat types described in the SWAP are present in this CFA. Dry-Mesic Oak Forests is the most abundant, composing roughly a third of the total area within the CFA. Dry Oak-Pine Forests are the second most abundant habitat type present within the CFA, covering slightly more than 20%. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat Type	% of Acres in CFA	% of WV Total CFA Area	% of WV Total for Type
Acidic Rock Outcrops, Cliffs, and Talus	4,433	0.30%	4.94%
Agriculture	34,674	2.37%	2.42%
Anthropogenic <u>Shrubland</u> & Grassland	2	0.00%	0.00%
Calcareous Cliffs and Talus	1,055	0.07%	11.46%
Developed	60,629	4.15%	5.32%
Dry Calcareous Forests, Woodlands, and Glades	1,501	0.10%	2.10%
Dry Oak (-Pine) Forests	112,399	7.70%	4.55%
Dry-Mesic Oak Forests	124,146	8.50%	2.49%
Heath-Grass Barrens	2,723	0.19%	96.69%
High Allegheny Wetlands	17,158	1.18%	81.96%
Mixed <u>Mesophytic</u> Forests	182,223	12.48%	6.19%
<u>Montane</u> Red Oak Forests	637	0.04%	3.02%
Northern Hardwood Forests	676,577	46.34%	68.01%
Pine-Oak Rocky Woodlands	1,895	0.13%	2.48%
Red Spruce Forests	168,441	11.54%	94.65%
River Floodplains	13,434	0.92%	11.18%
Shale Barrens	55	0.00%	3.06%
Sinkhole and Depression Ponds	0	0.00%	0.00%
Small Stream Riparian Habitats	50,883	3.49%	10.29%
Unresolved	7,101	0.49%	6.08%
Totals	1,459,967	100.00%	

Map 3. Terrestrial Habitats



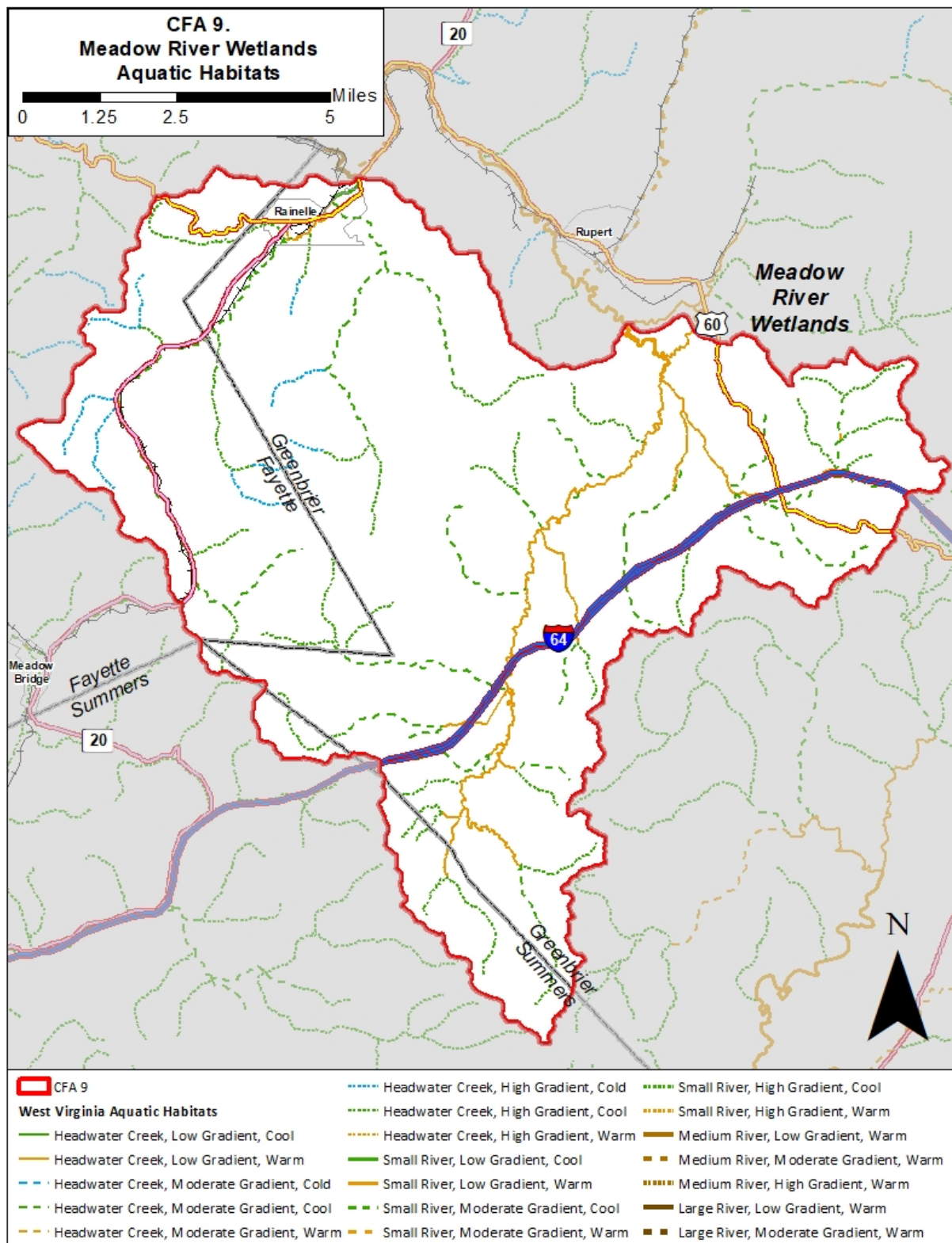
## Aquatic Habitats

Five of the aquatic habitat types described in the SWAP are present within the Meadow River Wetlands CFA, including almost 5% of the state's warm, low gradient headwater creek habitat. The most abundant aquatic habitat types are cool, high gradient headwater creeks and cool, moderate gradient headwater creeks, each covering over 40 miles and over 30% of stream habitat types in the CFA.

Table 2. Aquatic Habitat Summary

Habitat Type	% of Miles in CFA	% of WV Total CFA Miles	% of WV Total for Type
Headwater Creek, Low Gradient, Warm	27	21.06%	4.80%
Headwater Creek, Moderate Gradient, Cool	49	38.41%	2.22%
Headwater Creek, High Gradient, Cold	10	7.69%	0.33%
Headwater Creek, High Gradient, Cool	41	32.48%	0.66%
Small River, Low Gradient, Warm	0	0.37%	0.10%
Totals	127	100.00%	

Map 4. Aquatic Habitats



## Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa listed by WVDNR for the Meadow River Wetland CFA.

Table 3. SGCN summary by Taxa

Taxa	# SGCN
Amphibians	3
Birds	10
Crayfish	1
Dragonflies and Damselflies	3
Fish	1
Mammals	2
Plants	27
Reptiles	2
Snails	1
Totals	50

This area is most notable for its wetland species and in West Virginia is second only to Canaan Valley for its significance for wetland animals and plants. Notable avian SGCNs found in this area include:

- American Woodcock
- Great Blue Heron
- Green Heron
- Rusty Blackbird (this CFA provides optimal habitat and may be an important migration stopover for this species)

The federally threatened Virginia Spiraea (*Spiraea virginiana*) exists within the CFA's wetlands. The CFA also hosts the Meadow River mudbug (*Cambarus pauleyi*), a rare species within the state.

Altogether, the CFA supports 27 SGCN plants. A rare plant community, Meadow River Oak Swamp, is a notable refugium for species that rely on floodplain and small stream riparian habitats. This CFA accounts for over 80% of the relative abundance of this rare plant community within West Virginia.

This Action Plan will list the priority SGCN in each major habitat type in the CFA.

## Distinctive Stresses

The 2015 SWAP lists general stresses affecting SGCN and habitat in this CFA:

- Livestock graze in many wetland areas.
- Filling and draining wetlands have been documented.

In addition to this general stress, this Action Plan will list more specific local stresses affecting priority SGCN in each major habitat type.

## Conservation Actions

To address these stresses in the CFA, the 2015 SWAP recommends one primary type of action:

- There are high ecological benefits possible from focusing mitigation resources into additional wetland protection and restoration in these wetlands.

This Action Plan will also list more specific conservation actions to address the stresses affecting priority SGCN in each major habitat type.

## Potential Partners

The 2015 SWAP lists many potential partners for landowners and others interested in wildlife conservation in the CFA, including:

- WVDNR
- WV Division of Highways (WVDOH)
- West Liberty University
- WVDEP
- NRCS

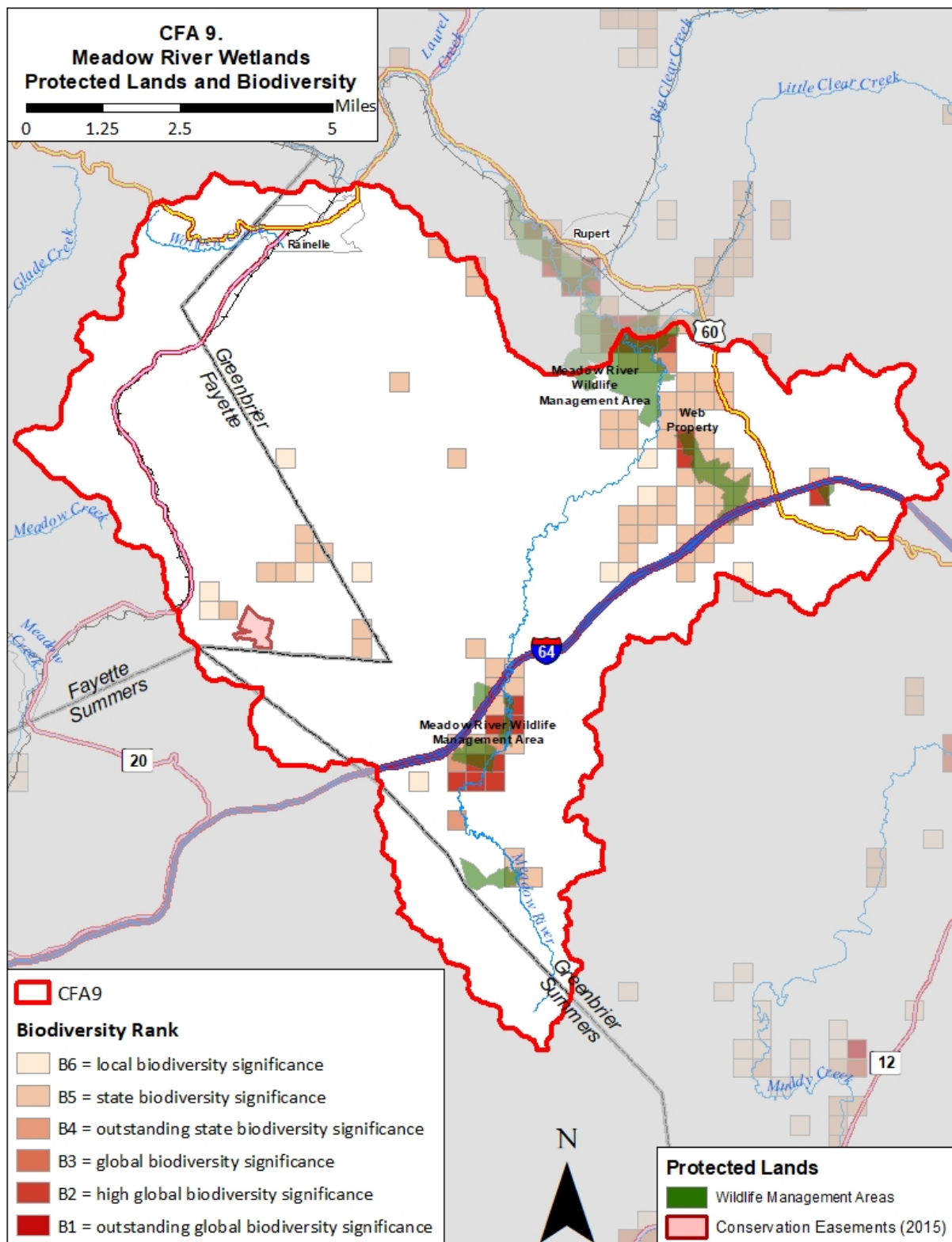
With an established “constituency”, many conservation partners can provide direct outreach to landowners and key stakeholders interested in wildlife conservation. The WVDNR will engage with these and other partners in regular face-to-face meetings and planning workshops during CFA planning, implementation and monitoring. In many cases, partners may assume a lead role in implementing conservation actions. Appendix 4 lists the types of programming and assistance each partner provides to landowners. Specific partners are also listed along with conservation actions supported through their programs in the implementation plan for each habitat type.

## Protected Lands

The 2,385-acre Meadow River Wildlife Management Area provides significant opportunities for wildlife conservation. Appendix 3 lists habitat types in the WMA. WVDNR will work with WMA managers to identify opportunities to plan and implement conservation actions that address stresses in constituent habitats to support priority SGCN. On state lands, this can include protection of important ecosystems, habitats, SGCN populations or plant communities through designation as State Natural Areas. In addition, the Fayette County Farmland Protection Board holds a conservation easement that may protect important wildlife habitat and provide additional wildlife conservation opportunities.

Map 5 shows the location of the WMA and a conservation easement in the CFA, based on data provided by The Conservation Fund (TCF), USGS Gap Analysis Program (GAP), The Nature Conservancy (TNC) and the National Conservation Easement Database (NCED) in 2015. It also shows known occurrences of SGCN and rare plant communities within 500- square meter areas and the biodiversity rank (including global, state or local significance) of those occurrences, as generated by WVDNR in 2017. This map illustrates that SGCN and rare plant communities have been recorded on the WMA and there may be opportunities for the WVDNR to protect them there. SGCN and rare plant communities have also been recorded on private land outside of the WMA. This indicates the importance of the WVDNR and other partners working with private landowners to restore and protect biodiversity on private lands.

Map 5. Protected Lands and Biodiversity



## Action Plan for the Conservation Focus Area

### Conservation Goals

This CFA Action Plan is an extension of the State Wildlife Action Plan. While it is driven by local issues, the overarching goals remain the same. These include:

1. Halt the decline of at-risk species and thus avoid the need for federal listing as threatened or endangered
2. Assist with the recovery of federally listed species
3. Keep common species common
4. Conserve the full array of habitat types and biological diversity in the state

The WVDNR will collaborate with agency partners, non-governmental organizations and the public to address threats to Species of Greatest Conservation Need, key habitats and unique communities.

### Priority Species

Effectiveness and efficiency are paramount in targeting actions in CFAs, and specifically addressing every SGCN present in the CFA is not feasible. From the list of SGCNs documented in the CFA as provided in the SWAP, WVDNR biologists selected priority species for conservation action that represent the best opportunity for successful conservation based on:

- their conservation status and known trends globally, across the state and in the CFA;
- the degree of dependence of each species on habitats within the CFA;
- the degree to which conservation activities to protect targeted species will also benefit a suite of other species occupying the same habitat or niche;
- conservation opportunities and likelihood of conservation success in the CFA;
- and other factors.

Table 4 lists SGCNs that were selected as priorities within the CFA based on the above criteria.

Additional field surveying and information is needed to document and monitor the distribution, abundance, and population trends of these priority species in the habitats where they occur, and to assess their vulnerability to climate change. This work is ongoing.

