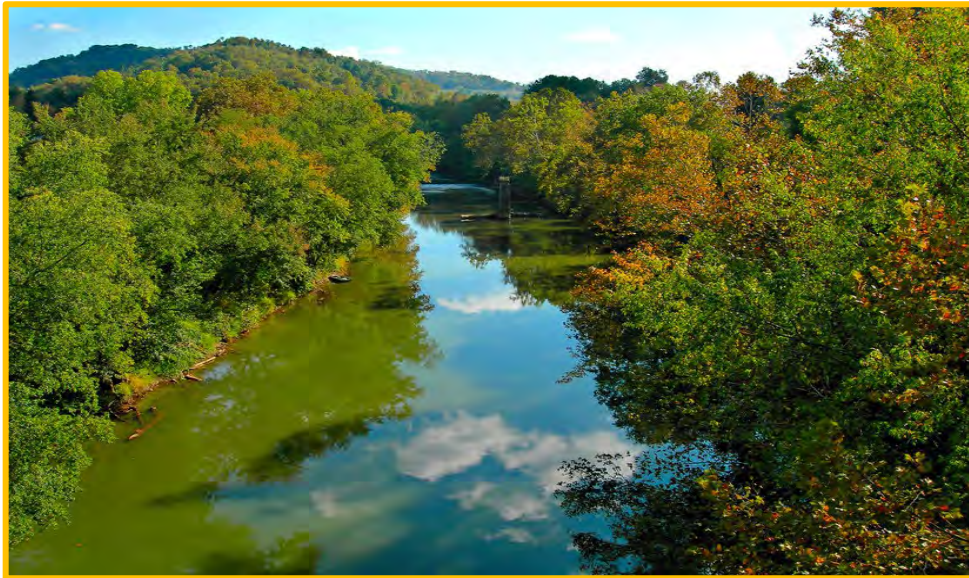


# Action Plan for the Central Reservoirs Conservation Focus Area

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November 2023



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## List of Acronyms Used

ACEP- Agricultural Conservation Easement Program	RGS- Roughed Grouse Society
AFF- American Forest Foundation	SGCN- Species of Greatest Conservation Need
AMJV- Appalachian Mountain Joint Venture	SFI- Sustainable Forestry Initiative
ATFS- American Tree Farm System	S Rank- State Rank
BMPs- Best Management Practices	SWAP- State Wildlife Action Plan
B-Rank- Biodiversity Rank	TNC- The Nature Conservancy
CFA- Conservation Focus Area	TCF- The Conservation Fund
CCV- Cave Conservancy of the Virginias	TU- Trout Unlimited
CCVI- Climate Change Vulnerability Index	USACE- United States Army Corps of Engineers
CERW- Cerulean Winged Warbler	USDA- United States Department of Agriculture
CREP- Conservation Reserve Enhancement Program	USFWS- United States Fish and Wildlife Service
CRP- Conservation Reserve Program	WVACS- West Virginia Association of Cave Studies
CSP- Conservation Stewardship Program	WVCA- West Virginia Conservation Agency
EQIP- Environmental Quality Improvement Program	WVCC- West Virginia Cave Conservancy
ESH- Early successional habitat	WVDHHR- Department of Health and Human Resources
FSA- Farm Service Agency	WVDNR- West Virginia Division of Natural Resources
FSC- Forest Stewardship Council	WMA- Wildlife Management Area
G Rank- Global Rank	WVDEP- West Virginia Department of Environmental Protection
GWWA- Golden-winged Warbler	WVDOP- West Virginia Division of Forestry
HUC- Hydrologic Unit Code	WVDOH- West Virginia Division of Highways
NRCS- Natural Resources Conservation Service	WVLT- West Virginia Last Trust
NWTF- National Wild Turkey Foundation	WVU- West Virginia University
OHCF- Outdoor Heritage Conservation Fund	

## Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed 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 and other non-profit conservation organizations working in the area to develop this Action Plan for the Central Reservoirs CFA. This Action 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 103 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 Action 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. A plan for implementation for each major habitat type lists partners and programs available to assist with each of the actions and 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 Action 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 this CFA.

Conserving wildlife species and their habitat within this 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 the plan, implement, and monitor conservation actions, facilitate stakeholder collaboration, and update the Action 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 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.

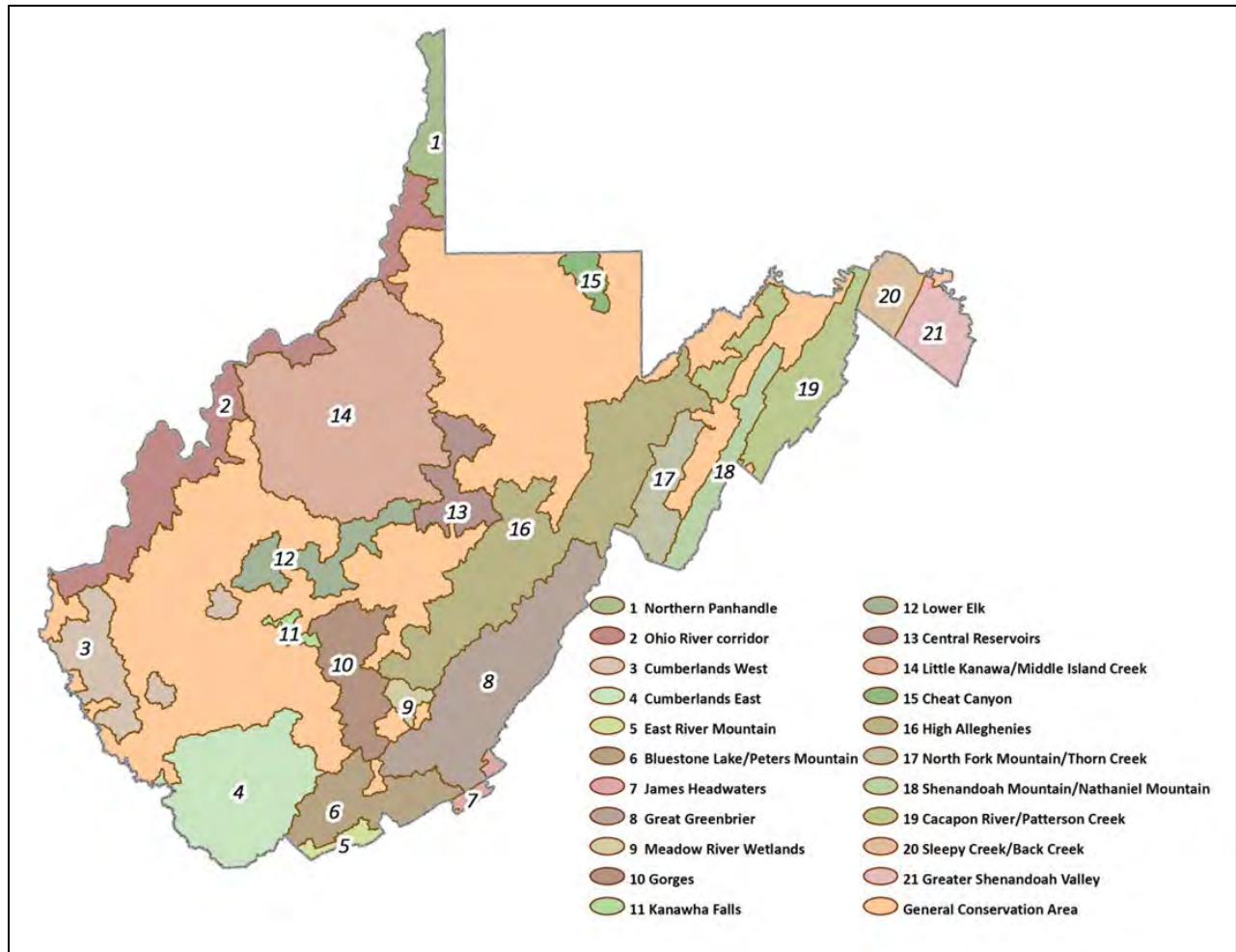
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve 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.



## Climate Change and Resilience

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

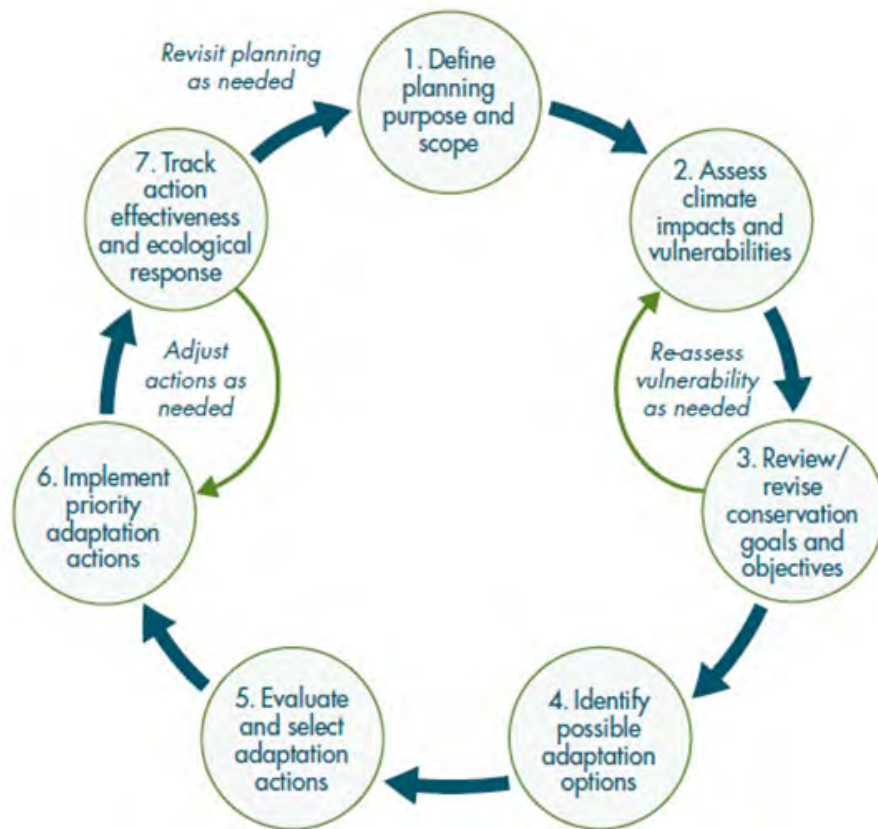
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, 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 vulnerable 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, 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



## Central Reservoirs Conservation Focus Area

### Overview

In the Western Allegheny Plateau Ecoregion, the Central Reservoirs landscape centers around US Army Corps of Engineers reservoirs on the upper reaches of the Elk River, Little Kanawha River, and West Fork River, and a power company reservoir on Stonecoal Creek within the West Fork River Watershed.

Together, these reservoirs cover 5,268 acres and provide a significant portion of the large lentic waters in West Virginia. Most of the upland areas are low elevation (below 2,000 feet), forested, and dissected hills, which are locally rugged. Small farms are locally extensive on ridgelines. This is a fragmented forested landscape of mostly small to medium-sized non-industrial, private properties. The area is dotted with small towns, and services to support the recreation provided by the reservoirs. A few blocks of relatively intact forests remain on public lands, with significant stands of old growth forest at Holly River State Park and Elk River, Stonewall Jackson, and Stonecoal Lake Wildlife Management Areas. Forests and streams in this CFA host a diversity of rare aquatic and terrestrial species. The biggest threats include habitat fragmentation by gas wells and pipelines, and water pollution by municipalities and residential areas, which can be countered by actions to conserve forest and aquatic habitat.





## Habitats

The Central Reservoirs CFA includes a variety of terrestrial, aquatic, and subterranean habitat types.

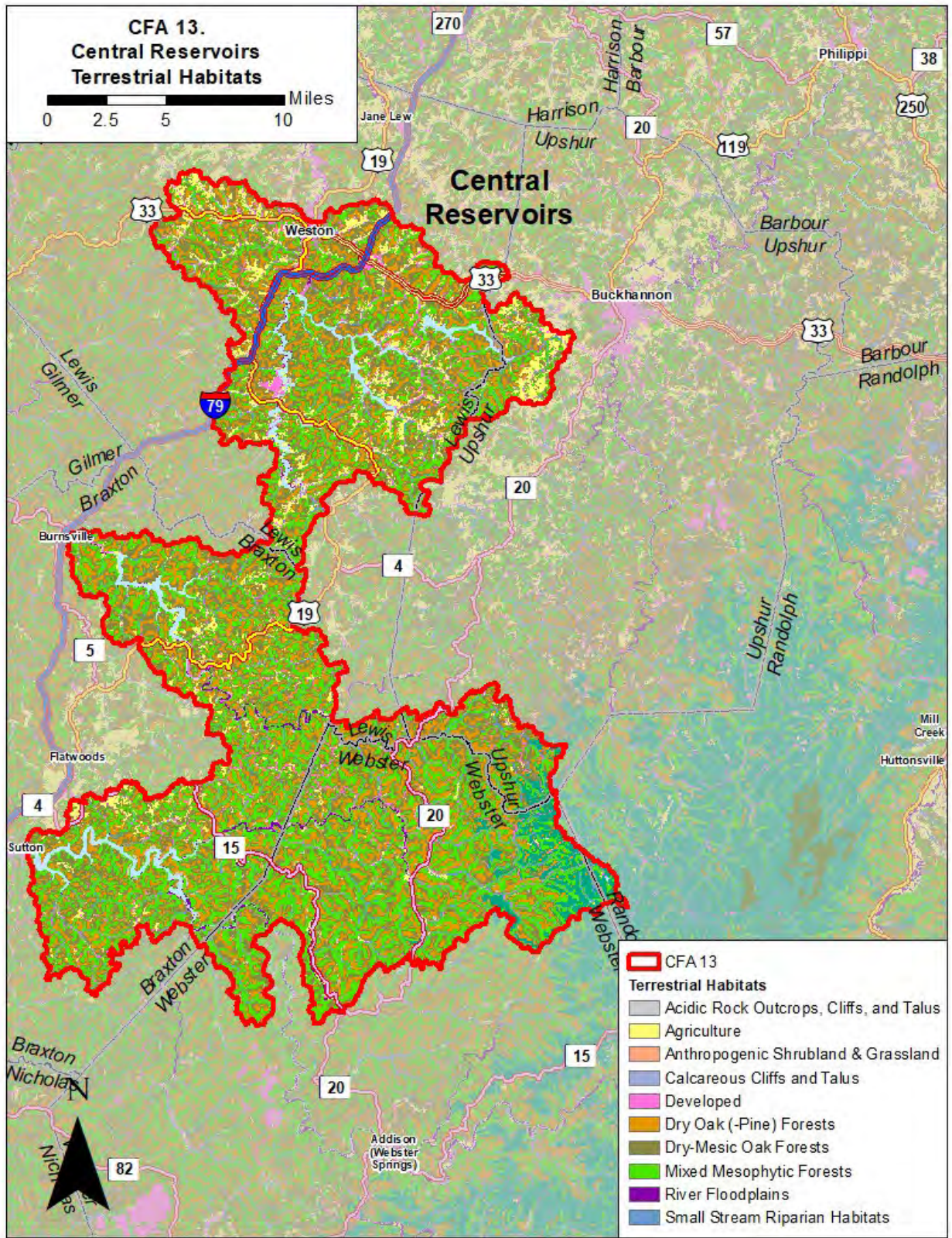
### Terrestrial Habitats

Twelve of the habitat types described in the SWAP are present in this CFA. The dominant habitat types found in the CFA include Dry-Mesic Oak, Mixed Mesophytic, and Dry Oak (Pine) Forests, which cover over 80% of the CFA collectively. The remaining area is composed of various rocky, riparian, and developed habitat types. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat	Acres in CFA	% of CFA Area	% of WV Total for Type
Acidic Rock Outcrops, Cliffs, and Talus	1,318	0.50%	1.47%
Agriculture	14,798	5.62%	1.03%
Anthropogenic Shrubland & Grassland	185	0.07%	0.12%
Calcareous Cliffs and Talus	6	0.00%	0.07%
Developed	13,990	5.32%	1.23%
Dry Oak (-Pine) Forests	50,842	19.33%	2.06%
Dry-Mesic Oak Forests	81,644	31.01%	1.64%
High Allegheny Wetlands	3	0.00%	0.01%
Mixed Mesophytic Forests	77,320	29.37%	2.62%
Northern Hardwood Forests	6,359	2.41%	0.64%
River Floodplains	2,054	0.78%	1.68%
Small Stream Riparian Habitats	8,303	3.15%	1.68%
Unresolved	6,364	2.44%	5.45%
<b>Totals</b>	<b>263,186</b>	<b>100.00%</b>	

Map 3. Terrestrial Habitats



## Aquatic Habitats

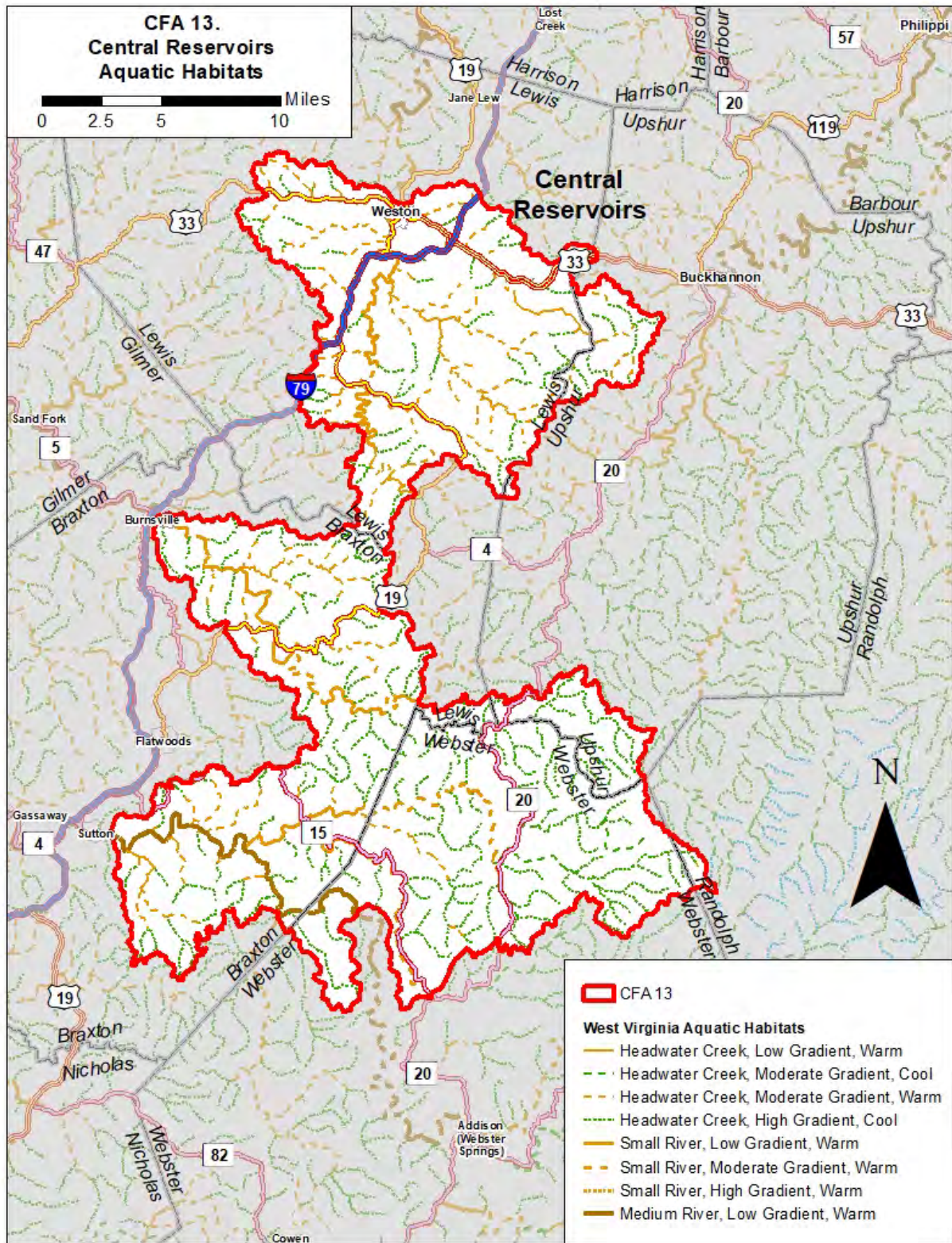
Eight of the aquatic habitat types described in the SWAP are present within the Greater Greenbrier CFA. The majority of aquatic habitat types are composed of cool, high gradient headwater creeks, which make up 296 miles of stream in the CFA. Aquatic habitats are described in Chapter 3 of the 2015 SWAP

Table 2. Aquatic Habitat Summary

Habitat Type	Miles in CFA	% of CFA Area	% of WV Total for Type
Headwater Creek, Low Gradient, Warm	34	5.67%	6.11%
Headwater Creek, Moderate Gradient, Cool	20	3.30%	0.90%
Headwater Creek, Moderate Gradient, Warm	155	25.80%	3.96%
Headwater Creek, High Gradient, Cool	296	49.35%	4.73%
Small River, Low Gradient, Warm	45	7.52%	9.81%
Small River, Moderate Gradient, Warm	32	5.26%	5.81%
Small River, High Gradient, Warm	0	0.03%	0.96%
Medium River, Low Gradient, Warm	18	3.08%	3.88%
<b>Totals</b>	<b>600</b>	<b>100.00%</b>	



Map 4. Aquatic Habitats



## Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa listed in the SWAP for the Central Reservoirs CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	4
Birds	23
Butterflies and Moths	12
Crayfish	1
Dragonflies and Damselflies	8
Fish	6
Mammals	6
Mussels	23
Other Invertebrates	2
Plants	12
Reptiles	7
Snails	7
<b>Total</b>	<b>111</b>

This Conservation Focus Area (CFA) supports important habitats for many aquatic Species of Greatest Conservation Need (SGCN) including 23 mussels and 6 fish species. Elk River Crayfish, endemic to the upper Elk Watershed, are largely restricted to the Elk and Holly river systems upstream of Sutton Lake. Inlet marshes, backwaters, and open waters on the reservoirs provide habitat for a variety of wetland and open water birds, including breeding Osprey and Great Blue and Green herons. Streams and wetlands in the CFA support seven SGCN dragonflies and damselflies. Forested uplands are important for a number of breeding forest interior and early successional forest bird species including:

- American Woodcock
- Wood Thrush
- Louisiana Waterthrush
- Worm-eating Warbler
- Blue-winged Warbler
- Cerulean Warbler
- Kentucky Warbler.

Stonewall Jackson WMA, with its diverse terrestrial and aquatic habitats, hosts rich communities of butterflies and dragonflies of concern.

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

## Distinctive Stresses

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

- Water contamination from municipal and residential sources
- Potential habitat loss and fragmentation from gas well and gas line development.
- Impacts from a large population of the invasive Chinese Mystery Snail are unknown.