Table 4. Priority Species in CFA

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>S RANK</b>	<b>G RANK</b>
Amphibians	<i>Pseudacris feriarum</i>	Upland Chorus Frog	S3	G5
Bird	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	S3B	G5
Bird	<i>Chaetura pelagica</i>	Chimney Swift	S3B	G5
Bird	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5
Bird	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4
Bird	<i>Spizella pusilla</i>	Field Sparrow	S3B, S3N	G5
Bird	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5
Bird	<i>Vermivora chrysoptera</i>	Golden-winged Warbler	S1B	G4
Crayfish	<i>Cambarus pauleyi</i>	Meadow River Mudbug	S2	GNR
Fish	<i>Ameiurus melas</i>	Black Bullhead	S1	G5
Plant	<i>Carex albolutescens</i>	Greenish-white Sedge	S1	G5
Plant	<i>Carex tuckermanii</i>	Tuckerman's Sedge	S1	G4
Plant	<i>Eleocharis elliptica</i>	Elliptic Spikerush	S1	G5
Plant	<i>Fraxinus nigra</i>	Black Ash	S2	G5
Plant	<i>Hierochloa hirta</i> ssp. <i>arctica</i>	Holy Grass, Sweetgrass	S1	G5T5
Plant	<i>Lysimachia hybrida</i>	Lowland Loosestrife	S1	G5
Plant	<i>Polygala cruciata</i> var. <i>aquilonia</i>	Cross-leaved Milkwort	S1	G5T4
Plant	<i>Rhynchospora fusca</i>	Brown Beaksedge	S1	G4G5
Plant	<i>Spiraea virginiana</i>	Virginia Spiraea	S1	G2

S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

## Forest and Woodland Habitats

Dry-Mesic Oak Forests and Dry Oak-Pine Forests represent the largest proportion of forest habitat types within the Meadow River Wetlands CFA and can be found in scattered patches throughout the CFA.

Northern Hardwood Forests are less abundant, covering under 5% of the total CFA area, but are less scattered than other forest habitat types and primarily occur at higher elevations concentrated around Boggs Knob and Keeney Mountain. Mixed Mesophytic forests have the smallest extent. Dry forest types are often threatened by invasive species, mesophication (gradual moistening) and lack of fire. Overbrowsing by deer also reduces regeneration of oaks and other palatable understory species.

Maps 6 and 7 on the following pages display forest habitat types and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity occurrences within the CFA. The diversity of forest types across elevational gradients provides great opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches provide core habitat for several priority species, as well as a matrix of forest habitat types within which forest species may shift and adapt to climate change.

## Priority Species

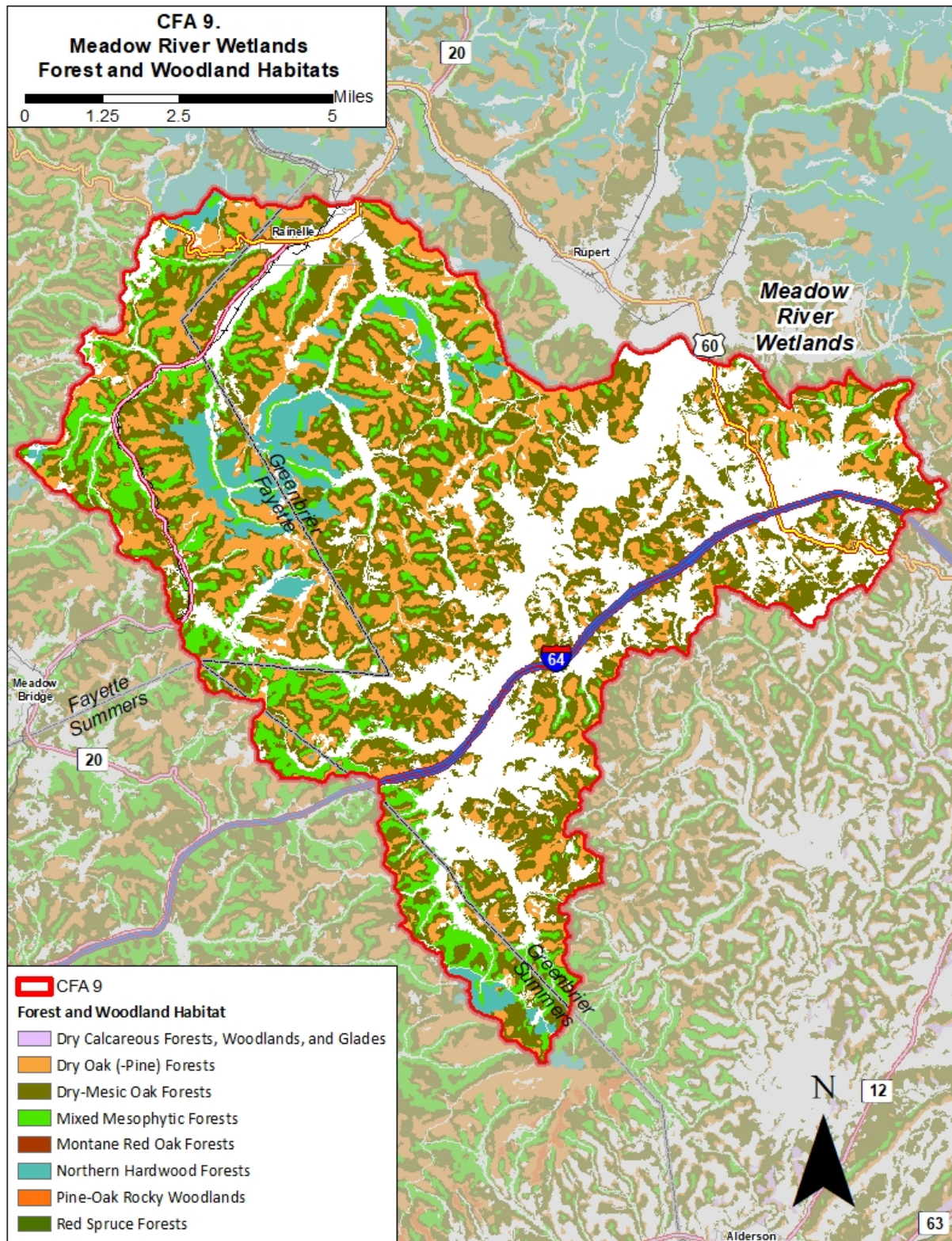
The table below lists priority species in the CFA associated with forest and woodland habitats.

Table 5. Priority species in Forest and Woodland habitats.

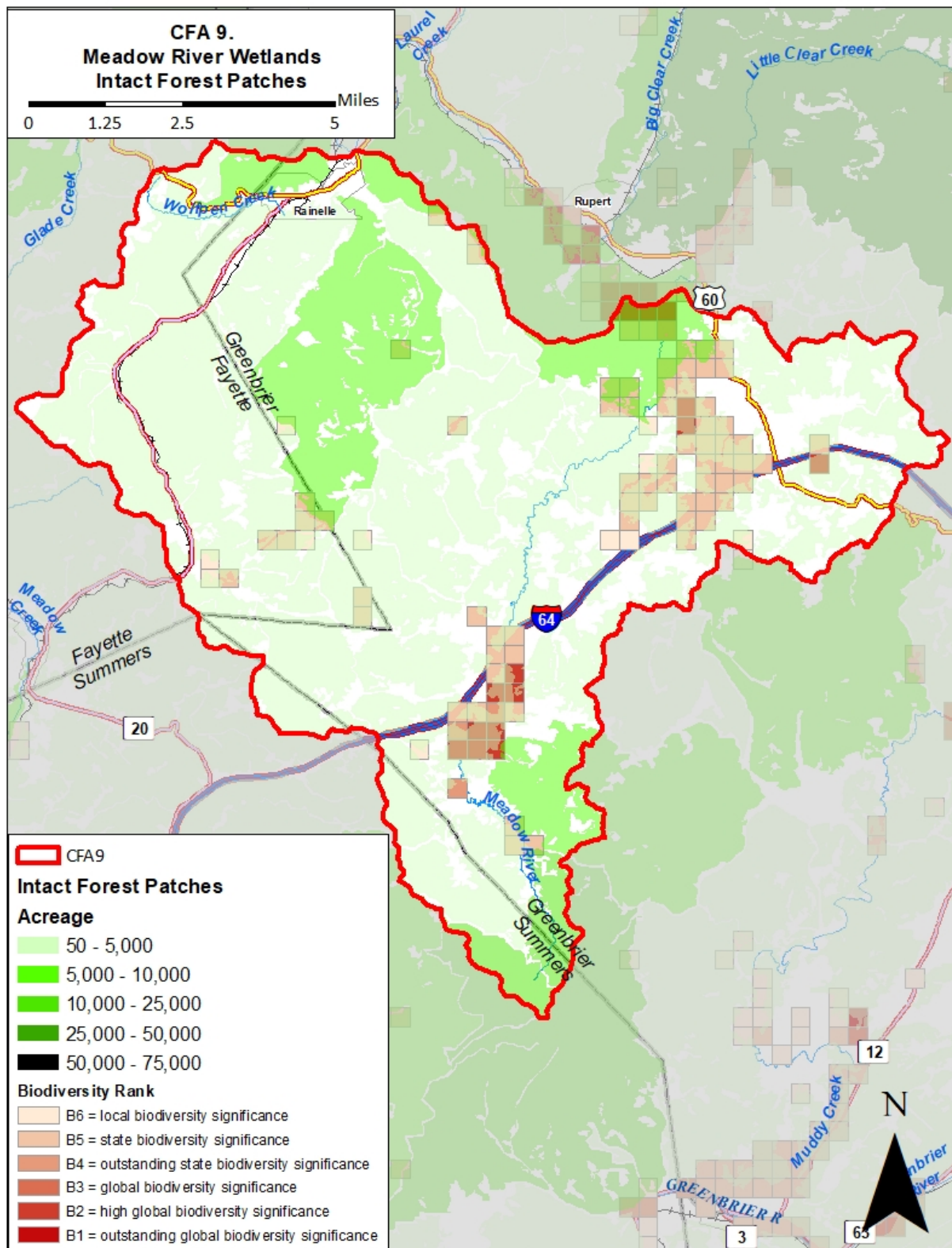
Taxa	Scientific Name	Common Name
Bird	<i>Antrostomus vociferous</i>	Eastern Whip-poor-will
Bird	<i>Hylocichla mustelina</i>	Wood Thrush
Bird	<i>Setophaga cerulean</i>	Cerulean Warbler
Bird	<i>Vermivora chrysoptera</i>	Golden-winged Warbler

Large, intact forest blocks support forest interior breeding birds, including Wood Thrush and Cerulean Warbler (CERW). Early-successional forest habitats may support Eastern Whip-poor-will and Golden-winged Warbler (GWWA).

Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



## Habitat Stresses and Conservation Actions

Table 6 lists stresses impacting species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses.

Table 6. Stresses and Actions in Forest and Woodland Habitats:

Habitat Stress	Conservation Action
Deforestation, forest fragmentation	Maintain and protect contiguous forest cover, structural complexity and habitat diversity
Early-successional habitat: poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early-successional habitat across 15-20% of forested landscapes and structural complexity, including gaps with healthy native grasses, forbs, vegetative cover and snags
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity: old growth, small openings with well-developed understories, snags and decaying logs
Poor understory habitat	Timber management for canopy openings
Fire suppression	Prescribed burning in fire-adapted systems
Forest pests and pathogens including Hemlock Woolly Adelgid, Emerald Ash Borer	Monitoring and treatment of target tree species in select priority areas
Deer browse impacting forest structure	Manage deer populations where abundant

In addition to the habitat-linked stresses listed above, direct stresses to priority species include mortality from vehicle collision (eastern whip-poor-will), nest failures via brood parasitism and predation, and decline associated with hybridization. To prevent vehicle collision, road signage can be put in place near high density areas.

Maintaining a diverse population of forest birds requires dynamic forest landscapes with mosaics of age classes and structure. Efforts to manage and restore both early-successional and interior forest habitats are needed for priority SGCNs.

## Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et al., 2015) describes many potential impacts of climate change on forests in the region. Likely impacts include increased temperatures (especially during the summer and fall), a decrease in winter snowpack, longer growing seasons, increased precipitation during spring and even greater decreases in precipitation during summer and fall, more frequent heavy precipitation events and increasing frequency and severity of storms. These impacts will likely lead to changing soil moisture patterns, increased risk of wildfire,

increased damage from pests and pathogens, and increased extent and abundance of invasive plants. Habitat for northern species is likely to decline. Tree seedlings will likely be more vulnerable to climate change impacts than mature trees. Forest ecosystems lacking a diversity of species, age classes and genotypes may be more susceptible to climate change than those with greater diversity. Forest species in fragmented landscapes will have less opportunity to migrate across the landscape in response to changing conditions, and ecological communities tied to specific hydrological conditions or geologic features may also be unable to migrate. Urban areas and impervious cover can exacerbate the effects of increasing temperatures and heavier precipitation. However, ecosystems within areas of high landscape complexity, including a diversity of topography and microhabitats, may be more able to persist and adapt in response to climate change.

The 2015 assessment also described likely impacts to specific forest types. Dry-Mesic Oak Forests support a large number of tree species over a diversity of terrain, and many of the tree species are tolerant of drought and fire, providing some resilience to climate change. However, drought may increase susceptibility to forest pests and pathogens, and drought as well as disturbances from stronger storms may enable the spread of nonnative invasive plants. Intense fires or droughts, combined with other stressors, could increase mortality of some species.

Dry Oak Pine Forests are adapted to heat, drought and fire, and may benefit from climate change. However, droughts may increase susceptibility to forest pests and pathogens, and enable nonnative invasive plants to outcompete native herbs and shrubs, providing additional fuel for fires and increasing fire intensity. Forest pests, pathogens and invasive plants need to be carefully managed to build resilience to climate change.

Mixed Mesophytic Forests may be vulnerable to increasing disturbance by wildfire, drought and invasion by nonnative plants. These ecosystems may decline in some areas, while sheltered sites in areas of complex topography may provide some refuge from climate change. Mesophytic Forests may also expand as mesophication occurs in other forest types.

The small areas of northern hardwood forests may be particularly impacted by climate change. Increased heat and moisture stress in summer and fall may interact with acid deposition as well as increases in insect pests and pathogens, storm disturbance and wildfires to stress these forests, reducing species diversity and coverage. Cool valley bottoms in areas of complex topography may provide some refuge and buffer the effects of climate change.

Some changes in forest composition and structure are likely to occur over time as these different forest types adapt and adjust in response to changes in climate. Conservation actions to reduce existing stresses on forests will aid in building their resilience. Protection of large forest blocks in areas with complex topography, and maintaining natural cover linkages between them, may further enable their adaptation and shifting distribution across the landscape.

Table 7 provides a summary of climate stresses on forest habitats and actions which could boost their resilience (Swanston et al., 2016). While climate stresses are listed separately, forest and woodland

habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions resemble previously listed conservation actions to reduce stress on priority species, meaning that they could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 7. Climate Stresses and Resilience Actions in Forest and Woodland Habitats

Climate Stresses	Habitat Resilience Actions
<ul style="list-style-type: none"> <li>Increased spring and summer temperatures</li> <li>Increased risk of drought and wildfire</li> <li>Increased frequency and severity of storms</li> <li>Increased competition from nonnative invasive species, pests and pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Restore or maintain fire in fire-adapted ecosystems</li> <li>Manage deer populations to promote regeneration</li> <li>Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species</li> <li>Promote diversity of native species and age classes through planting and silviculture</li> <li>Protect habitat refugia for rare plant communities and forest types dependent on unique soils, such as calcareous forests, woodlands and glades</li> <li>Protect forest reserves in areas of high biological diversity or priority species</li> <li>Reduce forest fragmentation</li> <li>Maintain or restore large patches and corridors of forest habitat</li> <li>Restore native forest vegetation on degraded lands within and adjacent to forested areas</li> </ul>

### Implementation Plan

The WVDNR will work with interested partners and landowners to plan, implement and measure the effectiveness of conservation actions to benefit priority species in forest and woodland habitats.