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

## Conservation Actions

To address these stresses, the 2015 SWAP recommended these main types of action in the CFA, listed below.

Land Protection – Work with landowners, local governments, and gas companies to develop plans for reducing impacts to aquatic and forest habitats from gas well pipeline development and associated infrastructure.

Aquatic Habitat Restoration – Work with landowners, local governments, and gas companies to reduce impacts and protect and improve water quality of significant streams.

Terrestrial (Forest) Habitat Conservation – Engage and partner with conservation agencies and landowners to implement forest management practices that benefit bird species such as American Woodcock, Wood Thrush, and Cerulean Warbler.

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:

- WV Department of Environmental Protection
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Watershed Associations
- USDA – Natural Resources Conservation Service
- Gas Companies
- National Wild Turkey Federation
- Appalachian Mountain Joint Venture

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 meetings during CFA planning, implementation and monitoring. In many cases partners may assume a lead role in implementing the conservation actions. Appendix 5 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

Public lands that may provide significant opportunities for wildlife conservation include:

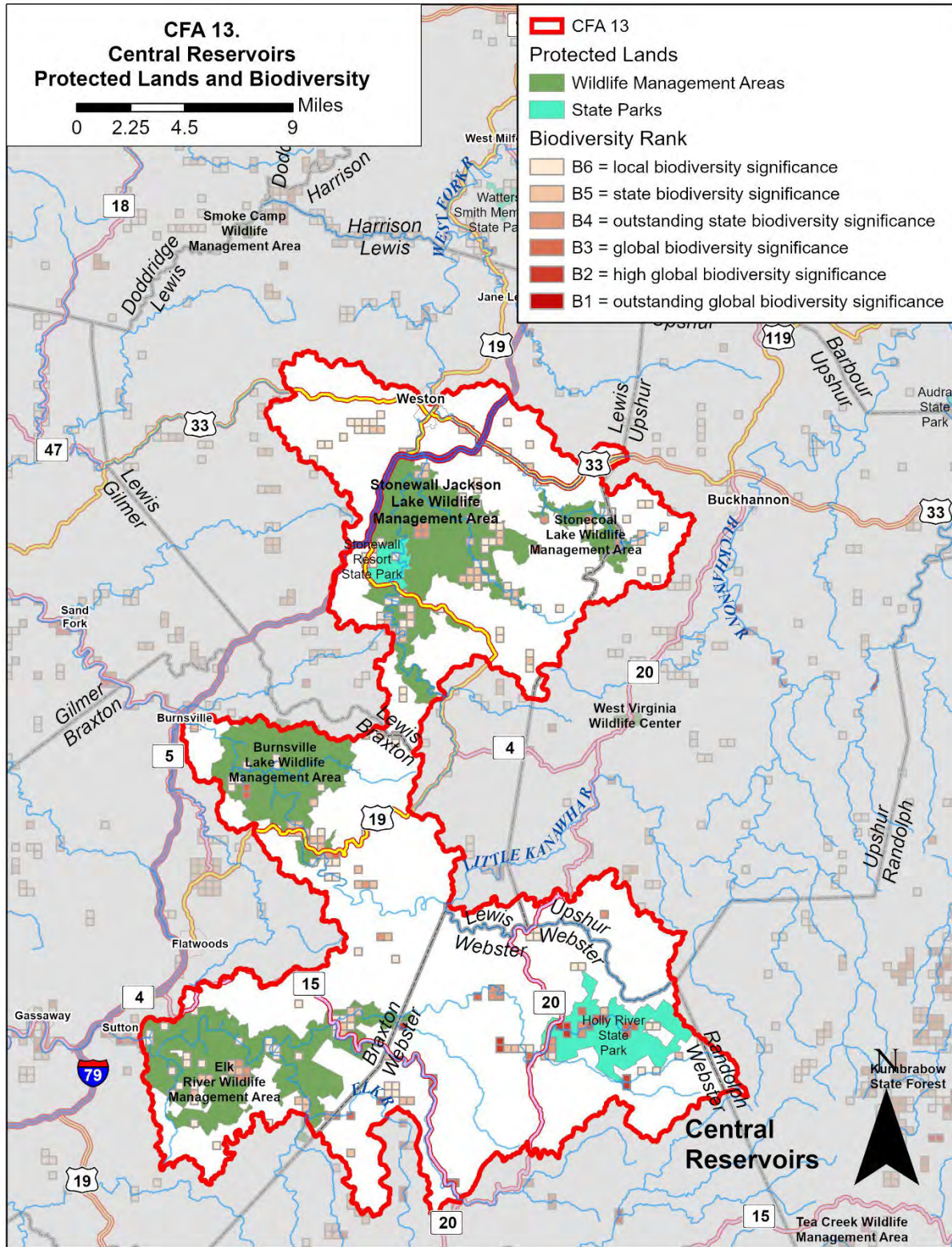
- Stonecoal Lake WMA
- Elk River WMA
- Burnsville Lake WMA
- Stonewall Jackson WMA
- Stonewall Jackson Resort State Park
- Holly River State Park

These public lands provide important wildlife habitat and are managed for conservation or other compatible goals. Appendix 3 lists habitat types occurring in each of the public lands within this CFA. WVDNR will work with public land managers to identify opportunities to plan and implement conservation actions that address stresses in these habitats and 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. City and county-owned public lands may also be managed to benefit wildlife and habitat.

Map 5 shows the location of public lands and conservation easements 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 many SGCN and rare plant communities occur on public lands, and there may be opportunities for WVDNR, public agencies and landowners to protect them there. Many SGCN and rare plant communities also occur on private land outside of public lands and conservation easements. This indicates how important it is for WVDNR and other partners to work 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 the CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	S3B	G5
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse	S3B,S3N	G5
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk	S3B	G5
Birds	<i>Chaetura pelagica</i>	Chimney Swift	S3B	G5

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>S Rank</b>	<b>G Rank</b>
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler	S3B	G5
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle	S3B,S3N	G5
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler	S3B	G5
Birds	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5
Birds	<i>Icteria virens</i>	Yellow-breasted Chat	S3B	G5
Birds	<i>Megaceryle alcyon</i>	Belted Kingfisher	S3B	G5
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush	S3B	G5
Birds	<i>Scolopax minor</i>	American Woodcock	S3B	G5
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4
Birds	<i>Setophaga discolor</i>	Prairie Warbler	S3B	G5
Birds	<i>Spizella pusilla</i>	Field Sparrow	S3B, S3N	G5
Birds	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5
Butterflies & Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper	S1	G4G5
Butterflies & Moths	<i>Calephelis borealis</i>	Northern Metalmark	S2	G3G4
Butterflies & Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr	S3	G4G5
Butterflies & Moths	<i>Euphydryas phaeton</i>	Baltimore Checkerspot	S3S4	G4
Butterflies & Moths	<i>Hesperia metea</i>	Cobweb Skipper	S2S3	G4G5
Butterflies & Moths	<i>Phyciodes cocyta selene</i>	Northern Crescent	S2	G5
Butterflies & Moths	<i>Speyeria diana</i>	Diana Fritillary	S2S3	G3G4
Crayfish	<i>Cambarus elkensis</i>	Elk River Crayfish	S1	G2
Dragonflies & Damselflies	<i>Neurocordulia yamaskanensis</i>	Stygian Shadowdragon	S3	G5
Fish	<i>Etheostoma maculatum</i>	Spotted Darter	S1	G2
Fish	<i>Percina macrocephala</i>	Longhead Darter	S2	G3
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut	S3	G4

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>S Rank</b>	<b>G Rank</b>
Mussels	<i>Pleurobema clava</i>	Clubshell	S1	G2
Other Invertebrates	<i>Diploperla kanawholensis</i>	Little Kanawha Perlodid Stonefly	S3	G3
Plants	<i>Carex roanensis</i>	Roan Mountain Sedge	S2	G3
Plants	<i>Carex seorsa</i>	Weak Stellate Sedge	S2	G4
Plants	<i>Lygodium palmatum</i>	American Climbing Fern	S3	G4
Plants	<i>Parnassia asarifolia</i>	Kidneyleaf Grass-of-parnassus	S2	G4
Plants	<i>Triphora trianthophora</i>	Threebirds Orchid	S2	G3G4
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	S5	G5T5
Snails	<i>Ventridens coelaxis</i>	Bidentate Dome	S3	G3

## Forest and Woodland Habitats

Dry Mesic Oak, Mixed Mesophytic, and Dry Oak (Pine) Forests are prevalent throughout the area and compose the majority of forest habitats found in the CFA. Many of the dry forest types present in the CFA are threatened by invasive species, mesophication (gradual moistening), and lack of fire, while overbrowsing by deer reduces regeneration of oak and other palatable understory species. Map 6 displays forest habitat types. 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. Map 7 shows intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity within the CFA. Intact forest patches provide core habitat for a significant portion of the SGCN and rare communities, as well as a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change. However, many of the biodiversity occurrences are found in smaller forest patches, which many place these organisms under increased stress.

Map 8 illustrates the rock outcrops, cliffs and talus habitats embedded within the larger forested landscape. Acidic rock outcrops, cliffs and talus are most heavily concentrated in the southern regions of the CFA, along the Elk River, Little Kanawha River, and the left and right forks of the Holly River. Calcareous cliffs and talus are present in only two locations within the CFA, along a small tributary of Pringle Fork, and along Cap Run. These habitats coincide with known biodiversity occurrences in several areas, and are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Those in smaller forest patches may be more vulnerable to stresses.

## Priority Species

The following priority species in the CFA are associated with forest and woodland habitats.

Table 5. Priority Species in Forest and Woodland Habitats.

Taxa	Scientific Name	Common Name
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle
Birds	<i>Helminthos vermivorum</i>	Worm-eating Warbler
Birds	<i>Hylocichla mustelina</i>	Wood Thrush
Birds	<i>Icteria virens</i>	Yellow-breasted Chat
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>
Birds	<i>Setophaga discolor</i>	Prairie Warbler
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler
Butterflies and Moths	<i>Calephelis borealis</i>	Northern Metalmark
Butterflies and Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr
Butterflies and Moths	<i>Phyciodes cocyta selene</i>	Northern Crescent
Butterflies and Moths	<i>Speyeria diana</i>	Diana Fritillary
Plants	<i>Carex roanensis</i>	Roan Mountain Sedge
Plants	<i>Lygodium palmatum</i>	American Climbing Fern
Plants	<i>Triphora trianthophora</i>	Threebirds
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle
Snails	<i>Ventridens coelaxis</i>	Bidentate Dome

Large, intact forest patches support many forest interior breeding birds, including Broad-winged Hawk, Wood Thrush, Cerulean Warbler and Worm-eating Warbler, while early successional forest habitats support species such as the Prairie Warbler. Several rare plant species are associated with Pine-Oak Rocky Woodlands and Dry Oak-Pine Forests, but additional surveying will be required to ascertain their status and location. Several woodland species, including Northern Metalmark, Cobweb Skipper, Northern Crescent and Timber Rattlesnake also occur in rock outcrops, cliffs and talus habitats.

### Rare Plant Communities

The following rare plant communities are found in Forest and Woodland habitats in this CFA. Note that all of the state's White Oak – American Beech Western Allegheny Plateau Forest is located here, as well as a quarter of the state's Western Plateaus Pitch Pine Woodland. These communities are vulnerable to disturbance by logging and grazing activities, and to the spread of nonnative invasive plants. Disturbance should be avoided, and nonnative invasive plant infestations should be treated. Carefully planned prescribed burns may restore and maintain Short Leaf Pine-Oak Forest communities.

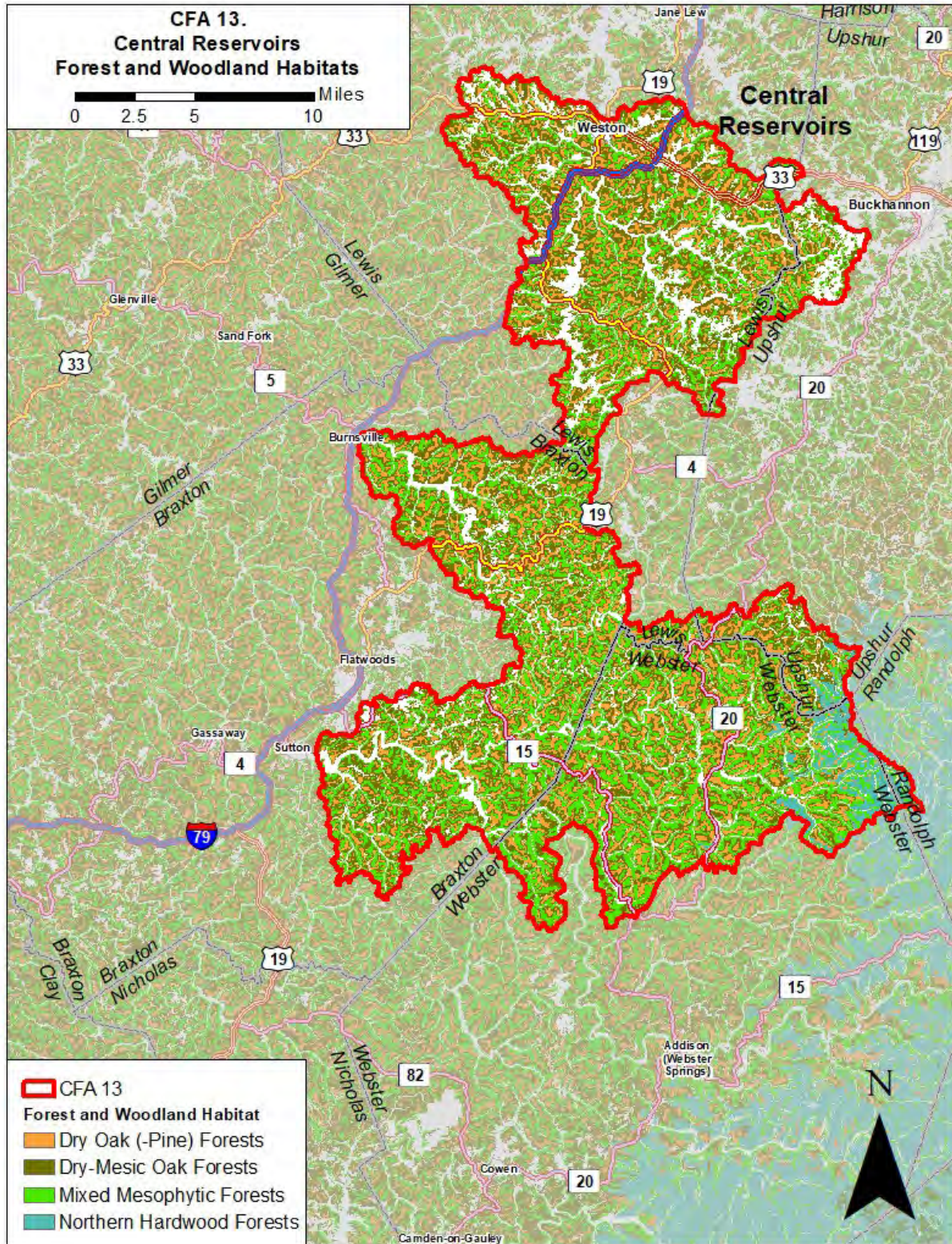
Table 6. Rare Plant Communities in Forest and Woodland Habitats.

<b>Habitat</b>	<b>Relative Abundance</b>	<b>G Rank</b>	<b>S Rank</b>
Short Leaf Pine - Oak Forest	17%	G2	S2
White Oak - American Beech Western Allegheny Plateau Forest	100%	GNR	S3
Western Plateaus Pitch Pine Woodland	25%	G4Q	S1

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## or G## indicates range of uncertainty of conservation status.

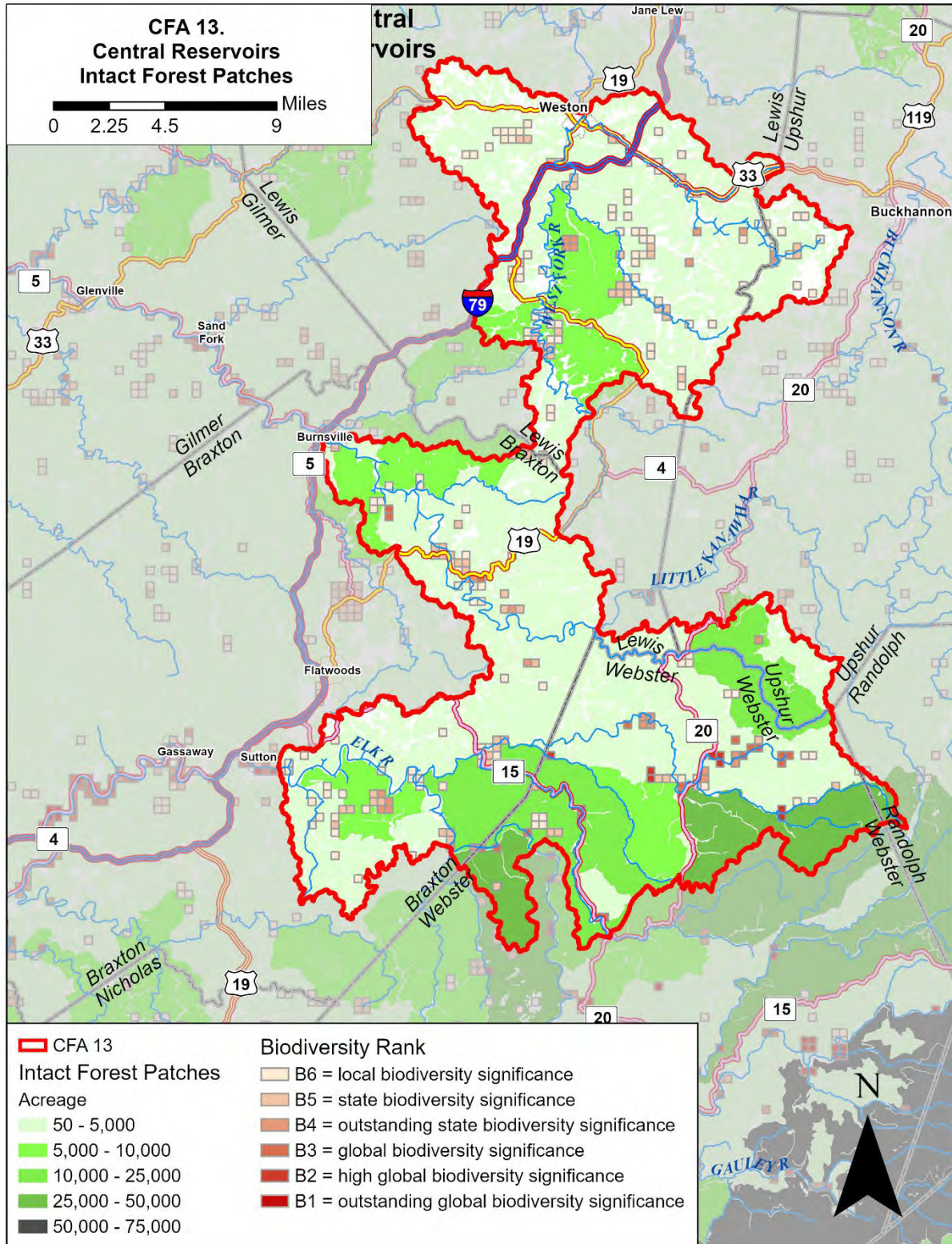


Map 6. Forest and Woodland Habitats



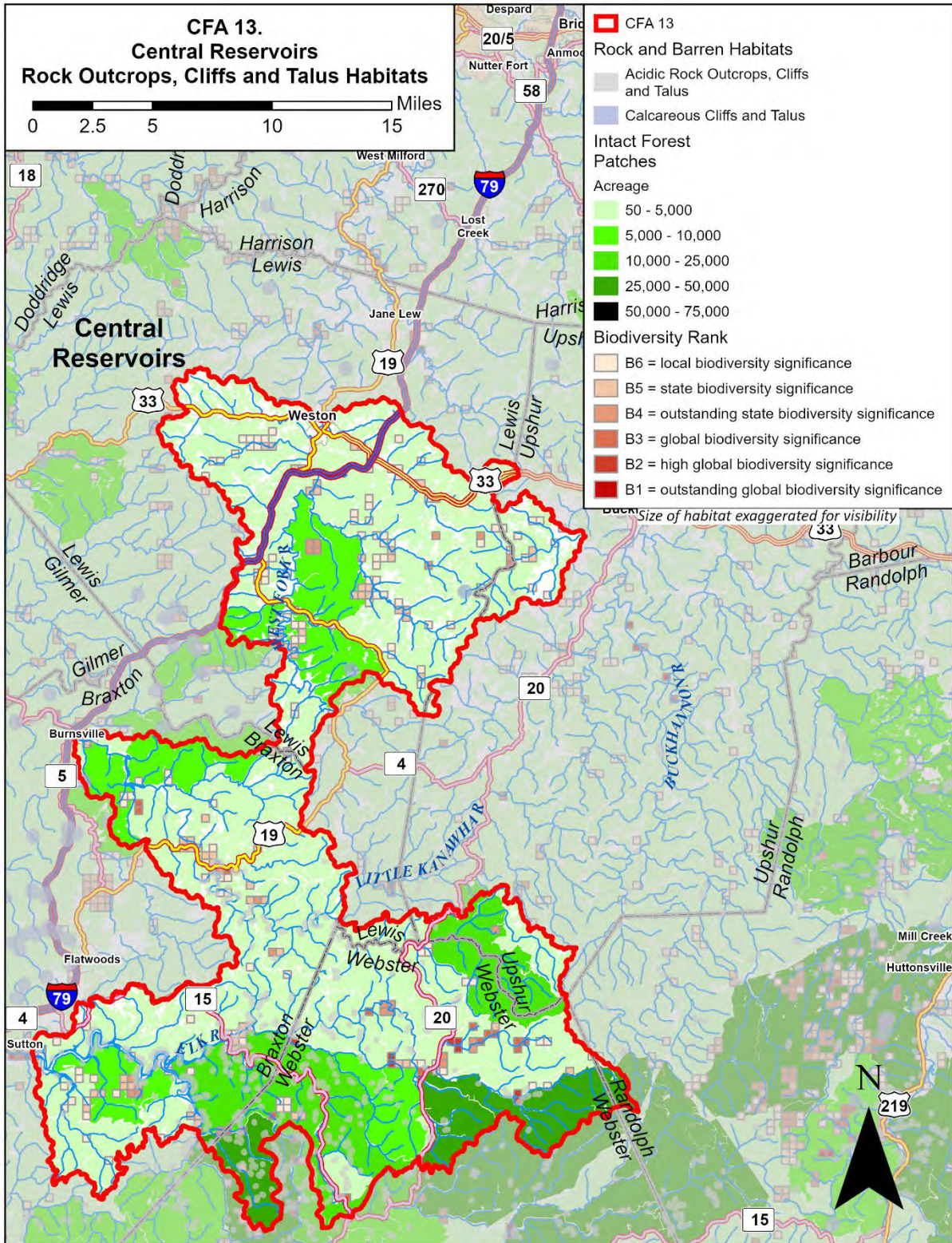


Map 7. Intact Forest Patches and Biodiversity





Map 8. Rock Outcrops, Cliffs and Talus Habitats



## Habitat Stresses and Conservation Actions

Below is a list of stresses impacting species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses.