Table 8. Implementation Plan for Forest and Woodland Habitats

Action	Partners	Effectiveness Measures
Forest Habitat, Reserve and Corridor Protection: <ul style="list-style-type: none"> <li>Land Acquisition</li> <li>Conservation Easements</li> <li>Natural Area designation</li> </ul>	<ul style="list-style-type: none"> <li>County Farmland Protection Boards</li> <li>OHCF, TCF, TNC, WVLT</li> <li>WVDOF Forest Legacy</li> <li>WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat protected for priority species</li> <li>Abundance and diversity of priority species and habitats</li> </ul>
Forest Habitat, Reserve and Corridor Protection: <ul style="list-style-type: none"> <li>Land use planning</li> </ul>	<ul style="list-style-type: none"> <li>County Planning Commissions</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat protected through land use planning in forested areas</li> </ul>

Action	Partners	Effectiveness Measures
<p>Forest Habitat, Reserve and Corridor Protection:</p> <ul style="list-style-type: none"> <li>• Incentive Programs</li> <li>• Forest Carbon projects</li> </ul>	<ul style="list-style-type: none"> <li>• AFF, TNC</li> <li>• USDA NRCS</li> <li>• Consulting Foresters</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected for priority species</li> <li>• Abundance and diversity of priority species and habitats</li> </ul>
<p>Manage forests at landscape scale for diversity of native species and age classes, structural and spatial complexity appropriate for the forest type</p>	<ul style="list-style-type: none"> <li>• AMJV</li> <li>• Consulting Foresters</li> <li>• Forest Certification Programs: AFTS, FSC, SFI</li> <li>• NWTF and RGS</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• WVU Extension</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
<p>Forest management to prevent woody encroachment or avoid disturbance of rare plants, create forest canopy gaps and vegetative cover</p>	<ul style="list-style-type: none"> <li>• WVU Extension</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• Consulting Foresters</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance, diversity and distribution of priority species</li> </ul>
<p>Create or maintain early-successional habitat (ESH) to benefit wildlife species through forest management on appropriate sites.</p> <p>GWWA guidelines for large forest patches with &gt; 70% forest cover:</p> <ul style="list-style-type: none"> <li>• Maintain ESH on 15-20% of forest at any one time, as part of shifting mosaic</li> <li>• ESH should include irregular, interspersed clumps of shrubs and/or saplings, grasses and forbs, and widely spaced overstory trees (10-30% canopy cover or 20-40 ft<sup>2</sup>/acre residual basal area)</li> </ul>	<ul style="list-style-type: none"> <li>• WVU Extension</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• Consulting Foresters</li> <li>• NWTF and RGS</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>

Action	Partners	Effectiveness Measures
<p>Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites</p> <p>CERW guidelines for large forest patches with &gt; 70% forest cover:</p> <ul style="list-style-type: none"> <li>• Provide heterogenous stand structure and species diversity with 40-90 ft<sup>2</sup>/acre residual basal area of well-spaced, large diameter trees (favor white oak, hickory, sugar maple) with canopy gaps and well-developed understory vegetation. Mesic north- and east-facing slopes optimal.</li> </ul>	<ul style="list-style-type: none"> <li>• WVU Extension</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• Consulting Foresters</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
<p>Restore native forest vegetation on adjacent degraded lands through planting and silviculture</p>	<ul style="list-style-type: none"> <li>• WVU Extension</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• Consulting Foresters</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance, diversity and distribution of priority species</li> </ul>
<p>Monitor and control invasive weeds, promptly revegetate disturbed sites</p>	<ul style="list-style-type: none"> <li>• WVDOF</li> <li>• WVCA and Conservation Districts</li> <li>• USDA NRCS</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected or restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
<p>Monitor and treat pests and pathogens targeting specific trees and plant communities in priority sites, including ash and hemlock</p>	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• WVDA, WVDOF, WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat maintained for priority species</li> <li>• Before and after comparison: abundance, diversity and distribution of priority species</li> </ul>

Action	Partners	Effectiveness Measures
Manage deer populations where abundant	<ul style="list-style-type: none"> <li>• WVDNR</li> <li>• Private landowners</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Change in deer population or forest structure</li> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Controlled burning by public agencies in fire adapted ecosystems	<ul style="list-style-type: none"> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat restored for priority species</li> <li>• Before and after comparison: abundance, diversity and distribution of priority species</li> </ul>

### Human Benefits

Actions to restore and protect forest and woodland habitat may provide human health and economic benefits for local residents and communities. These benefits include protection of water ways, water quality and drinking water sources, reduced flood damages, long-term timber production and opportunities for forest carbon sequestration, hunting, wildlife viewing, tourism and recreation.

## Aquatic, Floodplain, Wetland and Riparian Habitats

Streams and rivers within this CFA vary from warm, low gradient headwater creeks to warm, low gradient small rivers such as the Meadow River, running from the southern section of the CFA northwards into the eastern section. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are tightly connected with their adjacent floodplains, wetlands, and riparian habitats. Many plant and animal species rely on aquatic habitats such as streams, rivers and wetlands, as well as their adjacent terrestrial habitats, especially riparian areas and forests. The loss of natural floodplain habitats and riparian corridors often impacts water quality and adjacent aquatic habitat. Improving wildlife habitat in streams and rivers often requires conservation actions to improve adjacent floodplain and riparian habitats. Therefore, aquatic, floodplain, wetland and riparian habitats will be addressed together.

## Priority Species

Tables 9, 10 and 11 list priority species that occur in aquatic, riparian, floodplain and wetland habitats.

Table 9. Priority Aquatic Species

Taxa	Scientific Name	Common Name
Fish	<i>Ameiurus melas</i>	Black Bullhead

Table 10. Priority Riparian and Floodplain Species

Taxa	Scientific Name	Common Name
Amphibian	<i>Pseudacris feriarum</i>	Upland Chorus Frog
Crayfish	<i>Cambarus pauleyi</i>	Meadow River Mudbug
Plant	<i>Carex albolutescens</i>	Greenish-white Sedge
Plant	<i>Carex tuckermanii</i>	Tuckerman's Sedge
Plant	<i>Eleocharis elliptica</i>	Elliptic Spikerush
Plant	<i>Fraxinus nigra</i>	Black Ash
Plant	<i>Hierochloe hirta</i> ssp. <i>arctica</i>	Holy Grass, Sweetgrass
Plant	<i>Polygala cruciata</i> var. <i>aquilonia</i>	Cross-leaved Milkwort
Plant	<i>Rhynchospora fusca</i>	Brown Beaksedge
Plant	<i>Spiraea virginiana</i>	Virginia Spiraea
Plant	<i>Fraxinus nigra</i>	Black Ash
Plant	<i>Hierochloe hirta</i> ssp. <i>arctica</i>	Holy Grass, Sweetgrass
Plant	<i>Lysimachia hybrida</i>	Lowland Loosestrife

Aquatic environments also include ponds and wetlands. Like other aquatic environments, ponds and wetland habitats are influenced by land use practices in adjacent lands and waters.

Table 11. Priority Wetland Species

Taxa	Scientific Name	Common Name
Plant	<i>Fraxinus nigra</i>	Black Ash
Plant	<i>Eleocharis elliptica</i>	Elliptic Spikerush
Plant	<i>Lysimachia hybrida</i>	Lowland Loosestrife

### Rare Plant Communities

There are a significant number of rare plant communities found in wetland, floodplain and riparian habitats in this CFA. Note that the majority of Meadow River Oak Swamps in the state of West Virginia are found in this CFA, as well as a third of Hazel Alder Swamps. These plant communities are vulnerable to disturbance and the spread of nonnative invasive plants. Disturbance should be avoided and nonnative invasive plant infestations should be treated.

Table 12. Rare Plant Communities in Wetland, Floodplain and Riparian Habitats.

Habitat	Common Name	Relative Abundance	G RANK	S RANK
High Allegheny Wetlands	American Bur-Reed Marsh	9.76%	G3?	S2
High Allegheny Wetlands	Bushy St. Johnswort Shrub Swamp	5.88%	GNR	S3
High Allegheny Wetlands	Goldenrod Wet Meadow	9.52%	GNR	S3
High Allegheny Wetlands	Rice Cutgrass Marsh	11.76%	GNR	S3
High Allegheny Wetlands	Threeway Sedge Fen	7.14%	GNR	S1
High Allegheny Wetlands	Tussock Sedge Wet Meadow	13.79%	G4G5	S3
High Allegheny Wetlands	Woolgrass Wet Meadow	2.22%	GNR	S3
River Floodplains	American Bur-Reed Marsh	9.76%	G3?	S2
River Floodplains	Beech - Sugar Maple Floodplain Forest	20.00%	G2G3	S1
River Floodplains	Black Willow Ruderal Shrub Swamp	6.25%	G4?	SNA
River Floodplains	Bushy St. Johnswort Shrub Swamp	5.88%	GNR	S3

Habitat	Common Name	Relative Abundance	G RANK	S RANK
River Floodplains	Buttonbush Shrub Swamp	9.38%	G4	S3
River Floodplains	Goldenrod Wet Meadow	9.52%	GNR	S3
River Floodplains	Hazel Alder Swamp	30.00%	G4	S3
River Floodplains	Meadow River Oak Swamp	87.50%	GNR	S1
River Floodplains	Ohio River Silver Maple Floodplain Forest	12.71%	G4?	S2
River Floodplains	Rice Cutgrass Marsh	11.76%	GNR	S3
River Floodplains	Threeway Sedge Fen	7.14%	GNR	S1
River Floodplains	Tussock Sedge Wet Meadow	13.79%	G4G5	S3
River Floodplains	Woolgrass Wet Meadow	2.22%	GNR	S3
Small Stream Riparian Habitats	American Bur-Reed Marsh	9.76%	G3?	S2
Small Stream Riparian Habitats	Black Willow Ruderal Shrub Swamp	6.25%	G4?	SNA
Small Stream Riparian Habitats	Bushy St. Johnswort Shrub Swamp	5.88%	GNR	S3
Small Stream Riparian Habitats	Buttonbush Shrub Swamp	9.38%	G4	S3
Small Stream Riparian Habitats	Goldenrod Wet Meadow	9.52%	GNR	S3
Small Stream Riparian Habitats	Hazel Alder Swamp	30.00%	G4	S3
Small Stream Riparian Habitats	Meadow River Oak Swamp	87.50%	GNR	S1
Small Stream Riparian Habitats	Ohio River Silver Maple Floodplain Forest	12.71%	G4?	S2
Small Stream Riparian Habitats	Rice Cutgrass Marsh	11.76%	GNR	S3
Small Stream Riparian Habitats	Threeway Sedge Fen	7.14%	GNR	S1
Small Stream Riparian Habitats	Tussock Sedge Wet Meadow	13.79%	G4G5	S3
Small Stream Riparian Habitats	Woolgrass Wet Meadow	2.22%	GNR	S3

S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

Map 8, on the next page, illustrates riparian and floodplain habitats, and the correlation of these habitats with biodiversity occurrences. Map 9 on page 33 illustrates exemplary wetlands (as assembled by WVDNR in 2015) and their close association with biodiversity occurrences. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. The majority of floodplain and riparian habitats within this CFA can be found concentrated around the Meadow River, Otter Creek and their tributaries. A vast stretch of the riparian corridor along the Meadow River is occupied by exemplary wetlands, which are the conservation priority within the Meadow River Wetlands CFA. The Biodiversity Rank occurrences indicate that most of the CFA's SGCN and rare communities are concentrated in wetland, floodplain and riparian habitats. Those habitats outside of larger forest patches may be more vulnerable to stresses.

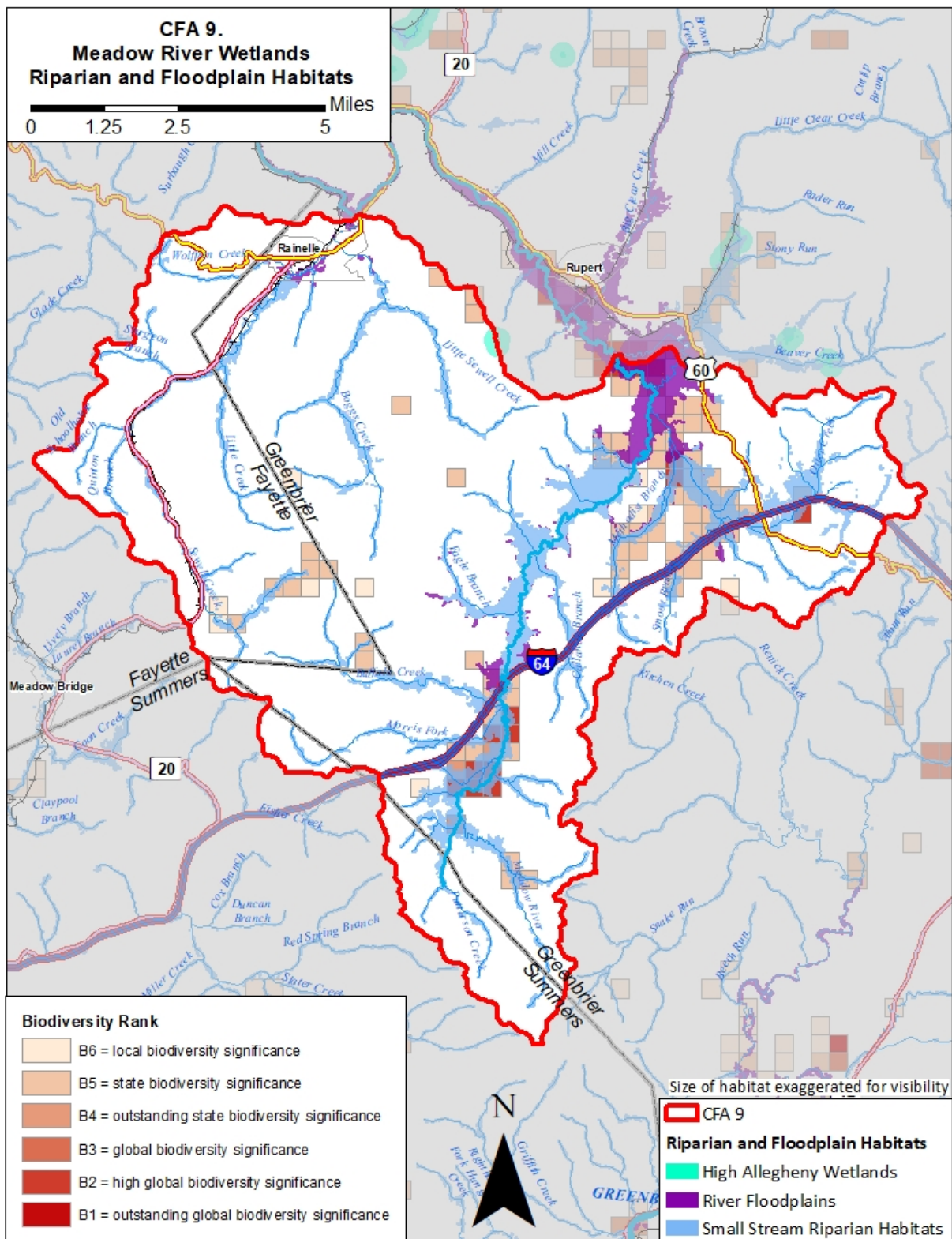
### Habitat Stresses and Conservation Actions

Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as in-stream, wetland, floodplain and riparian habitats for priority species and rare plant communities. Direct stresses to priority species include water quality and sedimentation, which can be improved by riparian improvements and Best Management Practices. Streams which have been impaired by fecal/bacteria or iron excess within the CFA include the Meadow River, Boggs Creek, Otter Creek, Sewell Creek and Little Sewell Creek. Map 10 illustrates impaired streams (WVDEP, 2014) and the biodiversity occurrences associated with them. Improving water quality in these areas would benefit numerous occurrences of rare species and plant communities in this CFA.