Table 7. Habitat Stresses and Conservation Actions in Forest and Woodland Habitats:

<b>Habitat Stress</b>	<b>Conservation Action</b>
Deforestation, forest fragmentation, poor forest structure, climate change	Maintain and protect contiguous forest cover, structural and spatial complexity
Deforestation and disturbance of rare habitats and hydrological features	Maintain and protect forest cover and hydrology, especially around seeps, streams, rock outcrops, cliffs and talus and other rare habitat features
Nonnative invasive species: forest fragmentation, climate change	Maintain forest cover and control nonnative invasive species, especially around rare habitat features
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early successional habitat 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
Deer browse impacting forest structure	Manage local deer populations where abundant
Loss of basking/ gestation/ denning habitat for timber rattlesnake	Use forest management to create canopy gaps; reduce canopy over known gestation and basking sites; develop basking structures; avoid impact to dens
Road collision/mortality (Eastern Whip-poor-will and Eastern Box Turtles)	Install highway signage in high density areas

Habitat Stress	Conservation Action
Loss of nectar resources and pollinator habitat due to nonnative invasive species and loss of fallow, open areas and native wildflower communities in and adjacent to forested landscapes	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. Control nonnative invasive species.
Fragmentation of core forests by natural gas infrastructure and other development	Develop state-level guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests
Incompatible utility corridor management	Improve vegetation management practices in utility corridors to provide suitable habitat
Forest pests and pathogens including Hemlock Woolly Adelgid, Emerald Ash Borer	Monitoring and treatment of target tree species in select priority areas
Holly River: Reduced number of red spruce in forest, climate change, acid deposition	Red spruce plantings & release, preservation of red spruce
Trampling and disturbance of rare plants and snails	Survey and avoid rare plants and snails

In addition to the habitat-linked stresses listed above, direct stresses to priority species include mortalities caused by the West Nile virus for Ruffed Grouse, lead poisoning of Bald Eagles, persecution and illegal collection of timber rattlesnake, spread of disease and illegal collection of Eastern Box Turtle and loss of nectar resources for the Northern Metalmark.

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) described 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, but may persist in cool, wet microclimates. 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 at greater risk from 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 and Pine-Oak Rocky Woodlands 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. Drought may increase the susceptibility of these forests to hemlock woolly adelgid, forest tent caterpillar, beech bark disease and other insect pests and diseases. Invasive plants may outcompete native species as conditions change, and drought may increase the risk of wildfire, to which these forests are not well adapted.

The small areas 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, moist sites within areas of complex topography may provide some refuge and buffer the effects of climate change. Restoring red spruce trees within higher elevation forests in and around Holly River State Park may further boost climate resilience.

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.



Ecosystems that are limited by geological features, including rock outcrops, cliffs and talus habitats, may be restricted from shifting across the landscape in response to climate change. These habitat types are dependent on underlying geology, so their ability to shift across the landscape in response to climate change is very limited. While they are usually adapted to extreme conditions, they may be vulnerable to increased disturbance from drought, fire and storms, and from invasion by nonnative invasive plants. Maintaining intact forest ecosystems around these rare habitats, and controlling invasive species, may help maintain resilience to a changing climate.

Table 8 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 8. Climate Stresses and Resilience Actions in 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 herbivory 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

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 9. Implementation Plan for Forest and Woodland Habitats

<b>Action</b>	<b>Partners</b>	<b>Effectiveness Measures</b>
<p>Forest Habitat, Reserve and Corridor Protection:</p> <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>• WVDNR</li> <li>• WVDOF Forest Legacy</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>Forest Planning and Management</p> <ul style="list-style-type: none"> <li>• Land Use Plans</li> <li>• Forest Management Plans</li> <li>• Forest Carbon Programs</li> <li>• Cost-Share Programs</li> <li>• Sustainable Forestry Certification Programs</li> <li>• USDA NRCS Climate Smart Forestry Activities</li> </ul>	<ul style="list-style-type: none"> <li>• AFF</li> <li>• AFTS, FSC, SFI</li> <li>• Consulting Foresters</li> <li>• Forest Carbon Programs</li> <li>• Planning Commissions</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• WVDOF</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>Promote diversity of native species and age classes in forested areas, and restore native forest vegetation on adjacent degraded lands through planting and silviculture</p>	<ul style="list-style-type: none"> <li>• Consulting Foresters</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• WVDOF</li> <li>• WVU Extension</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>

Action	Partners	Effectiveness Measures
<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> </ul> <p>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> residual basal area)</p>	<ul style="list-style-type: none"> <li>Consulting Foresters</li> <li>NWTF and RGS</li> <li>Public Land Managers</li> <li>USDA NRCS</li> <li>WVDOF</li> <li>WVU Extension</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>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: Provide heterogenous stand structure and species diversity with 40-90 ft<sup>2</sup> 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.</p>	<ul style="list-style-type: none"> <li>Consulting Foresters</li> <li>Public Land Managers</li> <li>USDA NRCS</li> <li>WVDOF</li> <li>WVU Extension</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>Survey and avoid rare plants and snails</p>	<ul style="list-style-type: none"> <li>Consulting Foresters</li> <li>Oil and Gas</li> <li>Public Land Managers</li> <li>WVDNR</li> <li>WVDOF</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>

Action	Partners	Effectiveness Measures
Monitor and control nonnative invasive species, promptly revegetate disturbed sites	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• WVCA</li> <li>• WVDOF</li> <li>• WVDOH</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>
Monitor and treat pests and pathogens targeting specific trees and plant communities in priority sites, including ash and hemlock	<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>
Create and maintain pollinator habitat with nectar resources in forest openings	<ul style="list-style-type: none"> <li>• Consulting Foresters</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• USFWS Partners for Wildlife Program</li> <li>• WVDOH</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>
Manage deer population where abundant	<ul style="list-style-type: none"> <li>• Private landowners</li> <li>• Public Land Managers</li> <li>• WVDNR</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>
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	<ul style="list-style-type: none"> <li>• Public land managers, partners, and utility companies</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
Provide guidance on timber rattlesnake den avoidance	<ul style="list-style-type: none"> <li>• Public land managers</li> <li>• WVU Extension</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>
Install highway signage to avoid collisions with priority species in high density areas	<ul style="list-style-type: none"> <li>• WVDNR</li> <li>• WVDOH</li> </ul>	<ul style="list-style-type: none"> <li>• Mortality surveys</li> <li>• # signs installed in high density areas</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>
Minimize impact on fragile rock outcrops, cliffs and talus habitat	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• Quarries and developers</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat protected for priority species</li> <li>• Before and after comparison: abundance, diversity, and distribution of priority species</li> </ul>
Holly River area: Red spruce plantings & release	<ul style="list-style-type: none"> <li>• CASRI</li> <li>• Public Land Managers</li> <li>• TNC</li> <li>• WV Highlands Conservancy</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>
Develop state-level guidance on siting and construction of oil and gas infrastructure to avoid fragmentation of core forests	<ul style="list-style-type: none"> <li>• Oil and Gas</li> <li>• WVDEP</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of core forests with avoided impacts or protected for priority species</li> </ul>

Action	Partners	Effectiveness Measures
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• WVDEP, WVCA and Conservation Districts</li> <li>• WVDNR</li> <li>• WVDNR, WVDOF</li> <li>• WVU Extension</li> </ul>	<ul style="list-style-type: none"> <li>• # Landowners engaged</li> <li>• # Landowners implementing actions</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 and Riparian Habitats

A diversity of aquatic habitats in the CFA range from warm, low-gradient headwater streams such as Stonecoal Creek, to warm, low gradient, medium sized rivers such as Elk River. 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

Below are lists of priority species in the CFA that occur in aquatic, floodplain and riparian habitats.

Table 10. Priority Species in Aquatic Habitats

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>
Crayfish	<i>Cambarus elkensis</i>	Elk River Crayfish
Dragonflies and Damselflies	<i>Neurocordulia yamaskanensis</i>	Stygian Shadowdragon
Fish	<i>Etheostoma maculatum</i>	Spotted Darter
Fish	<i>Percina macrocephala</i>	Longhead Darter
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut
Mussels	<i>Pleurobema clava</i>	Clubshell
Other Invertebrates	<i>Diploperla kanawholensis</i>	Little Kanawha Perlodid Stonefly

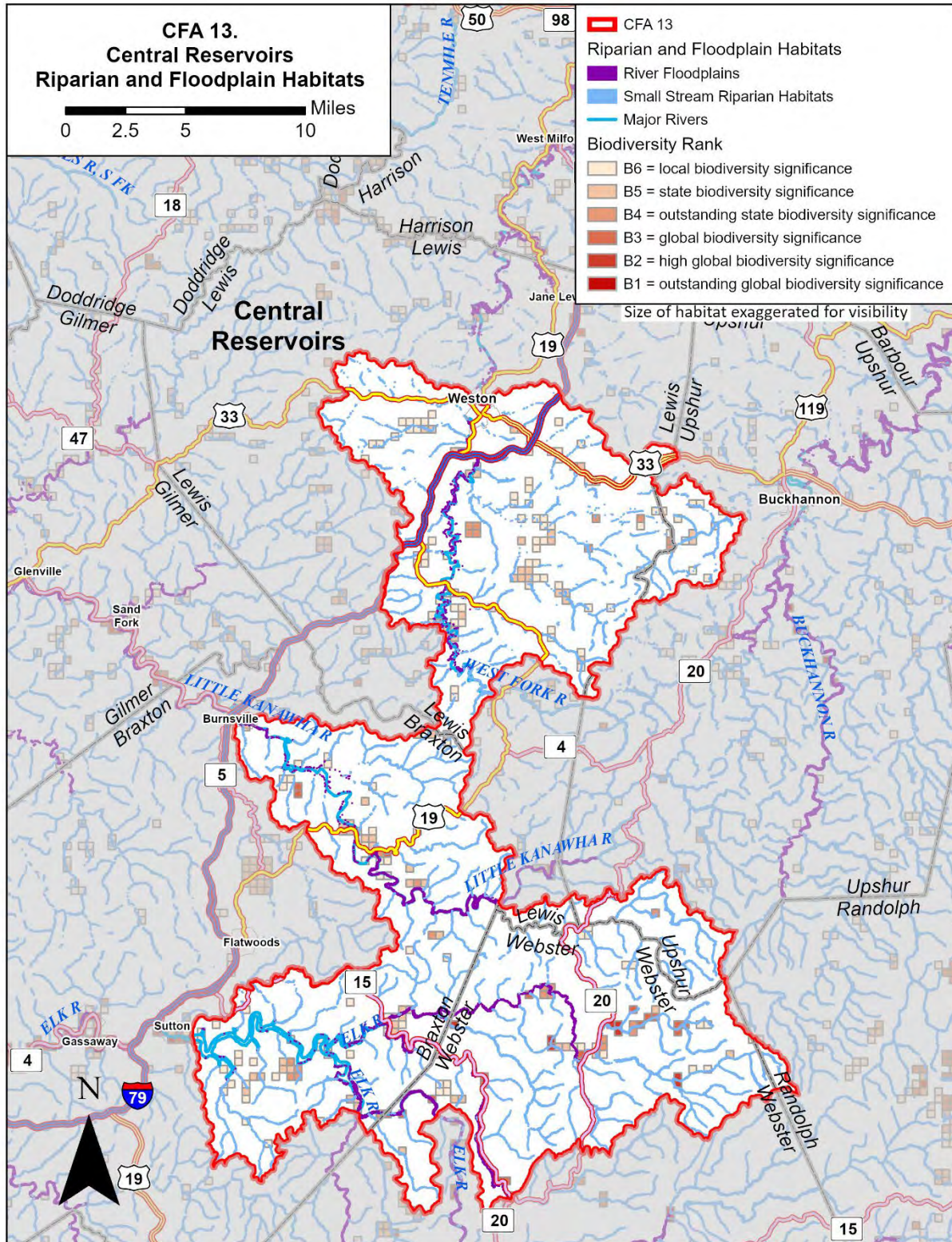
Table 11. Priority Species in Riparian and Floodplain Habitats

<b>TAXA</b>	<b>SCIENTIFIC NAME</b>	<b>COMMON NAME</b>
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle
Birds	<i>Megaceryle alcyon</i>	Belted Kingfisher
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush
Birds	<i>Scolopax minor</i>	American Woodcock
Butterflies and Moths	<i>Euphydryas phaeton</i>	Baltimore Checkerspot
Butterflies and Moths	<i>Speyeria diana</i>	Diana Fritillary

<b>TAXA</b>	<b>SCIENTIFIC NAME</b>	<b>COMMON NAME</b>
Plants	Carex seorsa	Weak Stellate Sedge
Plants	Lygodium palmatum	American Climbing Fern
Plants	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus
Reptiles	Terrapene carolina carolina	Eastern Box Turtle
Snails	Ventridens coelaxis	Bidentate Dome

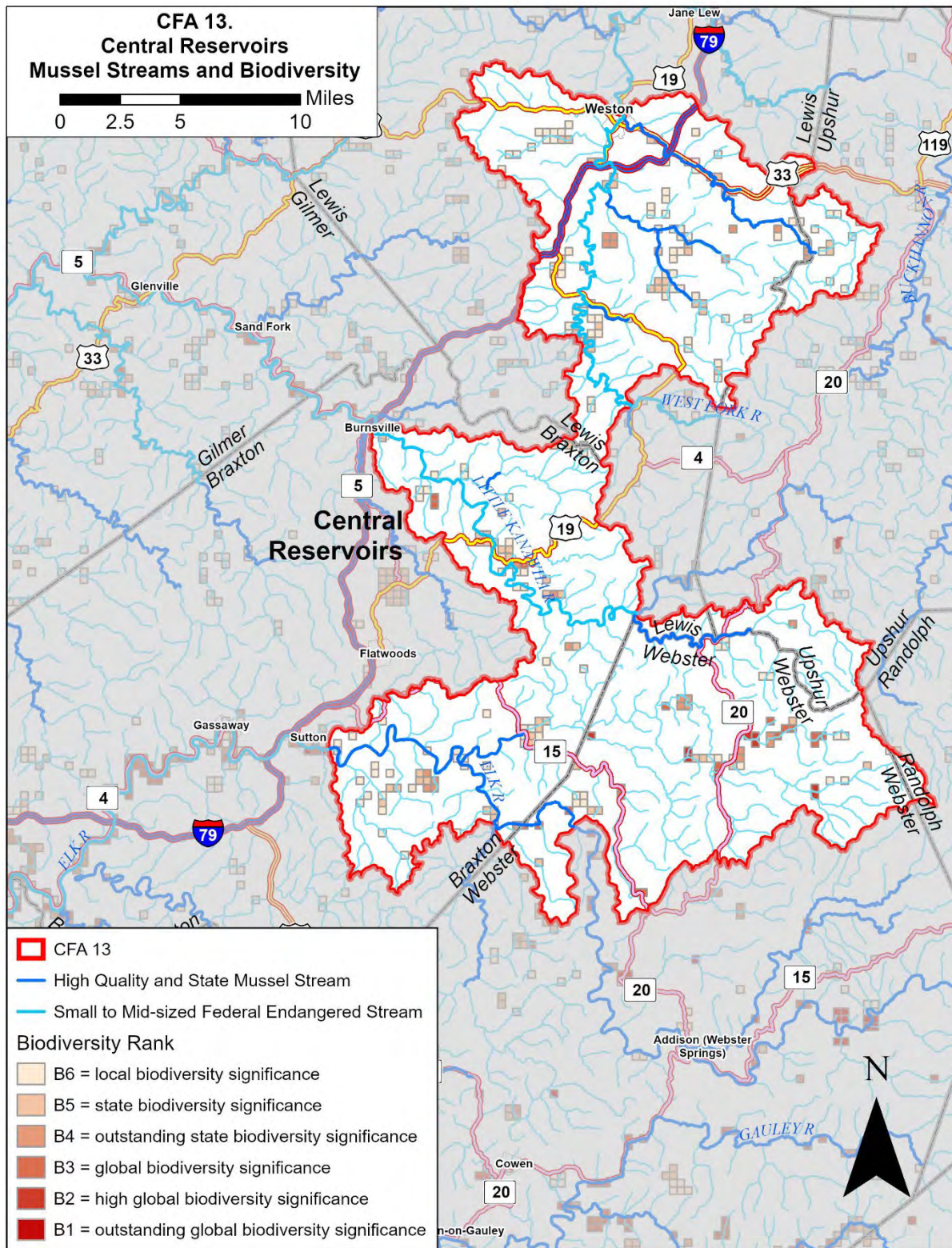
Map 9 illustrates riparian and floodplain habitats, and biodiversity occurrences. Map 10 shows mussel streams (mapped by WVDNR in 2018), and biodiversity. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. The B-Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats. Knaul Creek, Skin Creek, Stonecoal Creek, and the right fork of Little Kanawha River are designated State Mussel Streams, and portions of the Elk and Little Kanawha Rivers host federally endangered mussel species. Aquatic and riparian habitats outside of larger forest patches are well documented to be more vulnerable to climate and pollution stressors.

Map 9. Riparian and Floodplain Habitats



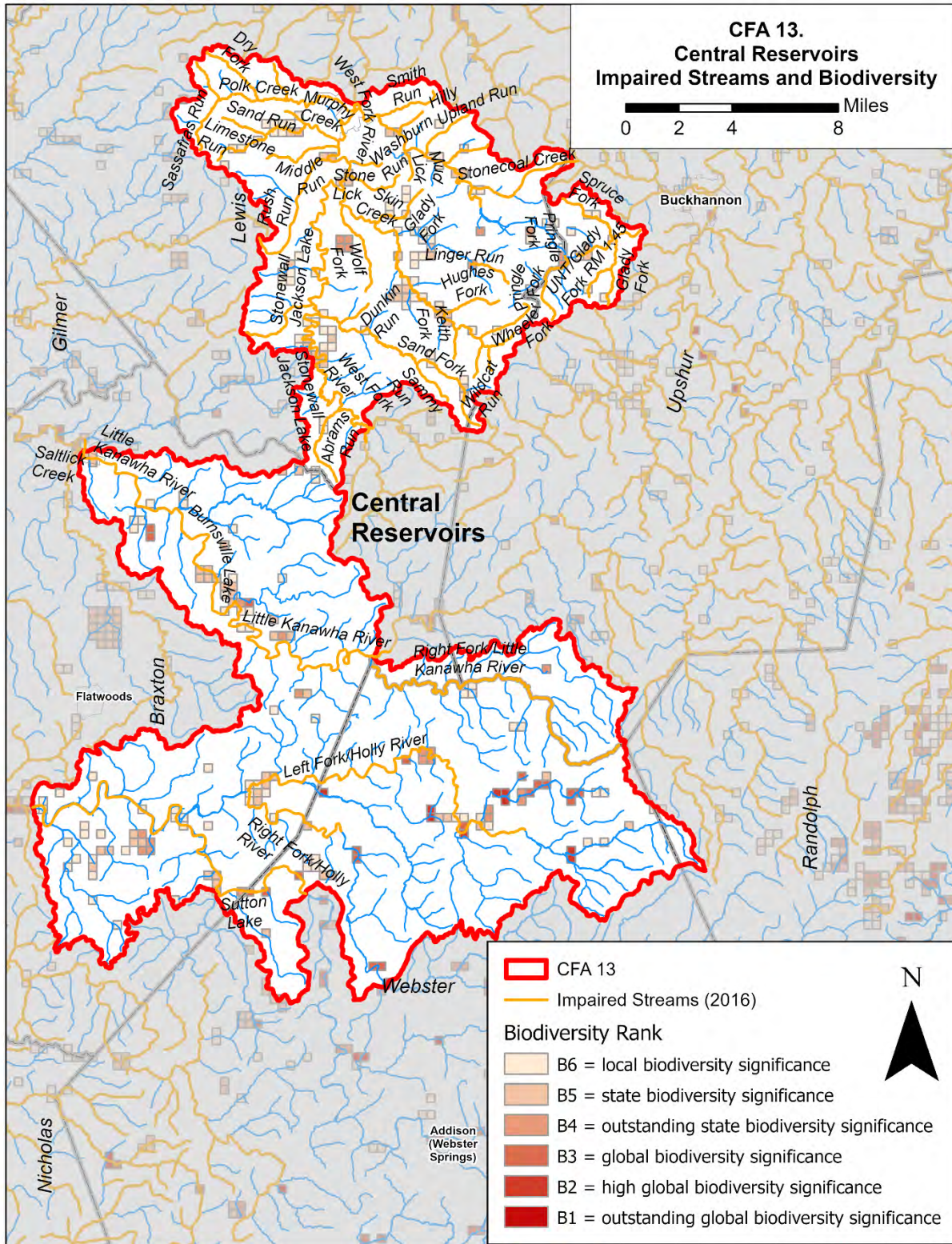


Map 10. Mussel Streams and Biodiversity





Map 11. Impaired Streams and Biodiversity



## Habitat Stresses and Conservation Actions

Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly, and plant species. Direct stresses to priority species include the illegal collection of Eastern Box Turtles and a low connectivity within populations for the Clubshell mussel and Elk River Crayfish.

Map 11 shows stream impairments (WVDEP, 2016), along with biodiversity. There are numerous streams impaired by fecal/bacteria and iron, including Dry Fork, Fall Run, and the Little Kanawha River. The most heavily impaired river within the CFA is the West Fork River, which suffers from four known causes: bio, fecal/bacteria, iron, and zinc. A table listing all impaired streams and their causes can be found in appendix 4. Many of these impaired streams host clusters of biodiversity and provide habitat for mussels and other priority species. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present.