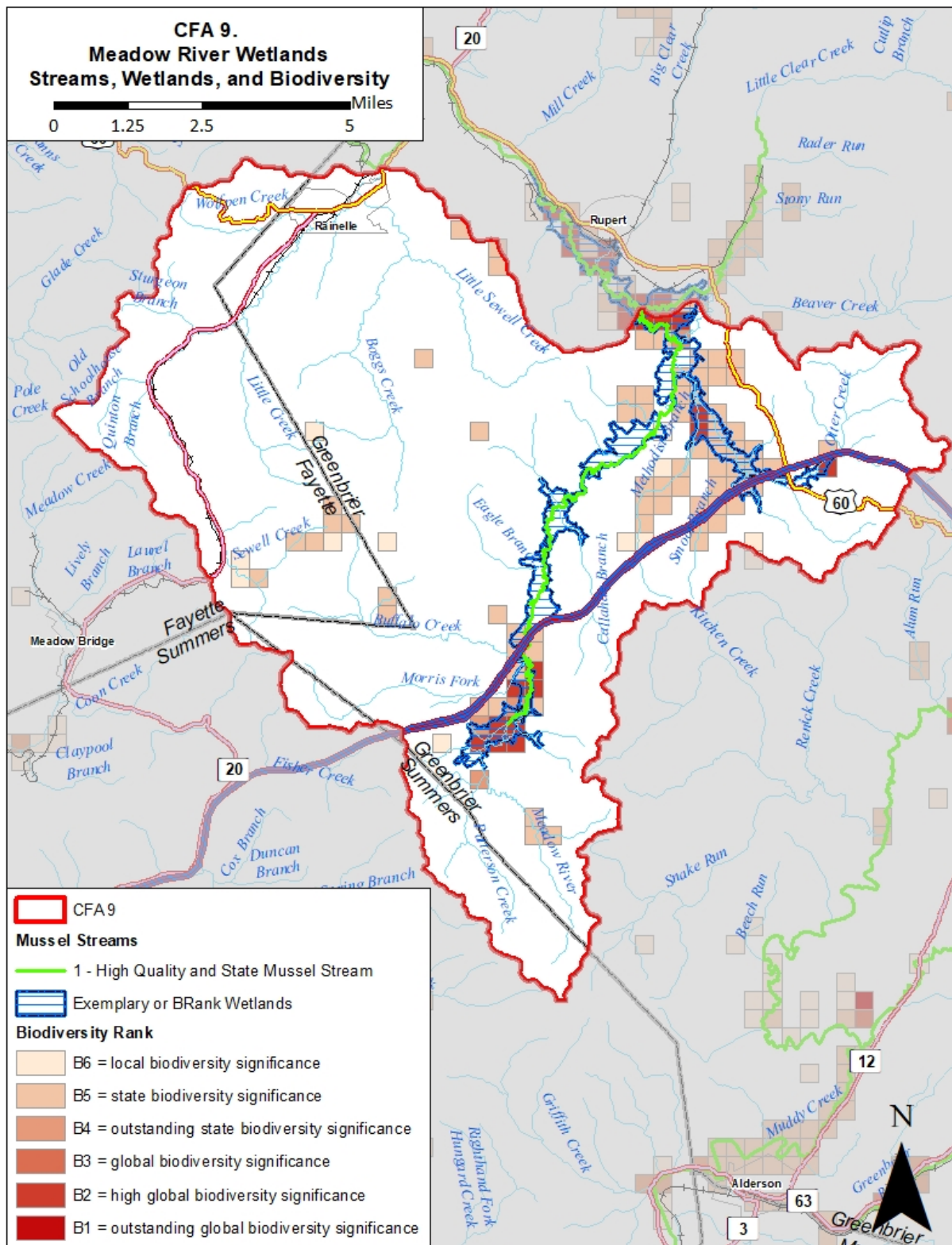
Table 13. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat

Habitat Stress	Conservation Action
Water quality degradation and sedimentation	Riparian improvements/Best Management Practices (BMPs)
Wetland degradation from livestock grazing, draining, filling and development	Protect, maintain and restore wetland habitats and buffers

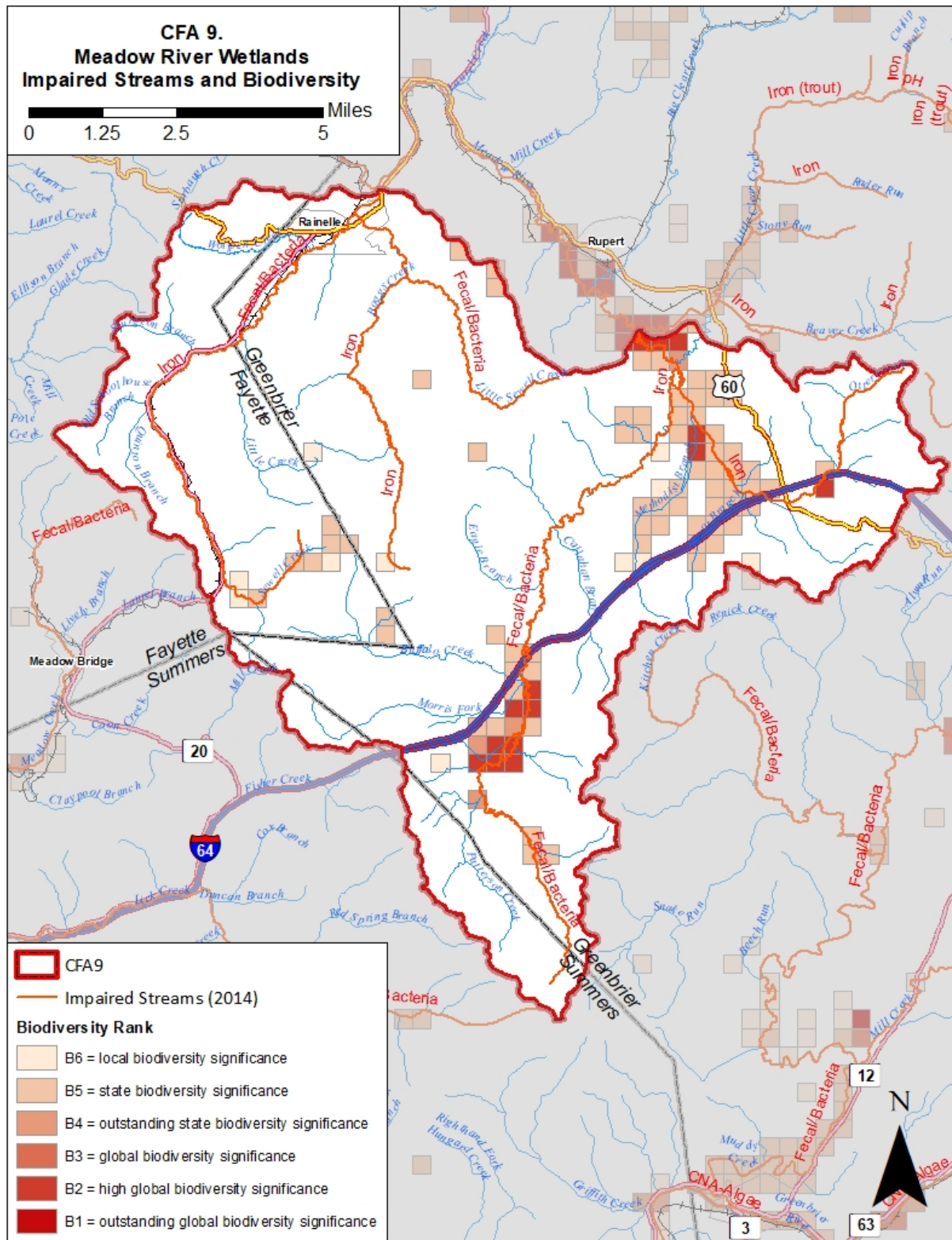
### Map 8. Riparian and Floodplain Habitats



Map 9. Streams, Wetlands and Biodiversity



Map 10. Impaired Streams and Biodiversity



## Climate Change and Habitat Resilience

As noted in the Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et al., 2015), riparian forests are vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation. Impervious cover may exacerbate these impacts. Drought may stress plants and increase their susceptibility to forest pests and pathogens. Warming temperatures and increased disturbances may enable nonnative invasive plant species to outcompete native species. Although riparian forests are adapted to some level of disturbance and variable conditions, habitat alterations and invasive species may limit the ability of riparian forests to adapt to climate change. Restoring and maintaining the health, acreage and connectivity of native riparian forests along streams and rivers will build their resilience to climate change.

The Assessment also describes how instream habitats and associated plant and animal species may be stressed by climate change-related increases in temperature, droughts, flood frequency and severity, and resulting erosion and sedimentation. Low flow events may also become more frequent and severe. Warming surface waters is likely to result in water quality degradation and eutrophication. Many aquatic species and life stages are adapted to specific timing and ranges of flow and temperature, as well as water quality variables. Climate change may impact different species and life stages in different ways. Cold water habitats and aquatic communities may be at particular risk. Areas within a watershed may be more or less sensitive to increases in air temperature, depending on local factors such as watershed characteristics, position within the watershed, upstream land uses, groundwater contributions, forest cover and shading.

Restoring and maintaining the health, size and connectivity of native riparian forests along streams and rivers can provide riparian habitat, shade and cooling, organic matter, structure and debris, protect stream banks and in-stream habitat during high flows and maintain water quality. Stabilizing eroding stream banks using natural channel design techniques and reconnecting streams with their floodplains can restore fluvial processes and floodplain habitats. Cleaning and enlarging culverts and stream crossings to accommodate increased peak flows and aquatic organism passage can reduce flood damage to infrastructure and habitat and allow aquatic organisms to reach additional habitat as they adapt to changing conditions.

Table 14 provides a summary of climate stresses on aquatic, floodplain and riparian habitat and actions to boost their resilience (Swanston et al., 2016). While climate stresses are listed separately, aquatic, floodplain and riparian habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions reiterate previously listed conservation actions to reduce stress on priority species and could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 14. Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat

Climate Stresses	Habitat Resilience Actions
<ul style="list-style-type: none"> <li>Increased flood frequency and severity, erosion and sedimentation</li> <li>Increased surface water temperatures, low-flow events and water quality degradation</li> <li>Increased risk of drought and wildfire</li> <li>Increased competition from nonnative invasive species, pests and pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Restore and maintain the health, diversity and connectivity of riparian forests</li> <li>Stabilize eroding streambanks and reconnect stream hydrology to floodplains</li> <li>Clean and enlarge culverts and stream crossings to accommodate peak flows and aquatic organism passage</li> <li>Minimize disturbance to riparian forests, promptly revegetate after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species</li> <li>Protect refugia for cold water habitat</li> </ul>

### Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement and measure the effectiveness of conservation actions to benefit priority species in aquatic, floodplain and riparian habitats.

Table 15. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <ul style="list-style-type: none"> <li>Conservation Easements</li> <li>Land Acquisition</li> <li>Natural Area designation</li> </ul>	<ul style="list-style-type: none"> <li>County Farmland Protection Boards</li> <li>OHCF, TCF, TNC, WVLT</li> <li>USDA NRCS</li> <li>WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>Acres of aquatic and riparian habitat protected for priority species</li> <li>Abundance and diversity of priority species and habitats</li> </ul>
Habitat Protection <ul style="list-style-type: none"> <li>Incentive Programs</li> </ul>	<ul style="list-style-type: none"> <li>USDA FSA</li> </ul>	<ul style="list-style-type: none"> <li>Acres of aquatic and riparian habitat protected for priority species</li> <li>Abundance and diversity of priority species and habitats</li> </ul>
Habitat Protection: <ul style="list-style-type: none"> <li>Land Use Planning</li> </ul>	<ul style="list-style-type: none"> <li>County Planning Commissions</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat protected through land use planning, floodplain and stormwater regulations</li> </ul>
Planting and fencing stream buffer zones	<ul style="list-style-type: none"> <li>USDA FSA &amp; NRCS</li> <li>Trout Unlimited</li> <li>USFWS Partners for Fish and Wildlife</li> <li>WV DOF</li> <li>WVDEP and WVCA</li> <li>Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>Acres or linear feet of stream buffer zones planted and fenced to protect priority species</li> <li>Before and after comparison: abundance and diversity of priority species</li> </ul>

Action	Partners	Effectiveness Measures
In-stream and riparian habitat restoration	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• Trout Unlimited</li> <li>• USFWS Partners for Fish and Wildlife</li> <li>• WVDEP and WVCA</li> <li>• Public Land Managers</li> <li>• WVDNR</li> <li>• Mitigation providers: WVDEP In-Lieu Fee Stream &amp; Wetland Mitigation Program, mitigation banks and others</li> </ul>	<ul style="list-style-type: none"> <li>• Acres or linear feet of in-stream and riparian habitat restored for priority species</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Improved wastewater treatment	<ul style="list-style-type: none"> <li>• WVDEP</li> <li>• WVDHHR</li> </ul>	<ul style="list-style-type: none"> <li>• # systems installed or improved</li> <li>• Change in fecal and other water quality measurements</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Remove or redesign aquatic passage barriers	<ul style="list-style-type: none"> <li>• Trout Unlimited</li> <li>• USFWS Partners for Fish and Wildlife</li> <li>• WVDOH</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• # barriers re-designed or removed</li> <li>• # miles stream opened</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Treat and underplant remaining riparian hemlock stands along headwater streams	<ul style="list-style-type: none"> <li>• Trout Unlimited</li> <li>• USFWS Partners for Fish and Wildlife</li> <li>• Public Land Managers</li> <li>• WVDA</li> <li>• WV DNR</li> </ul>	<ul style="list-style-type: none"> <li>• Acres or linear feet of riparian area treated</li> <li>• Treatment and planting success rate</li> </ul>
Improve water quality in streams and wetlands	<ul style="list-style-type: none"> <li>• WVDEP and WVCA</li> <li>• USDA FSA &amp; NRCS</li> </ul>	<ul style="list-style-type: none"> <li>• Change in water quality measurements</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Improve pH in headwater streams	<ul style="list-style-type: none"> <li>• WVDEP</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Change in water quality measurements</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Treat cattail and other invasive plants in wetlands	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• USFWS Partners for Fish and Wildlife</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of wetland treated</li> <li>• Treatment success rate</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>

## Human Benefits

Actions to restore and protect aquatic, floodplain and riparian habitat may have numerous health and economic benefits for local residents and communities, including absorption and reduction of pollution in water ways and drinking water sources, absorption and reduction of flood waters and reduced flood damages, soil conservation and improved agricultural productivity, and improved hunting, fishing and recreational opportunities.

## Agricultural and Developed Habitats

Many species of wildlife rely on agricultural lands, and some even rely on more developed lands. Most agricultural areas and developed areas are in valley bottoms and floodplains. Map 11 on the following page shows the location of agricultural and developed habitats and illustrates that there are many examples of biodiversity occurrences in and around agricultural areas in the CFA.

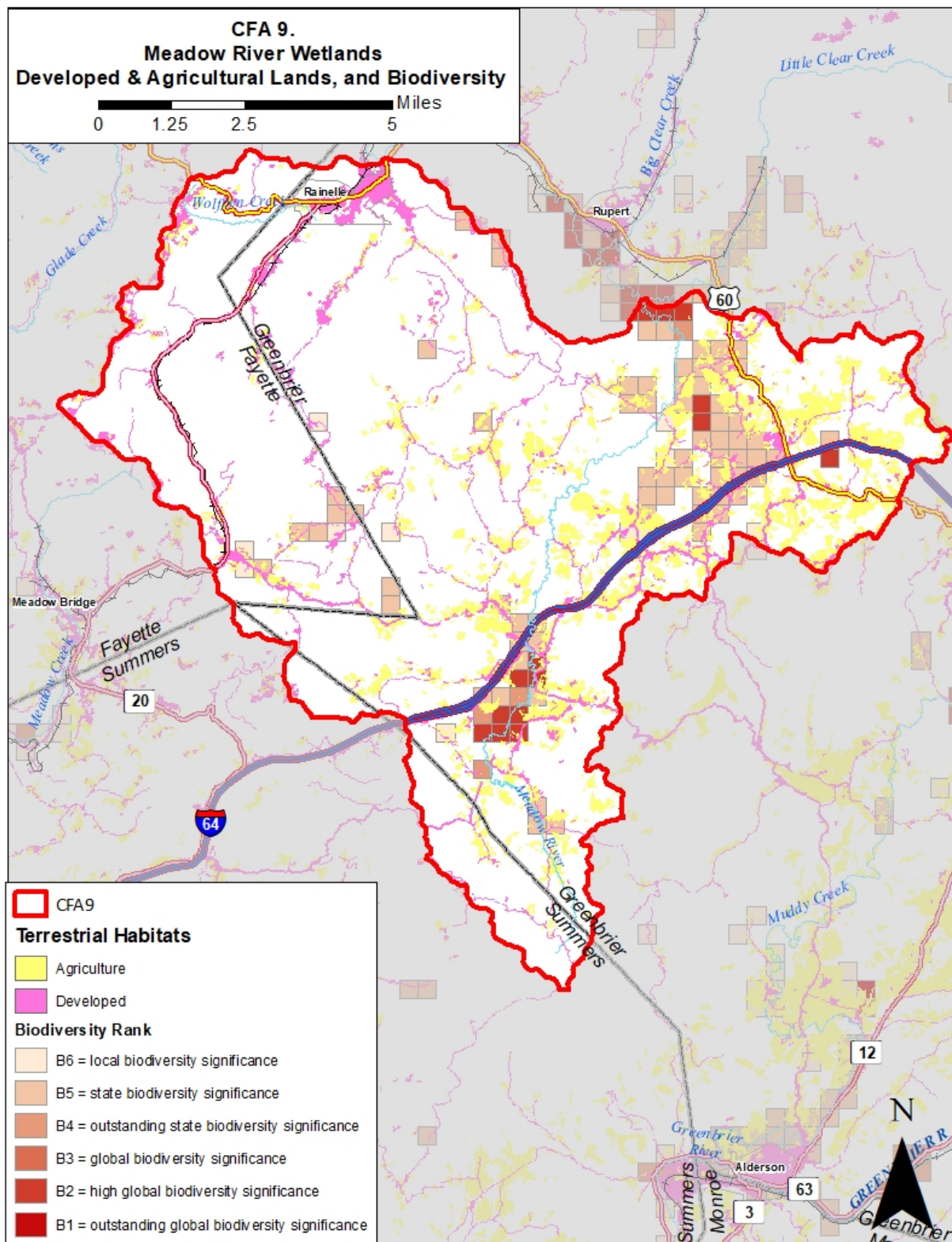
## Priority Species

Agricultural lands including cultivated crops, pastures and hayfields, along with adjacent areas of natural vegetation in and around adjacent forests and woodlots, hedgerows, fallow areas, ponds, wetlands and streams provide valuable habitat for several priority grassland bird species in the CFA. The following is a list of priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habitat, most notably for the Chimney Swift.

Table 16. Priority Species associated with Agricultural and Developed Habitats

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>
Bird	<i>Chaetura pelagica</i>	Chimney Swift
Bird	<i>Spizella pusilla</i>	Field Sparrow
Bird	<i>Sturnella magna</i>	Eastern Meadowlark

Map 11. Developed & Agricultural Lands and Biodiversity



### Habitat Stresses and Conservation Actions

The conversion of farmland for residential and commercial development reduces valuable habitat for wildlife, especially grassland birds. In addition, modern farming practices have resulted in the intensification of mechanized farming practices and the expansion of areas cleared for agriculture. Consequently, much natural vegetation providing wildlife habitat in grasslands, wetlands, fallow areas, riparian corridors, hedgerows and forest edges has been cleared. Table 17 lists stresses to wildlife habitat in agricultural areas and conservation actions to address them.

Table 17. Habitat Stresses and Conservation Actions in Agricultural & Developed Habitats:

Habitat Stress	Conservation Action
Conversion to crop agriculture/ Clean farming practices	Retain or create woody structure such as hawthorns in fields or along field margins
Decline in suitable nest sites and migration roosts, possible decline in aerial insects (chimney swifts)	Landowner outreach, reduce chimney capping, build chimney swift towers, retain large hollow snags
Wetland loss and degradation	Protection, restoration and fencing of wetlands
Non-native invasive species	Monitoring and careful treatment, replace with native plantings

### Climate Change and Habitat Resilience

According to Adaptation Resources for Agriculture (Janowiak et al., 2016), agriculture will likely be impacted by many of the same climate changes that affect forest and freshwater habitats. Likely changes include increasing temperatures, longer growing seasons, increasing number of hot days and nights, and changing precipitation patterns. Impacts include increases in the risk of damage to soil, crops, and infrastructure from extreme storm and precipitation events, flood damage, soil moisture stress and drought, competition from nonnative invasive plants, crop damage from insects and pathogens, and livestock parasites and pathogens. Butler et al. (2015) also noted that impervious surfaces in developed areas can exacerbate many of these impacts.

Many wildlife species associated with agricultural and developed lands rely on hayfields and pastures, fallow fields, floodplain and riparian corridors, streams and wetlands, and areas of natural vegetation around field and forest edges. In agricultural settings, these areas may already be degraded and sensitive to disturbance. As we have seen in previous sections of this plan, these areas may also be susceptible to impacts from climate change. Riparian forests may be vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation in streams. Drought may stress streams and aquatic life, as well as plants, and increase their susceptibility to pests and pathogens. Warming temperatures and increased storm disturbances may enable nonnative invasive plant species to outcompete native species.

Janowiak et al. (2016) lists numerous strategies to boost the resilience of agriculture to climate change, including maintaining soil health and water quality, reducing competition from nonnative invasive species, creating pollinator habitat, adapting farm infrastructure such as stream crossings to higher peak flows, adapting farm practices or shifting agricultural land use to match changing conditions. Managing farms as part of a larger landscape by maintaining, restoring and connecting natural habitats such as streams, wetlands, riparian areas and forest edges can boost the resilience of farms by buffering hydrological impacts while providing habitat and corridors wildlife to persist and adapt to climate change. In developed areas, limiting and buffering impervious surfaces, and using constructed wetlands and other green infrastructure can also reduce the hydrological impacts of climate change.

Table 18 provides a summary of climate stresses on wildlife habitat in agricultural and developed areas, and actions to boost their resilience. Climate stresses are listed separately, but agricultural habitats are often impacted by multiple climate stresses occurring simultaneously. Therefore, actions to boost habitat resilience are intended to address multiple climate stresses. These actions reinforce conservation actions to reduce stress on priority species in agricultural and developed habitats. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Table 18. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

Climate Stress:	Habitat Resilience Action:
<ul style="list-style-type: none"> <li>Increased flood frequency and severity, erosion and sedimentation</li> <li>Increased surface water temperatures, low-flow events and water quality degradation</li> <li>Increased risk of drought and wildfire</li> <li>Increased competition from nonnative invasive species, pests and pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Maintain soil health and water quality</li> <li>Reduce competition from weeds and invasive species</li> <li>Create pollinator habitat</li> <li>Maintain, restore and connect aquatic, riparian and forest habitats to buffer against hydrological impacts</li> <li>Adapt farm practices, infrastructure and land uses to changing conditions</li> <li>Reduce and buffer impervious surfaces, and use green infrastructure to absorb runoff and mitigate hydrological impacts</li> </ul>

### Implementation Plan

WVDNR will seek to engage the following partners and programs in implementing and measuring effectiveness of conservation actions in agricultural habitats.

Table 19. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
Habitat Protection: <ul style="list-style-type: none"> <li>Conservation Easements</li> <li>Land Acquisition</li> </ul>	<ul style="list-style-type: none"> <li>County Farmland Protection Boards</li> <li>OHCF, TCF, TNC, WVLT</li> <li>USDA NRCS</li> <li>WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat protected for priority species</li> <li>Abundance and diversity of priority species and habitats</li> </ul>
Habitat Protection <ul style="list-style-type: none"> <li>Incentive Programs</li> </ul>	<ul style="list-style-type: none"> <li>USDA FSA</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat protected for priority species</li> <li>Abundance and diversity of priority species and habitats</li> </ul>
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants	<ul style="list-style-type: none"> <li>USDA FSA &amp; NRCS</li> <li>USFWS</li> <li>WVCA</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Acres or linear feet of native vegetation planted and protected</li> <li>Change in abundance, diversity and distribution of priority species and habitats</li> </ul>
Maintain or restore stream and wetland habitats, riparian and wetland buffers as well as species and structural diversity in natural areas in and around farmland, and enhance connections between them	<ul style="list-style-type: none"> <li>USDA FSA &amp; NRCS</li> <li>Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat restored for priority species</li> <li>Abundance &amp; distribution of priority species and habitats</li> </ul>
Install fencing and watering systems, control livestock access, protect water quality, riparian buffers and natural vegetation in and around agricultural land	<ul style="list-style-type: none"> <li>USDA FSA &amp; NRCS</li> <li>USFWS Partners for Wildlife Program</li> <li>WVCA and GVCD</li> <li>WVU Extension</li> </ul>	<ul style="list-style-type: none"> <li>Acres of habitat maintained or restored</li> <li>Before and after comparison: abundance and diversity of priority species</li> </ul>
Create and maintain pollinator habitat and nectar resources, including diverse native and non-invasive flowering forbs, shrubs, trees, larval host plants and undisturbed nesting and overwintering areas along field edges, woodlots, water bodies, roads, on fallow fields and other appropriate sites.	<ul style="list-style-type: none"> <li>Consulting Foresters</li> <li>USDA NRCS</li> <li>USFWS Partners for Wildlife Program</li> <li>WVDOH</li> <li>Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>Acres or linear feet of pollinator habitat created or maintained</li> <li>Change in abundance, diversity and distribution of priority species and habitats</li> </ul>
Prevent conversion of grasslands to croplands	<ul style="list-style-type: none"> <li>USDA FSA</li> </ul>	<ul style="list-style-type: none"> <li>Acres of grasslands planted and protected</li> <li>Change in abundance, diversity and distribution of priority species and habitats</li> </ul>

Action	Partners	Effectiveness Measures
Monitoring and careful treatment of nonnative invasive species, replace with native plantings	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• WVCA and GVCD</li> <li>• WVU Extension</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat maintained or restored</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Adapt farm practices, infrastructure and land uses to changing conditions	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• Public Land Managers</li> </ul>	<ul style="list-style-type: none"> <li>• # practices or acres adapted</li> <li>• Change in abundance, diversity and distribution of priority species</li> </ul>
Landowner outreach, uncapping chimneys, install swift towers	<ul style="list-style-type: none"> <li>• WVU Extension</li> <li>• Landowners and volunteer groups</li> </ul>	<ul style="list-style-type: none"> <li>• # chimneys uncapped</li> <li>• # swift towers installed</li> <li>• Change in abundance, diversity and distribution of chimney swifts</li> </ul>

### Human Benefits

Actions to restore and protect wildlife habitat within agricultural areas and developed lands may provide benefits for human health and economies in surrounding communities. Benefits may include erosion control and improved water quality, improved hunting, fishing and recreational opportunities, and conservation of native pollinators for crop production.

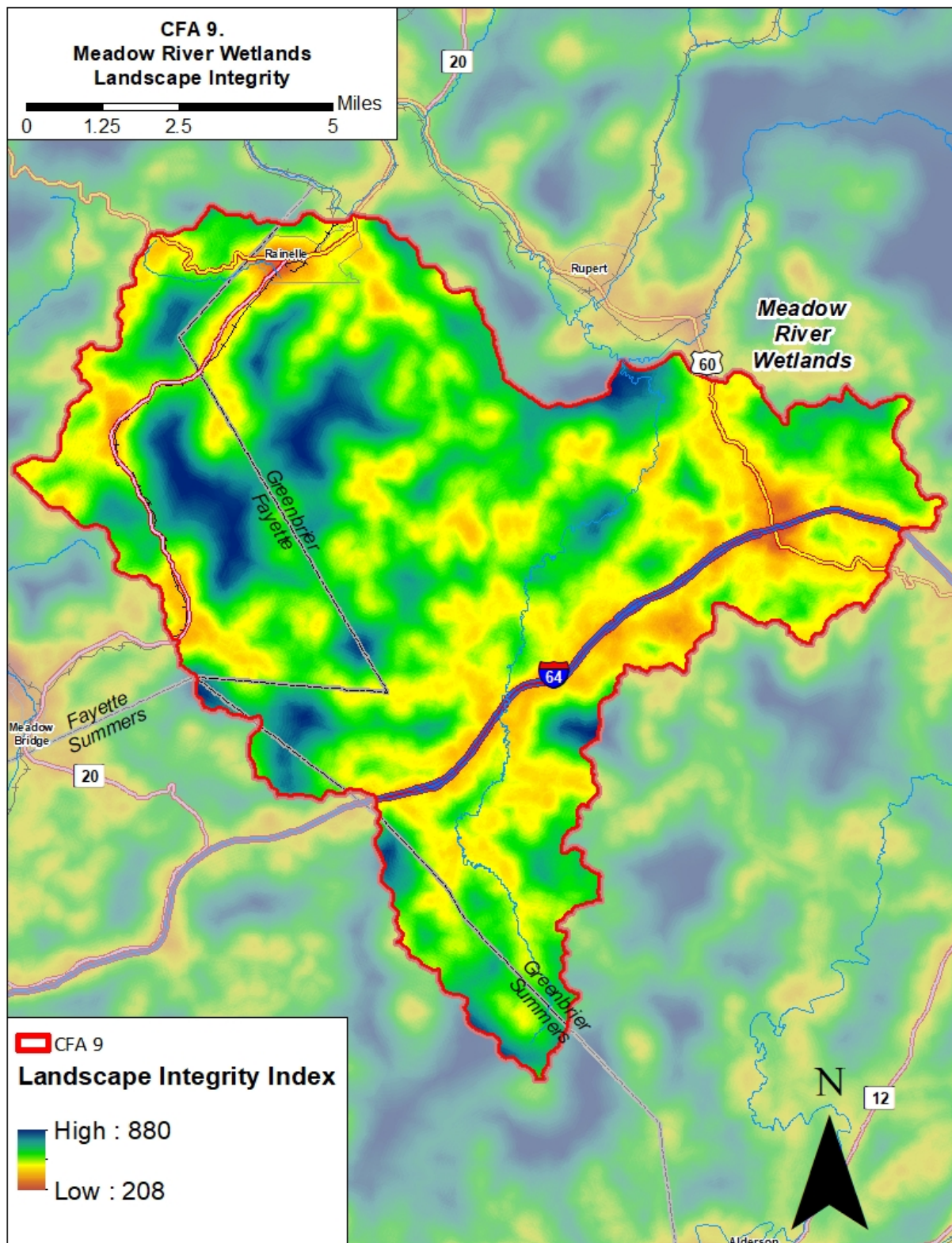
## Landscape Resilience and Connectivity

The conservation and resilience actions described previously in this plan aim to reduce stressors on priority species in each major habitat type and enhance the resilience of those habitats to climate change. Some of those actions include protecting refugia, core areas of intact habitats and habitat corridors. Habitat cores are patches of high-quality habitat for priority species, surrounded by areas with a different community structure, and serve as nodes in a connected ecological network (Harrison and Odell, 2016; USDA Natural Resources Conservation Service, 2004). Habitat cores identified for protection in this CFA include large forest blocks, wetlands, habitats limited to specific soil types and geology such as shale barrens, cliffs and talus, biologically significant caves and their buffer zones, and core aquatic habitat such as mussel streams. Important habitat corridors identified for protection include connected forest patches, intact river floodplains and small stream riparian forests. Protecting corridors of terrestrial and aquatic habitat connected to habitat patches and larger core areas may allow for species movement and enhance the flow of genetic material in response to climate change (Butler et al., 2015; Anderson et al., 2016a).