Table 12. Habitat Stresses and Conservation Actions in Aquatic, Floodplain and Riparian Habitat

Habitat Stress	Conservation Action
Lack of protected floodplain, wetland and riparian habitat, and upland stream valley forests	Habitat protection through land use planning, conservation easements, land acquisition and other programs and activities
Water quality degradation (point and nonpoint-source pollution including sedimentation, wastewater, dredging)	Pollution control, improved sewage treatment, storm water management, sediment load reductions, implementation of forestry BMPs, plant and protect riparian buffers
Riparian habitat disturbance and deforestation, road crossings, altered hydrology, increased runoff and stream temperatures, climate change	Landowner outreach Plant, fence, maintain forested riparian corridors Minimize disturbance
Nonnative invasive plants	Carefully treat nonnative invasive plants
Deforestation, disturbance and runoff from agriculture, oil and gas development	Increased coordination with WVDNR, maintain forested riparian corridors, minimize disturbance, control invasive plants and runoff
Deer herbivory on host plants (butterflies and moths)	Identify and reduce deer populations near host plant populations

Habitat Stress	Conservation Action
Riparian habitat disturbance to rare plants	Survey and avoid disturbance to rare plants, landowner outreach, maintain forested riparian corridors
In-stream habitat impacts from dredging and development (mussels)	Consider habitat needs in activity plans; survey and salvage before activities
Aquatic passage barriers	Modify or remove barriers
Degradation of wetlands	Maintain wetland integrity and buffers
Water withdrawals and sedimentation by shale gas development activities	Increased coordination with shale gas companies, WVDNR and WVDEP to minimize disturbance, control sediment, develop and implement sustainable water use protocol for streams, and implement Unconventional Oil & Gas BMPs
Habitat degradation and fragmentation, isolated populations of mussels	Protect isolated populations and refugia; Explore stocking of rare mussels

**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 13 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 13. 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 14. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

<b>Action</b>	<b>Partners</b>	<b>Effectiveness Measures</b>
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>• WVDNR</li> <li>• WVDOF Forest Legacy</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>
In-stream and riparian habitat restoration and protection	<ul style="list-style-type: none"> <li>• Oil and Gas Companies</li> <li>• Public Land Managers</li> <li>• Trout Unlimited</li> <li>• USDA FSA &amp; NRCS</li> <li>• USFWS Partners for Fish and Wildlife</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>
Planting and fencing stream and wetland buffer zones	<ul style="list-style-type: none"> <li>• Trout Unlimited</li> <li>• USDA FSA &amp; NRCS</li> <li>• USFWS Partners for Fish and Wildlife</li> <li>• WVDEP and WVCA</li> <li>• WVDOF</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
Remove aquatic passage barriers	<ul style="list-style-type: none"> <li>• Trout Unlimited</li> <li>• USFWS Partners for Fish and Wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• # barriers enlarged or removed</li> <li>• # miles stream opened</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Improved wastewater and stormwater treatment	<ul style="list-style-type: none"> <li>• County governments</li> <li>• WVDEP</li> <li>• WVDHHR</li> </ul>	<ul style="list-style-type: none"> <li>• # wastewater and stormwater systems installed or improved</li> <li>• Change in fecal, sediment and other water quality measurements</li> <li>• Before and after comparison: abundance &amp; distribution of priority species</li> </ul>
Improve water quality in streams and wetlands	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• WVDEP and WVCA</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>
Careful treatment of nonnative invasive plants around streams and wetlands	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• USFWS Partners for Fish and Wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• Acres treated</li> <li>• Treatment success rate</li> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Explore stocking or rare mussels	<ul style="list-style-type: none"> <li>• USFWS</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Identify and reduce deer populations near host plant populations (butterflies & moths)	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>

Action	Partners	Effectiveness Measures
Minimize riparian and in-stream disturbance and water withdrawals, implement Unconventional Oil & Gas BMPs and sediment controls	<ul style="list-style-type: none"> <li>• WVDEP</li> <li>• WVDNR</li> <li>• Oil and Gas companies</li> </ul>	<ul style="list-style-type: none"> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Avoid disturbance of mussel beds, consider habitat needs in construction plans, survey and salvage before construction activities	<ul style="list-style-type: none"> <li>• USACE</li> <li>• USFWS</li> <li>• WVDEP</li> <li>• WVDNR</li> </ul>	<ul style="list-style-type: none"> <li>• Before and after comparison: abundance and diversity of priority species</li> </ul>
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> <li>• Local communities and organizations</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• USFWS</li> <li>• WV Rivers Coalition</li> <li>• WVCA and Conservation Districts</li> <li>• WVDEP, WVDNR, WVDOF</li> <li>• WVU Extension</li> </ul>	<ul style="list-style-type: none"> <li>• # of people involved in outreach activities</li> <li>• # of people involved in restoration and protection activities</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, especially pastures and woody vegetation in fallow areas, abandoned fields, field borders, wetlands, and riparian corridors. Some species even rely on habitat in more developed lands in residential and urban areas. Map 12 shows the location of agricultural and developed habitats and illustrates many examples of biodiversity occurrences in and around these areas. Agricultural lands are dispersed throughout the northern section of the CFA with sparse patches occurring in the south. Developed lands are most heavily concentrated around Weston and along roadways running throughout the CFA. Maintaining pastures, fallow fields, woody vegetation, wetlands, and riparian corridors is a priority for SGCN in agricultural habitats.

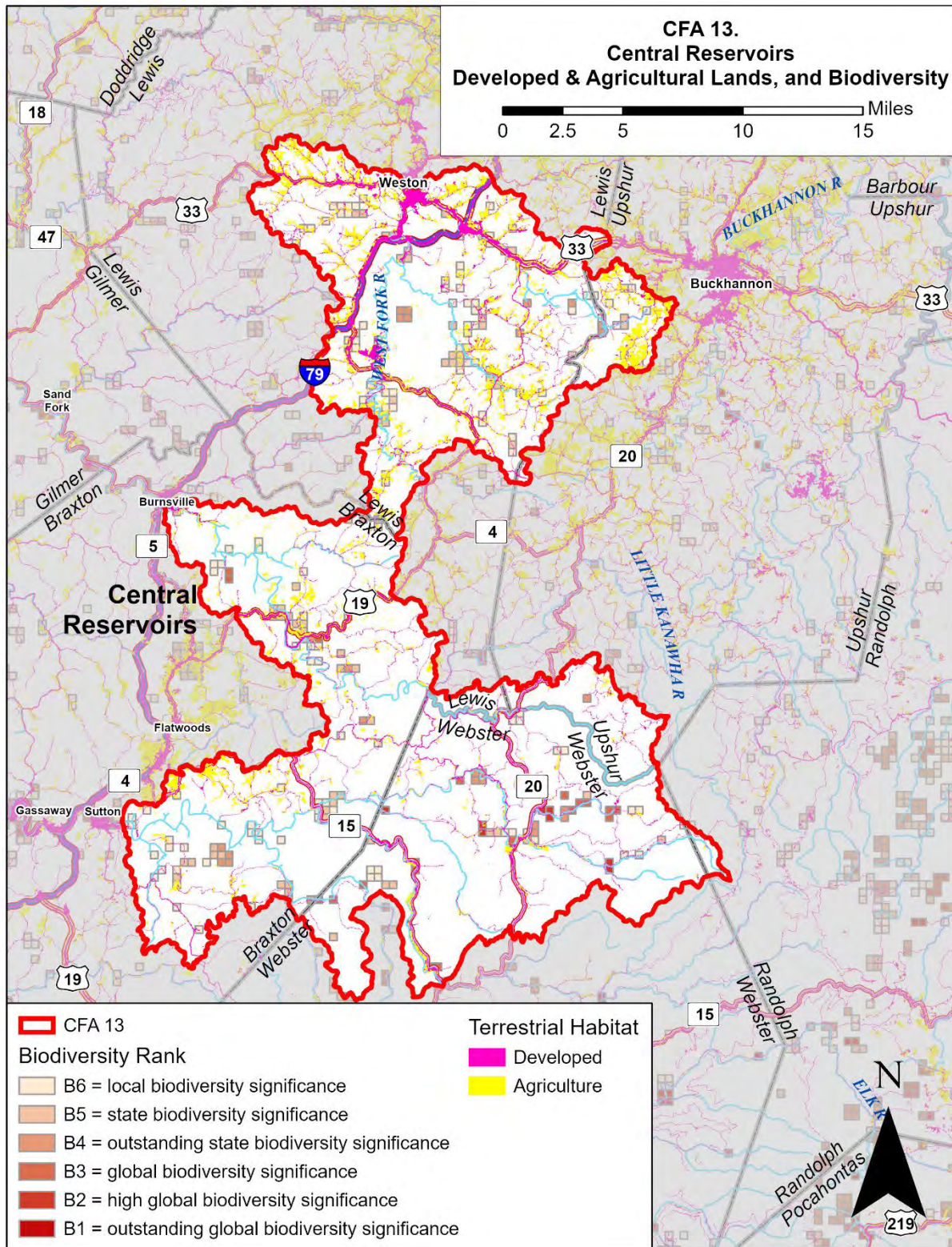
## Priority Species

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. Dusted and Cobweb Skippers require big and little bluestem grasses as larval hosts. Below 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 15. Priority Species in Agricultural and Developed Habitats

<b>Taxa</b>	<b>Scientific Name</b>	<b>Common Name</b>
Birds	<i>Chaetura pelagica</i>	Chimney Swift
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Spizella pusilla</i>	Field Sparrow
Birds	<i>Sturnella magna</i>	Eastern Meadowlark
Butterflies and Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper
Butterflies and Moths	<i>Hesperia metea</i>	Cobweb Skipper

Map 12. 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. The timing of agricultural practices also impacts some priority species. For example, early haying impacts ground nesting birds. Many SGCN also rely on habitat created by utility corridors, where the cutting of vegetation or herbicide treatment can have direct impacts on native birds and their nests. Rodenticides used to kill pests may also harm Barn Owls and other birds of prey. The table below lists stresses to wildlife habitat in agricultural areas, and conservation actions to address them.

Table 16. Habitat Stresses and Conservation Actions in Agricultural & Developed Habitats:

Habitat Stress	Conservation Action
Conversion to crop agriculture and clean farming practices: loss of grassland, woody veg., bird breeding and roosting sites	Retain or plant shrubs, hedgerows, and hawthorns in pastures; retain and improve grasslands
Loss of early successional habitat in and around agricultural land, overgrazing	Retain early successional habitat with healthy grasses and forbs, monitor grazing impacts and prevent overgrazing
Chimney capping (Chimney Swifts)	Landowner outreach, uncap chimneys, install towers for chimney swifts, retain hollow snags, logs and migration roosts
Loss of pollinator habitat in fallow or open areas	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
Incompatible timing of hay harvest	Adjust timing of hay harvest
Nonnative invasive species	Monitor and control nonnative invasive species

## 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 weeds and 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 grassland and pasture, 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) list numerous strategies to boost the resilience of agriculture to climate change, including maintaining soil health and water quality, reducing competition from weeds and 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.

Below is 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 17. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

<b>Climate Stress:</b>	<b>Habitat Resilience Action:</b>
<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 the effectiveness of conservation actions in agricultural habitats.

Table 18. Implementation Plan for Agricultural and Developed Habitats.

<b>Action</b>	<b>Partners</b>	<b>Effectiveness Measures</b>
<p>Habitat Protection:</p> <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>
<p>Habitat Protection</p> <ul style="list-style-type: none"> <li>• Incentive Programs</li> </ul>	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• WVCA and Conservation Districts</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>Reduce clearing of native vegetation; Retain or plant hedgerows, pollinator habitat and areas with native plants</p>	<ul style="list-style-type: none"> <li>• USDA FSA &amp; NRCS</li> <li>• USFWS Partners for Wildlife Program</li> <li>• WVCA and Conservation Districts</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>

Action	Partners	Effectiveness Measures
Maintain or restore aquatic, riparian and forest habitat 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>• Public Land Managers</li> <li>• USDA FSA &amp; NRCS</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>
Create early successional habitat	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• USDA NRCS</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of habitat created</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>
Adjust timing of hay harvest	<ul style="list-style-type: none"> <li>• USDA FSA</li> </ul>	<ul style="list-style-type: none"> <li>• Acres of hay fields under delayed harvest management</li> <li>• Change in abundance, diversity and distribution of priority species</li> </ul>
Adapt farm practices, infrastructure and land uses to changing conditions	<ul style="list-style-type: none"> <li>• Public Land Managers</li> <li>• USDA FSA &amp; NRCS</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, protect migration roosts and snags	<ul style="list-style-type: none"> <li>• Landowners and volunteer groups</li> </ul>	<ul style="list-style-type: none"> <li>• # chimneys uncapped</li> <li>• # swift towers installed</li> <li>• # roosts protected</li> <li>• Change in abundance and distribution</li> </ul>

Action	Partners	Effectiveness Measures
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> <li>• Local communities and organizations</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• USFWS</li> <li>• WV Rivers Coalition</li> <li>• WVCA and Conservation Districts</li> <li>• WVDEP, WVDNR, WVDOF</li> <li>• WVU Extension</li> </ul>	<ul style="list-style-type: none"> <li>• # of people involved in outreach activities</li> <li>• # of people involved in restoration and protection activities</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 most lie in the southern portion of the CFA with large areas encompassed by public lands, including the Elk River Wildlife Management Area and Holly River State Park. There are also landscapes of high integrity in private ownership adjacent to public lands. These areas are important for species movement in response to climate change and are priorities for protection of wildlife habitat.