Maintaining or restoring wildlife populations in a changing climate may require conservation actions at a landscape level, across habitat types and beyond individual habitat cores and corridors. Anderson (2016b) summarized a wealth of current research demonstrating how the increasing frequency and severity of storms, floods, droughts and fires may cause species to respond by shifting location or behavior within their existing habitat, evolving to adapt to new conditions, or shifting their distributions across the landscape. Evidence has been documented for over 1,000 species currently shifting one of four ways: locally toward suitable microclimate, upslope to higher elevations, downslope towards moist riparian areas, and northward toward cooler latitudes. However, landscape fragmentation has been shown to slow movement in response to climate change. Enabling wildlife to shift and adapt to climate change will require the conservation of a network of unfragmented landscapes within which species can shift their range to more suitable local microclimates or upslope, downslope or northward.

In 2008 the WVDNR developed a model of landscape integrity to identify unfragmented landscapes. Map 12 illustrates areas of high landscape integrity in the CFA. Landscape integrity is estimated to increase with distance from roads, powerlines, development and other features that fragment the landscape. These high integrity landscapes tend to correspond to larger forest patches and include WMA lands along the Meadow River and private lands along the Greenbrier/Fayette county line, where there are fewer documented biodiversity occurrences and more surveying may be warranted. These areas are important for species movement in response to climate change and are priorities for protection of wildlife habitat. It should also be noted that many of the documented biodiversity occurrences are along the Meadow River and its exemplary wetlands in the Interstate 64 corridor, which are lower integrity landscapes that may be vulnerable to fragmentation and associated habitat stressors. Additional conservation may be warranted in these areas.

Map 12. Landscape Integrity



Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic diversity that offer a range of habitat types and microclimates for species and ecosystems to adapt to climate change. Resilient sites also have high landscape integrity, enabling species to move locally in response to climate change and natural processes like fire and floods to continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the regional flow of species across the landscape over time in response to climate change, as constrained by natural and human-caused barriers. This led to the identification of corridors of constrained movement, and flow zones of dispersed movement. These are corridors and core areas for species movement and adaptation at a landscape level.

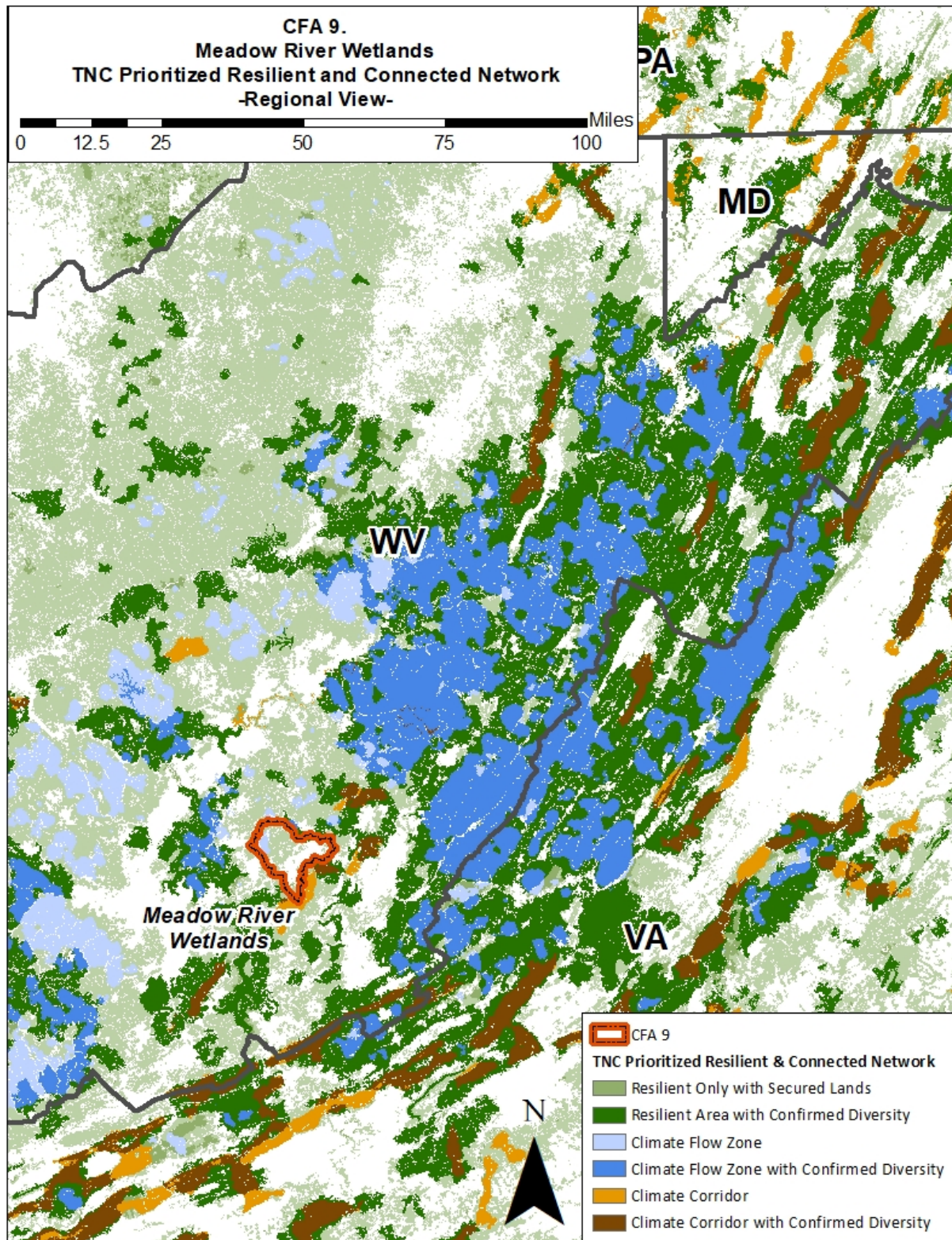
Next, the team developed models that integrated landscape resilience, connectivity and the flow of species across the landscape. They selected a connected network of sites that represents the full suite of geophysical settings, includes known records of biological diversity, and has the configuration and connections necessary to support the continued movement of species in response to change conditions. Within this network they identified the places most essential for sustaining biodiversity in a changing climate and are also aligned to the natural flow patterns across the region. This included the most resilient and diverse lands representing all of the region's geophysical settings, recorded occurrences of biological diversity, resilient lands already secured through public ownership or conservation easements, and the riparian corridors and other landscape linkages with the most concentrated movement of species. This prioritized network covers 23% of the land in the Eastern United States.

This work is documented in *Resilient Sites for Terrestrial Conservation in Eastern North America* (Anderson et al., 2016a), and *Resilient and Connected Landscapes for Terrestrial Conservation* (Anderson et al., 2016b). The studies produced a series of maps (see <http://maps.tnc.org/resilientland/>) that identified the following areas:

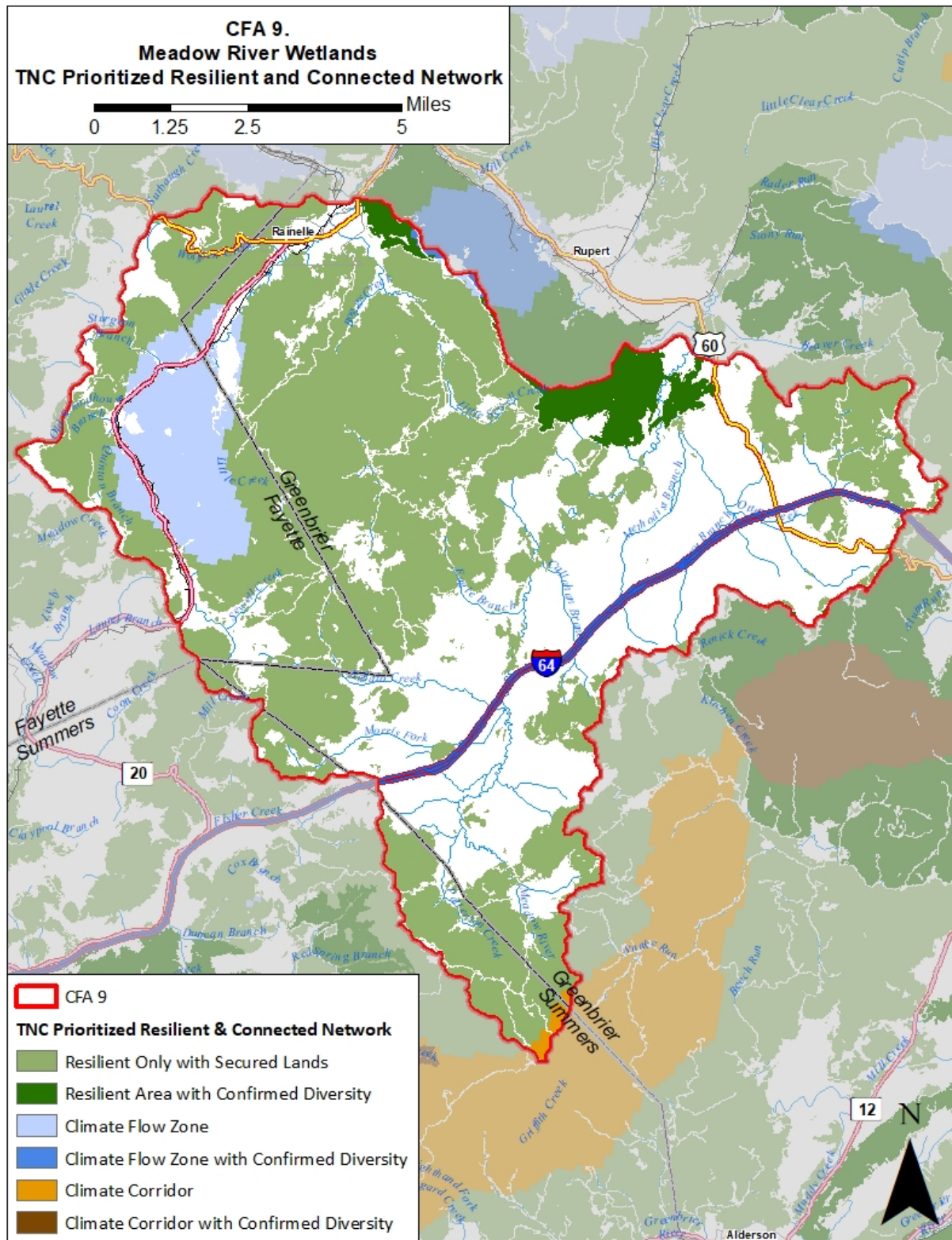
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes concentrated, often along a stream corridor or ridgeline
- Climate flow zone: areas with high levels of plant and animal movement that is less concentrated than in a corridor, such as an intact forest patches and areas of high integrity

Map 13 illustrates that the resilient, connected landscapes in the western portion the CFA forms part of a matrix of resilient lands between the hub of resilient lands and climate flow zones in and around the Monongahela National Forest to the north and the New River Gorge to the south. These resilient landscapes and flow zones link the narrower climate corridors to the north in Maryland and Pennsylvania with those to the south in Virginia. The resilient landscapes in this CFA are critical to species adapting to climate change within across the Eastern United States.

Map 13. Priority Resilient and Connected Regional Network – Regional View



Map 14. Priority Resilient and Connected Network – Detailed View



Map 14 provides a detailed view of the resilient, connected landscapes in the Meadow River CFA. Resilient landscapes cover the northeast and southeast corners of the CFA, as well as the northwest portion. There is also a climate flow zone along the Greenbrier/Fayette county line. These landscapes contain the CFA's larger forest patches and high integrity areas, as well as portions, but not all of the exemplary wetlands which are of such high biological significance within the CFA. Protecting and maintaining these areas of high landscape integrity and the resilient areas, climate corridors and climate flow zones within the region's priority resilient and connected network is critical in order to enable priority SGCN and their habitat to adapt to climate change and persist in this CFA. Conservation actions to enhance landscape connectivity and resilience in and around the exemplary wetlands would support climate adaption and long-term survival by numerous rare plant communities and priority species there. These areas are priorities for conservation action within the CFA.

The table below summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Table 20. Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	Conservation Action
<ul style="list-style-type: none"> <li>• Changing conditions exacerbating existing stresses on species and habitat</li> <li>• Species responding to climate change by shifting locally as well as across the landscape</li> <li>• Landscape fragmentation that prevents or constrains species movement</li> </ul>	<ul style="list-style-type: none"> <li>• Protect and maintain a connected network of resilient landscapes, flow zones and climate corridors across the landscape for species to adapt and shift locally and regionally in response to climate change</li> <li>• Enhance landscape connectivity and resilience in and around exemplary wetlands</li> </ul>

### Implementation Plan

The resilient and connected landscapes in this CFA provide critical links to the larger network of resilient and connected landscapes in West Virginia, the Central Appalachians and Eastern North America. They provide a blueprint of habitat cores and corridors where conservation actions to restore, maintain and protect natural habitat and remove barriers to movement will be crucial to enabling priority species and habitats to shift and adapt to climate change at both local and regional scales. The following implementation plan lists specific actions to protect, maintain and restore the network of resilient, connected lands within the CFA.

Table 21. Implementation Plan for Landscape Resilience and Connectivity

Action	Partners	Effectiveness Measures
Protection of Resilient, Connected Landscapes <ul style="list-style-type: none"> <li>• Conservation Easements</li> <li>• Land Acquisition</li> </ul>	<ul style="list-style-type: none"> <li>• County Farmland Protection Boards</li> <li>• OHCF, TCF, TNC, WVLT</li> <li>• USDA NRCS</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected for priority species in resilient landscapes and climate corridors</li> <li>• Abundance &amp; distribution of priority species and habitats</li> </ul>
Protection of Resilient, Connected Landscapes <ul style="list-style-type: none"> <li>• Land use planning</li> </ul>	<ul style="list-style-type: none"> <li>• County Planning Commissions</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected through land use planning in resilient, connected landscapes</li> </ul>
Protection of Resilient, Connected Landscapes <ul style="list-style-type: none"> <li>• Incentive Programs</li> <li>• Forest Carbon Projects</li> </ul>	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• Consulting Foresters</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected for priority species in resilient landscapes and climate corridors</li> <li>• Abundance &amp; distribution of priority species and habitats</li> </ul>
Protection of Resilient, Connected Landscapes <ul style="list-style-type: none"> <li>• Conservation, Restoration and Management</li> </ul>	<ul style="list-style-type: none"> <li>• AFF, AMJV, NWTF, RGS, TNC</li> <li>• Forest Certification Programs: ATFS, FSC, SFI</li> <li>• WVDNR</li> <li>• WVDOP</li> <li>• Private Landowners</li> <li>• Public Land Managers</li> <li>• Partner Organizations</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected, restored and maintained in resilient landscapes and climate corridors</li> <li>• Abundance &amp; distribution of priority species and habitats</li> </ul>

## Conclusion

### Habitat Conservation Priorities

This action plan lists priority species and rare plant communities targeted for conservation action on public and private land and within each major habitat type. The major habitat types include forests and woodland habitats, aquatic, wetland, floodplain and riparian habitats, and developed and agricultural habitats. For each major habitat type the plan identifies stresses that affect priority species, conservation actions to reduce those stresses, climate stresses on those habitats, actions to boost resilience, partners that can assist with conservation actions to implement the plan and the human benefits of conservation.

Below is a list of the priority habitats identified by this Action Plan for conservation action.

- Exemplary wetlands
- Small stream riparian and river floodplain habitats
- Intact forest patches, including interior forest habitat
- Early-successional forest habitat
- Riparian corridors, wetlands, grasslands and fallow fields, field borders and other areas of natural and woody vegetation within and around agricultural lands

These priority habitats include habitat cores and corridors that are critical for maintaining wildlife populations in this CFA. To protect priority SGCN and enable them to adapt to changing conditions within these priority habitats, landowners and partner organizations are encouraged to plan and implement conservation actions to alleviate stresses on priority species and boost habitat resilience, and carefully monitor the results using an adaptive management framework such as the Climate Smart Conservation Cycle provided in the introduction. Stakeholders are also encouraged to coordinate with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to these priority habitats.

### Integration of Conservation Actions

Integration of conservation actions within the above priority habitats, such as projects to improve aquatic habitat by improving wastewater treatment, enlarging stream crossings and planting riparian stream buffers may benefit multiple plant communities and wildlife species. Coordinating actions across multiple habitats, such as improving water quality, planting riparian corridors and protecting intact forest patches around wetlands, may benefit additional species. Private landowners, public land managers and conservation partners are encouraged to focus resources across priority habitats to maximize benefits to multiple species.

### Connecting Conservation Actions for Climate Resilience

As we have seen, conservation actions to relieve stresses on priority species and efforts to boost the resilience of wildlife habitat are essential for enabling climate adaptation. Maintaining and protecting areas of high landscape integrity as well as the regional network of resilient lands, climate corridors and

flow zones is also critical for enabling wildlife species to adapt to changing conditions and shift across the landscape.

Furthermore, creating local networks of connected habitat cores and corridors will enhance their resilience and connectivity and the ability of wildlife species to adapt to changing conditions within this CFA. Connected local networks of headwater streams and larger rivers, their riparian corridors, floodplains and wetlands enhances the stability of these habitats and enables fish, reptiles, birds and other priority wildlife species that depend on those habitats to move across the landscape as conditions change. Conservation of aquatic, riparian and floodplain corridors along with areas of native vegetation in and around agricultural areas, small forest patches and larger blocks of forest habitat can create a local network of resilient, connected lands that merges into the larger regional network. Beyond undertaking conservation actions in the priority habitats listed above, and even beyond protecting the regional network of climate connectors and flow zones, stakeholders are encouraged to restore and protect the connections between these areas in order to maintain an interwoven fabric of natural systems for wildlife within this CFA to thrive long into the future.

### Next Steps in Implementation

WVDNR engaged a working group of partner organizations and public land managers in developing this Action Plan and will seek to remain engaged by convening semi-annual meetings with the working group to collaborate on actions including the following:

- Planning, implementing and evaluating ongoing field surveys of priority species to document and monitor their abundance, distribution, population trends, vulnerability and range shifts
- Planning, implementing, monitoring and evaluating the results of the conservation actions
- Engaging and supporting private landowners in this work.

WVDNR may lead some of these efforts but will most often play the role of supporting efforts by the many partners active in this CFA with ongoing projects, established programs, and connections with landowners. In the case of public lands, WVDNR will also seek to incorporate conservation actions targeting priority species, habitats and priority areas for conservation action into agency planning processes and support those actions. WVDNR will also work with state agencies and other authorities to promote avoidance, minimization and mitigation of development impacts to priority habitats and other priority areas for conservation action.

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## Appendix 1. SGCN in Meadow River Wetlands CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS Priority At Risk
Amphibians	Desmognathus quadramaculatus	Black-bellied Salamander	S3	G5		
Amphibians	Plethodon wehrlei	Wehrle's Salamander	S4	G4		
Amphibians	Pseudacris feriarum	Upland Chorus Frog	S3	G5		
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5		At Risk- Conserv
Birds	Butorides virescens	Green Heron	S3B			
Birds	Chaetura pelagica	Chimney Swift	S3B	G5		
Birds	Colinus virginianus	Northern Bobwhite	S1B, S1N	G5		
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5		
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5	R	At Risk- Conserv
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4		At Risk- Conserv
Birds	Spizella pusilla	Field Sparrow	S3B, S3N	G5	R	
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5	R	
Birds	Vermivora chrysoptera	Golden-winged Warbler	S1B	G4		At Risk- Conserv
Crayfish	Camburus pauleyi	Meadow River Mudbug	S2	GNR		
Dragonflies and Damselflies	Aeshna tuberculifera	Black-tipped Darner	S3	G4		
Dragonflies and Damselflies	Lestes inaequalis	Elegant Spreadwing	S3	G5		
Dragonflies and Damselflies	Somatochlora linearis	Mocha Emerald	S3	G5		
Fish	Ameiurus melas	Black Bullhead	S1	G5		
Mammals	Myotis septentrionalis	Northern Long-eared Bat	S2*	G2	T	
Mammals	Zapus hudsonius	Meadow Jumping Mouse	S3	G5		
Plants	Calopogon tuberosus var. tuberosus	Tuberous Grass-pink	S1	T5		
Plants	Carex albolutescens	Greenish-white Sedge	S1	G5		
Plants	Carex bromoides ssp. bromoides	Brome-like Sedge	S3	T5		

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>S Rank</b>	<b>G Rank</b>	<b>Federal Status</b>	<b>USFWS Priority At Risk</b>
Plants	Carex lacustris	Lake Sedge	S2	G5		
Plants	Carex normalis	Greater Straw Sedge	S3	G5		
Plants	Carex pellita	Woolly Sedge	S2	G5		
Plants	Carex straminea	Straw Sedge	S2	G5		
Plants	Carex tuckermanii	Tuckerman's Sedge	S1	G4		
Plants	Carex typhina	Cattail Sedge	S2	G5		
Plants	Eleocharis elliptica	Elliptic Spikerush	S1	G5		
Plants	Eleocharis palustris	Marsh Spikerush	S3	G5		
Plants	Fraxinus nigra	Black Ash	S2	G5		
Plants	Hierochloe hirta ssp. arctica	Holy Grass, Sweetgrass	S1	T5		
Plants	Lysimachia hybrida	Lowland Loosestrife	S1	G5		
Plants	Pedicularis lanceolata	Swamp Lousewort	S2	G5		
Plants	Piptochaetium avenaceum	Eastern Speargrass	S2	G5		
Plants	Platanthera ciliaris	Yellow-fringe Orchid	S3	G5		
Plants	Platanthera peramoena	Pride-of-the-peak	S3	G5		
Plants	Polygala cruciata var. aquilonia	Cross-leaved Milkwort	S1	T4		
Plants	Potamogeton tennesseensis	Tennessee Pondweed	S2	G2		At Risk- Science
Plants	Rhynchospora fusca	Brown Beaksedge	S1	G4		
Plants	Sanguisorba canadensis	Canada Burnet	S2S3	G5		
Plants	Scirpus atrocinctus	Blackgirdle Bulrush	S3	G5		
Plants	Sparganium androcladum	Branched Bur-reed	S2S3	G4		
Plants	Spiraea virginiana	Virginia Spiraea	S1	G2	T	
Plants	Stachys tenuifolia	Smooth Hedge-nettle	S3	G5		
Plants	Veronica scutellata	Grassleaf Speedwell	S2	G5		
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4		
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	T5	R	
Snails	Vallonia perspectiva	Thin-lip Vallonia	S3			

S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

Federal Status: R = Rare, T= Threatened, E = Endangered.

USFWS Priority At Risk: Conserv = need management attention, Science = need more research.

## Appendix 2. Priority SGCN, Known Stresses and Actions

Forests and Woodlands		
Common Name	Local Stress	Action
Eastern Whip-poor-will	<ul style="list-style-type: none"> <li>• Forest maturation.</li> <li>• Understory habitat degradation from fire suppression.</li> <li>• Deer overabundance.</li> </ul>	<ul style="list-style-type: none"> <li>• Timber management for canopy openings.</li> <li>• Implement prescribed burning in fire adapted systems.</li> <li>• Reduce deer abundance.</li> </ul>
Wood Thrush	<ul style="list-style-type: none"> <li>• Forest fragmentation and loss.</li> <li>• Incompatible forest structure.</li> <li>• Deer browse.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain and improve core forests with scattered openings and well-developed understories.</li> <li>• Manage local deer populations.</li> </ul>
Cerulean Warbler	<ul style="list-style-type: none"> <li>• Forest fragmentation and loss from development.</li> <li>• Incompatible forest structure.</li> </ul>	<ul style="list-style-type: none"> <li>• Implement management guidelines at suitable locations on public lands.</li> <li>• Implement guidelines on private lands via CERW/farm bill programs.</li> </ul>
Golden-winged Warbler	<ul style="list-style-type: none"> <li>• Forest maturation.</li> <li>• Incompatible forest structure.</li> <li>• Habitat loss on wintering grounds.</li> </ul>	<ul style="list-style-type: none"> <li>• Implement management guidelines at suitable locations on public lands.</li> <li>• Implement guidelines on private lands via GWWA/farm bill programs.</li> </ul>

Developed and Agricultural Habitats		
Common Name	Local Stress	Action
Eastern Meadowlark	<ul style="list-style-type: none"> <li>• Incompatible field and pasture management.</li> <li>• Conversion to crop agriculture.</li> </ul>	<ul style="list-style-type: none"> <li>• Implement Farm Bill practices that maintain or improve grasslands.</li> </ul>
Field Sparrow	<ul style="list-style-type: none"> <li>• Incompatible field and pasture management.</li> <li>• Conversion to crop agriculture.</li> </ul>	<ul style="list-style-type: none"> <li>• Implement Farm Bill practices that retain or create woody structure in fields.</li> </ul>
Chimney Swift	<ul style="list-style-type: none"> <li>• Decline in suitable nest sites and migration roosts.</li> <li>• Decline in aerial insects.</li> </ul>	<ul style="list-style-type: none"> <li>• Educate residents to reduce chimney capping.</li> <li>• Mitigate loss of nest and roost sites through constructing dedicated towers.</li> <li>• Retain large hollow snags.</li> </ul>

Aquatic, Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Meadow River Mudbug	<ul style="list-style-type: none"> <li>Water quality impairments and sedimentation</li> </ul>	<ul style="list-style-type: none"> <li>Restore, protect and maintain riparian forest buffers</li> </ul>
Black Bullhead	<ul style="list-style-type: none"> <li>Degraded water quality.</li> <li>Increased sedimentation.</li> </ul>	<ul style="list-style-type: none"> <li>Restore and protect riparian buffers.</li> <li>Develop riparian BMP's.</li> </ul>
Elliptic Spikerush	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Lowland Loosestrife	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Black Ash	<ul style="list-style-type: none"> <li>Mortality from infestation by emerald ash borer.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine extent of mortality and identify resistant individuals.</li> </ul>
Brown Beaksedge	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Cross-leaved Milkwort	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Greenish-white Sedge	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Holy Grass, Sweetgrass	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Tuckerman's Sedge	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>
Virginia Spiraea	<ul style="list-style-type: none"> <li>Unknown status and threats.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct surveys to determine distribution and threats.</li> </ul>

### Appendix 3. Terrestrial and Aquatic Habitats in Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
Meadow River Wildlife Management Area	<ul style="list-style-type: none"> <li>• <b>Forest and Woodland</b> <ul style="list-style-type: none"> <li>• Dry-Mesic Oak Forests</li> <li>• Dry Oak (-Pine) Forests</li> <li>• Mixed Mesophytic Forests</li> </ul> </li> <li>• <b>Aquatic, Floodplain and Riparian</b> <ul style="list-style-type: none"> <li>• Small Stream Riparian Habitat</li> </ul> </li> <li>• <b>Agricultural and Developed</b> <ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Developed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Headwater Creek, Low Gradient, Warm</li> <li>• Headwater Creek, Moderate Gradient, Cool</li> <li>• Headwater Creek, High Gradient, Cool</li> <li>• Small River, Low Gradient, Warm</li> </ul>

## Appendix 4. Partners and Assistance Provided

The table below lists partners and assistance provided to landowners for wildlife conservation actions in the CFA.

Partner	Role/Assistance Provided
Appalachian Mountains Joint Venture (AMJV) <a href="https://amjv.org/">https://amjv.org/</a>	<ul style="list-style-type: none"> <li>The Appalachian Mountains Joint Venture (AMJV) is a regional partnership of state and federal agencies, conservation organizations, and universities who work to restore and sustain viable populations of native birds and their habitats in the Appalachian Mountains. AMJV works with partners to provide private landowners with guidance and opportunities to improve habitat for birds and other wildlife.</li> </ul>
American Forest Foundation (AFF) <a href="https://www.forestfoundation.org/">https://www.forestfoundation.org/</a> <a href="https://www.familyforestcarbon.org/">https://www.familyforestcarbon.org/</a>	<ul style="list-style-type: none"> <li>The American Forest Foundation's mission is to deliver meaningful conservation impact through the empowerment of family forest landowners.</li> <li>The American Tree Farm System (ATFS) recognizes landowners for their good stewardship and adhering to the ATFS Standards of Sustainability while meeting their own goals and objectives for their land.</li> <li>The Family Forest Carbon Program focuses on two specific practices: Growing Mature Forests (encouraging Forest Management Plans) and Enhancing the Future Forest (control of competing vegetation to improve regeneration before or after a regeneration harvest)</li> </ul>
Consulting Foresters <a href="https://wvforestry.com/forestry-consultants/">https://wvforestry.com/forestry-consultants/</a>	<ul style="list-style-type: none"> <li>Developing Forest Stewardship Plans</li> <li>Promoting Forestry BMPs</li> <li>Designing forest management practices to achieve landowner goals and ecological objectives</li> <li>Assisting landowners with developing forest carbon projects aimed at achieving verifiable carbon sequestration through improved forest management practices</li> </ul>

Partner	Role/Assistance Provided
<p>County Farmland Protection Boards  <a href="http://wvfp.org/">http://wvfp.org/</a></p>	<ul style="list-style-type: none"> <li>• County Farmland Protection Boards and West Virginia Agricultural Land Protection Authority are authorized through WV Department of Agriculture, under the Voluntary Farmland Protection Act, to</li> <li>• Assist in sustaining the farming community</li> <li>• Provide sources of agricultural products within the state for citizens of the state</li> <li>• Control the urban expansion which is consuming the agricultural land, topsoil and woodland of the state</li> <li>• Curb the spread of urban blight and deterioration</li> <li>• Protect agricultural land and woodland as open-space land</li> <li>• Enhance tourism</li> <li>• Protect worthwhile community values, institutions &amp; landscapes which are inseparably associated with traditional farming</li> </ul>
<p>Forest Certification Programs:</p> <ul style="list-style-type: none"> <li>• American Tree Farm System (ATFS)  <a href="https://www.treefarmssystem.org/">https://www.treefarmssystem.org/</a></li> <li>• Sustainable Forestry Initiative (SFI)  <a href="https://www.forests.org/">https://www.forests.org/</a>  <a href="https://www.wvfa.org/sfi/">https://www.wvfa.org/sfi/</a></li> <li>• Forest Stewardship Council (FSC)  <a href="https://fsc.org/en">https://fsc.org/en</a></li> </ul>	<ul style="list-style-type: none"> <li>• Resources, assistance and certification for sustainable forest management on public and private lands</li> </ul>
<p>Master Naturalists Program  <a href="http://mnofwv.org/">http://mnofwv.org/</a></p>	<ul style="list-style-type: none"> <li>• Training interested people in the fundamentals of natural history, nature interpretation and teaching.</li> <li>• Instilling an appreciation of the importance of responsible environmental stewardship.</li> <li>• Providing a corps of highly qualified volunteers to assist government agencies, schools and non-government organizations with research, outdoor recreation development, and environmental education and protection</li> </ul>
<p>National Wild Turkey Federation (NWTf)  <a href="https://www.nwtf.org/">https://www.nwtf.org/</a></p>	<ul style="list-style-type: none"> <li>• Provides information to landowners on hunting and habitat management for wild turkey and other wildlife</li> <li>• Partners with state and federal agencies on hunting access and habitat management for wild turkey and other wildlife species</li> </ul>
<p>Outdoor Heritage Conservation Fund (OHCF)  <a href="https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/">https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/</a></p>	<ul style="list-style-type: none"> <li>• The Outdoor Heritage Conservation Fund (OHCF) protects lands that host West Virginia's wild and wonderful natural resources. The OHCF's land-protection projects can include important wildlife habitats, working forests and farmlands, as well as hunting, fishing, and outdoor recreational areas. The OHCF is working to protect the best of our natural resources for all West Virginians.</li> </ul>

Partner	Role/Assistance Provided
<p>Ruffed Grouse Society/American Woodcock Society (RGS)  <a href="https://ruffedgrousesociety.org/#">https://ruffedgrousesociety.org/#</a></p>	<ul style="list-style-type: none"> <li>• Creates healthy forest habitat for the benefit of ruffed grouse, American woodcock and other forest wildlife</li> <li>• Works with landowners and government agencies to develop critical habitat using scientific management practices</li> <li>• RGS works with the forest product industry, including landowners, foresters, loggers, and forest product manufacturers, to scale up capacity building, investment and conservation benefits from working forests to the landscape scale.  <a href="https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/">https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/</a></li> </ul>
<p>The Conservation Fund (TCF)  <a href="https://www.conservationfund.org/where-we-work/west-virginia">https://www.conservationfund.org/where-we-work/west-virginia</a></p>	<ul style="list-style-type: none"> <li>• Works with public, private and nonprofit partners to protect America’s legacy of land and water resources through land acquisition, sustainable community and economic development, and leadership training, emphasizing the integration of economic and environmental goals.</li> </ul>
<p>The Nature Conservancy (TNC)  <a href="https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/">https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/</a></p>	<ul style="list-style-type: none"> <li>• Assist public land managers with land protection, management and restoration to maintain landscape resilience and connectivity</li> <li>• Assist private landowners with land protection and improved management, including conservation easements and forest carbon projects</li> <li>• Manages a network of nature preserves and conservation easements for conservation and recreation</li> </ul>
<p>Trout Unlimited (TU)  <ul style="list-style-type: none"> <li>• <a href="http://www.wvtu.org/">http://www.wvtu.org/</a></li> <li>• <a href="http://www.tu.org/">http://www.tu.org/</a></li> </ul> </p>	<ul style="list-style-type: none"> <li>• Plans and implements restoration projects with landowners and in coordination with USFWS Partners program and USDA Natural Resource Conservation Service and Forest Service and other partners</li> <li>• Projects focus on riparian corridor and in-stream habitat restoration, invasive weed treatment and aquatic passage barrier removal/replacement to benefit brook trout and other wildlife species</li> </ul>

Partner	Role/Assistance Provided
<p>USDA Farm Service Agency (FSA)  <a href="https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index">https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index</a></p> <ul style="list-style-type: none"> <li>• Conservation Reserve Program (CRP)</li> <li>• Conservation Reserve Enhancement Program (CREP)</li> <li>• State Acres for Wildlife Enhancement (SAFE)</li> <li>• Farmable Wetlands Program (FWP)</li> <li>• Grasslands Reserve Program (GRP)</li> </ul>	<ul style="list-style-type: none"> <li>• CRP provides rental payments to agricultural producers participating voluntarily to safeguard environmentally sensitive land, conserve water quality, control soil erosion and enhance wildlife habitat, including floodplain wetlands.</li> <li>• CREP provides extra incentives and payments to eligible producers to reduce soil erosion and pollution, improve water quality and enhance terrestrial and aquatic wildlife habitat through practices such as riparian buffers and wetland restoration</li> <li>• The State Acres for Wildlife Enhancement (SAFE) Initiative provides farmers and landowners with assistance to establish wetlands, grasses and trees to enhance important wildlife populations by creating critical habitat and food sources, while protecting soil and water health.</li> <li>• The Farmable Wetlands Program (FWP) provides farmers and ranchers annual rental payments in return for restoration wetlands and wetland buffers zones.</li> <li>• The Grassland Reserve Program (GRP) provides farmers a rental payment to voluntarily prevent grazing and pasture land from being converted into cropland or urban development.</li> </ul>

Partner	Role/Assistance Provided
<p>USDA Natural Resources Conservation Service (NRCS):  <a href="https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/">https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/</a>  Environmental Quality Incentive Program (EQIP)</p> <ul style="list-style-type: none"> <li>• Conservation Stewardship Program (CSP)</li> <li>• Agricultural Management and Assistance Program (AMA)</li> <li>• Agricultural Conservation Easement Program (ACEP)</li> </ul>	<ul style="list-style-type: none"> <li>• EQIP provides cost-share to forest and agricultural landowners targeting for activities such as forestry and grazing BMPs, reduction of nutrient, sediment and pesticide pollution, stream restoration and wildlife habitat enhancement, including stream buffers</li> <li>• Working Lands for Wildlife is a partnership between NRCS and USFWS to work with agricultural producers and forest land managers on habitat conservation for seven at-risk species, including Golden-winged Warbler</li> <li>• The RCPP-EQIP Cerulean Warbler Initiative is designed to enhance Cerulean Warbler habitat and increase their populations</li> <li>• The RCPP-EQIP WV Aquatic Passage-Working Farms project is a partnership between NRCS, TU and USFWS designed to improve fish and aquatic wildlife habitat, reduce infrastructure risk and increase flood resiliency. CSP provides payments to farm and forest landowners for actively managing, maintaining and expanding conservation activities to enhance natural resources and improve their business operations. Priority resource concerns for funding include terrestrial habitat for wildlife and invertebrates.</li> <li>• AMA provides technical and financial assistance to agricultural producers on a voluntary basis to address issues such as water management, water quality and erosion control by incorporating conservation into their farming operations.</li> <li>• ACEP is a voluntary program providing technical and financial assistance to landowners for both agricultural land easements and wetland reserve easements to protect farmland and wetland habitat.</li> </ul>
<p>US Fish and Wildlife Service (USFWS)  Partners for Fish and Wildlife Program  <a href="https://www.fws.gov/northeast/ecologicalservices/partners.html">https://www.fws.gov/northeast/ecologicalservices/partners.html</a></p>	<ul style="list-style-type: none"> <li>• Provides technical and financial assistance to private landowners for restoration and enhancement of fish and wildlife habitat for the benefit of Federal Trust species (Migratory Birds, Threatened and Endangered and At-Risk Species)</li> <li>• Efforts focus on controlling nonnative invasive plants, managing livestock access to forests, wetland restoration, riparian buffer planting and fencing, in-stream habitat improvement, aquatic passage barrier removal and creating pollinator habitat</li> <li>• Works in coordination with the USDA Natural Resources Conservation Service farm bill programs, Trout Unlimited and other partners</li> </ul>

Partner	Role/Assistance Provided
<p>WV Conservation Agency (WVCA) and Greenbrier Valley and Southern Conservation Districts</p> <p><a href="http://www.wvca.us">http://www.wvca.us</a></p> <ul style="list-style-type: none"> <li>• Ag Enhancement Program (AgEP)</li> <li>• Non-Point Source Program</li> <li>• Stream Partners Program</li> </ul>	<ul style="list-style-type: none"> <li>• The Ag Enhancement Program (AgEP), administered by Conservation Districts and the WVCA, offers technical and financial assistance to implement conservation best management practices for the reduction of nutrients and sediment entering waterways and increasing farm profitability and sustainability. Practices may include invasive species management and exclusion fencing to protect streams, wetlands and other environmentally sensitive areas.</li> <li>• Through Conservation Districts, the statewide Non-Point Source Program uses federal Clean Water Act, Section programs to reduce nonpoint source pollution related to agriculture, construction and urban stormwater management.</li> <li>• Through the Stream Partners Program, WVDNR, WVCA, WVDOF and WVDEP provide grants up to \$5,000 to citizens' groups who want to improve, restore, protect, study or celebrate the state's rivers and streams.</li> </ul>
<p>WV Department of Environmental Protection (WVDEP)</p> <ul style="list-style-type: none"> <li>• Nonpoint Source Program <a href="https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx">https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx</a></li> <li>• Watershed Based Plans <a href="https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx">https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx</a></li> <li>• Save Our Streams Program <a href="https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx">https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx</a></li> <li>• In Lieu Fee (ILF) Stream and Wetland Mitigation Program <a href="https://dep.wv.gov/wwe/programs/pages/in-lieu-fee.aspx">https://dep.wv.gov/wwe/programs/pages/in-lieu-fee.aspx</a></li> <li>• Rehabilitation Environmental Action Plan (REAP) <a href="https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx">https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx</a></li> <li>• WVDEP Youth Environmental Program (YEP) <a href="https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx">https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx</a></li> </ul>	<ul style="list-style-type: none"> <li>• Supports partners and citizen-based watershed organizations in restoring impaired watersheds</li> <li>• Provides assistance in proper installation and maintenance of Best Management Practices</li> <li>• Provides funding for projects by watershed groups and partners to improve water quality in watersheds listed as impaired, including the Greenbrier River and many tributaries</li> <li>• Practices include wastewater treatment, agricultural BMPs, rain gardens for stormwater runoff, streambank restoration and community outreach</li> <li>• Save our Streams provides training for volunteers to monitor local wadable streams and rivers</li> <li>• ILF Program achieves compensatory mitigation for unavoidable impacts to waters of the United States and state waters, including wetlands, streams and associated buffers. The goal is to achieve no net loss of existing stream and wetland acreage and functions in WV through effective restoration, enhancement, replacement and preservation of aquatic resources.</li> <li>• REAP provides communities with technical, financial and resource assistance in cleanup efforts.</li> <li>• YEP organizes youth and volunteer groups for hands-on conservation projects</li> </ul>

Partner	Role/Assistance Provided
<p>WV Department of Health and Human Resources (WVDHHR)</p> <ul style="list-style-type: none"> <li>On-Site Sewage Program</li> </ul> <p><a href="https://www.wvdhhr.org/phs/sewage/index.asp">https://www.wvdhhr.org/phs/sewage/index.asp</a></p>	<ul style="list-style-type: none"> <li>Provides rule interpretation and technical assistance on conventional and non-conventional on-site sewage systems, including information on septic systems, installers, permits, fees and loan programs.</li> </ul>
<p>WV Division of Forestry (WVDOF)</p> <p><a href="http://www.wvforestry.com/">http://www.wvforestry.com/</a></p>	<ul style="list-style-type: none"> <li>Oversees the Managed Timberland Program to provide tax incentives for landowners who manage their forest land sustainably according to a management plan</li> <li>Oversee timber sales and Best Management Practices</li> <li>Provides training workshops for loggers on safety and Best Management Practices</li> <li>Maintains list of consulting foresters who can help landowners with Forest Stewardship Plans to enhance wildlife habitat</li> <li>Protection of large private forest tracts through Forest Legacy Program</li> </ul>
<p>WV Division of Natural Resources (WVDNR)</p> <p><a href="http://www.wvdnr.gov/wildlife/wdpintro.shtm">http://www.wvdnr.gov/wildlife/wdpintro.shtm</a></p>	<ul style="list-style-type: none"> <li>Identification of SGCN and rare communities</li> <li>Education, outreach and teaching resources</li> <li>Field guides, Landscaping and Management guidelines</li> <li>Fish and game management</li> <li>Habitat restoration assistance</li> <li>Natural Areas Program</li> </ul>
<p>West Virginia Land Trust (WVLT)</p> <p><a href="https://www.wvlandtrust.org/">https://www.wvlandtrust.org/</a></p>	<ul style="list-style-type: none"> <li>WVLT's mission is to protect land with significant conservation values through the use of conservation easements and real estate acquisitions, and by working with a statewide network of partners to build a passionate land conservation movement in the state.</li> </ul>
<p>West Virginia University Extension Service (WVU Extension):</p> <ul style="list-style-type: none"> <li>Forestry</li> </ul> <p><a href="https://extension.wvu.edu/natural-resources/forestry">https://extension.wvu.edu/natural-resources/forestry</a></p> <ul style="list-style-type: none"> <li>Wildlife</li> </ul> <p><a href="https://extension.wvu.edu/natural-resources/wildlife">https://extension.wvu.edu/natural-resources/wildlife</a></p>	<ul style="list-style-type: none"> <li>Landowner technical assistance and information on financial assistance for forest and wildlife management</li> <li>Training workshops and conferences on forestry Best Management Practices and safety practices</li> </ul>

## Appendix 5. Resources

<p>Upper Meadow River Watershed Based Plan. Summarizes water quality impairments, causes, sources, load reductions, management measures, technical and financial resources and implementation schedule and milestones, information and education activities and monitoring. Available at:  <a href="https://dep.wv.gov/WWE/Programs/nonptsources/WBP/Pages/WBP.aspx">https://dep.wv.gov/WWE/Programs/nonptsources/WBP/Pages/WBP.aspx</a></p>
<p>Long Range Plans for the Greenbrier Valley and Southern Conservation Districts  Summarizes natural resources conditions and ranks resource concerns that could be addressed through NRCS technical and financial assistance. Available at:  <a href="https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/equip/?cid=nrcseprd1167606">https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/equip/?cid=nrcseprd1167606</a></p>
<p>National Wild Turkey Foundation- Landowner's Toolbox  <a href="https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Responsible_Caving_2016.pdf-tool-box">https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Responsible_Caving_2016.pdf-tool-box</a></p>
<p>Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests  <a href="http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf">http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf</a></p>
<p>Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners.  <a href="https://www.allaboutbirds.org/bbimages/clo/pdf/GWWA-APPLRegionalGuide_130808_lo-res.pdf">https://www.allaboutbirds.org/bbimages/clo/pdf/GWWA-APPLRegionalGuide_130808_lo-res.pdf</a></p>
<p>Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors: <a href="https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf">https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf</a></p>
<p>Brochures about Aquatic Invasive Species, Forest Pests and Pathogens and Invasive Plant Species  <a href="https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/">https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/</a></p>
<p>West Virginia Invasive Species Strategic Plan and Voluntary Guidelines, 2014  <a href="https://eos.ucs.uri.edu/seagrant_Linked_Documents/mdu/2014-09_RO_Anderson_M_INV-3b.pdf">https://eos.ucs.uri.edu/seagrant_Linked_Documents/mdu/2014-09_RO_Anderson_M_INV-3b.pdf</a></p>
<p>Fighting Invasive Plants in West Virginia  <a href="http://www.wvnps.org/FightingInvasives.pdf">http://www.wvnps.org/FightingInvasives.pdf</a></p>

<p>American Forest Foundation: Woodland owners planning tool for forest management  <a href="https://mylandplan.org/">https://mylandplan.org/</a></p>
<p>The Nature Conservancy Resilient Land Mapping Tool and Documents:  <a href="http://maps.tnc.org/resilientland/">http://maps.tnc.org/resilientland/</a></p>
<p>USDA Forest Service, Northern Research Station's Climate Change Atlas: documentation of current and possible future distribution of 134 tree species and 147 bird species in the Eastern United States  <a href="https://www.fs.fed.us/nrs/atlas/">https://www.fs.fed.us/nrs/atlas/</a></p>
<p>Rudnick, D.A. et al., 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America.  <a href="https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities">https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities</a></p>
<p>Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science:  <a href="https://adaptationworkbook.org/">https://adaptationworkbook.org/</a></p>
<p>U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information and subject matter expertise to build climate resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location.  <a href="https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice">https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice</a></p>
<p>Forest Adaptation Resources: climate change tools and approaches for land managers, 2<sup>nd</sup> edition, 2016, published by the USDA Forest Service, Northern Research Station  <a href="https://www.nrs.fs.fed.us/pubs/52760">https://www.nrs.fs.fed.us/pubs/52760</a></p>
<p>Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture.  <a href="https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf">https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf</a></p>