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.

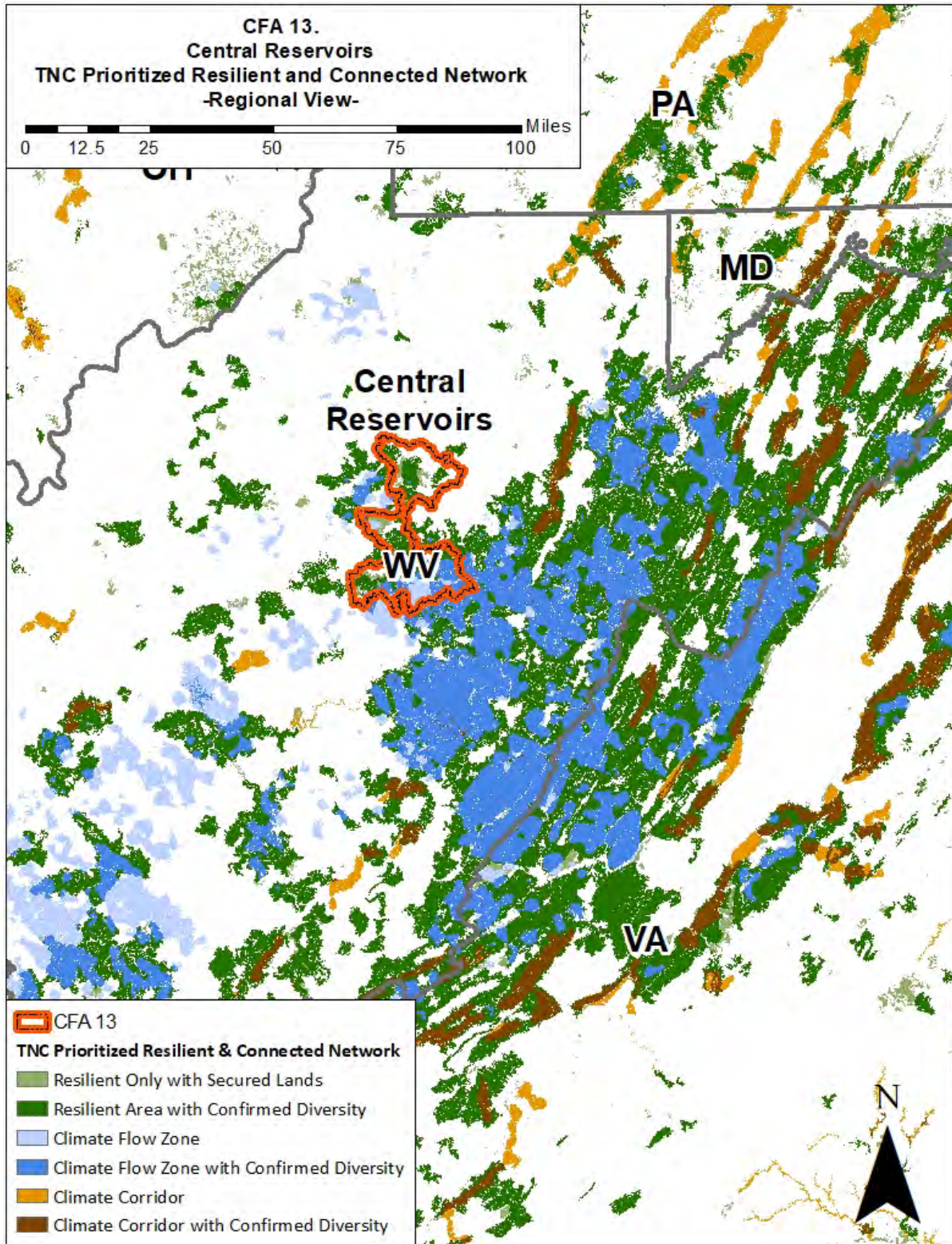
This work is documented in Resilient Sites for Terrestrial Conservation in Eastern North America (Anderson et al, 2016a), and Resilient and Connected Landscapes for Terrestrial Conservation (Anderson et al, 2016b). The studies produced a series of maps (see <http://maps.tnc.org/resilientland/>) that 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 14 provides a regional view of priority resilient and connected landscapes, illustrating that the resilient, connected landscapes throughout the CFA form part of a hub of large forest blocks, resilient landscapes and flow zones that link the narrower climate corridors both north into Maryland and Pennsylvania and south into Virginia. The resilient, connected landscapes in this CFA are critical to the species adapting to climate change within the larger network across the Eastern United States.

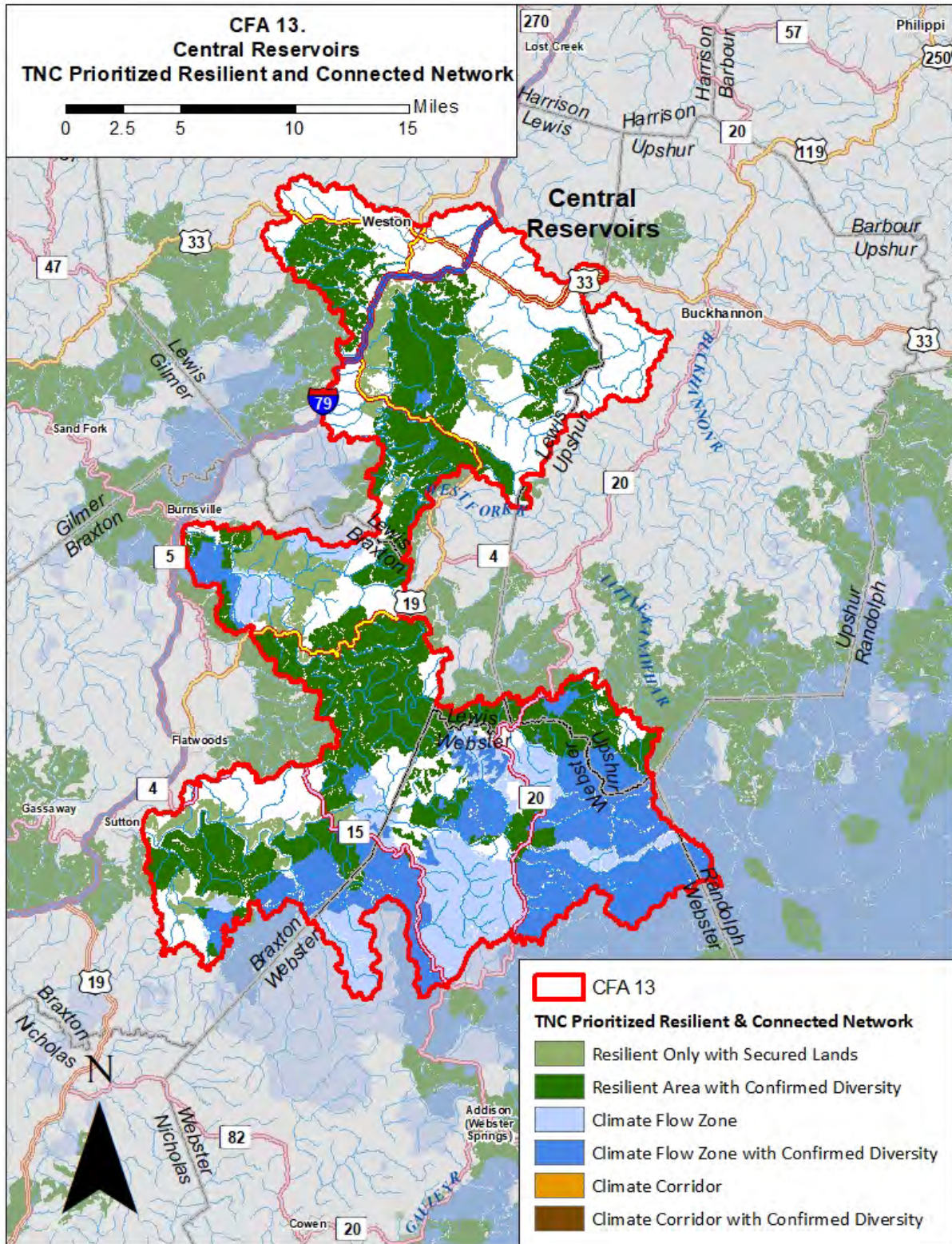


Map 14. Priority Resilient and Connected Network – Regional View





Map 15. Priority Resilient and Connected Network – Detailed View





Map 15 provides a detailed view of the resilient, connected landscapes in the Central Reservoirs CFA. Climate flow zones exist primarily in the southern portion of the CFA, while resilient landscapes occupy northern portions in large patches. These priority resilient and connected landscapes contain the CFA’s large forest patches and high integrity areas, most of the CFA’s rock outcrop, cliff and talus habitats, and known biodiversity.

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. 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 19. 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> </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, Maryland, 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 20. Implementation Plan for Landscape Resilience and Connectivity

Action	Partners	Effectiveness Measures
<p>Protection of Resilient, Connected Landscapes</p> <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>
<p>Forest Planning and Management</p> <ul style="list-style-type: none"> <li>• Land Use Plans</li> <li>• Forest Management Plans</li> <li>• Forest Carbon Programs</li> <li>• Cost-Share Programs</li> <li>• Sustainable Forestry Certification Programs</li> <li>• USDA NRCS Climate Smart Agricultural &amp; Forestry Activities</li> </ul>	<ul style="list-style-type: none"> <li>• AFF</li> <li>• AFTS, FSC, SFI</li> <li>• Consulting Foresters</li> <li>• Forest Carbon Programs</li> <li>• Planning Commissions</li> <li>• Public Land Managers</li> <li>• USDA NRCS</li> <li>• WVDOF</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>Protection of Resilient, Connected Landscapes</p> <ul style="list-style-type: none"> <li>• Conservation 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>• Partner Organizations</li> <li>• Private Landowners</li> <li>• Public Land Managers</li> <li>• WVDNR</li> <li>• WVDOF</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 woodlands, barrens, cliffs and talus, caves and karst, aquatic, riparian, floodplain, 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 within each major habitat type.

- Large, intact forest patches, including interior forest habitat
- Early successional forest habitat
- Small areas of unique, geologically derived habitat including:
  - Acidic rock outcrops, cliffs and talus
  - Calcareous cliffs and talus
- Special aquatic habitats, such as mussel streams
- Small stream riparian and river floodplain habitats
- 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 included 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 mussel stream habitat by improving wastewater treatment, re-designing stream crossings for aquatic organism passage and high flows, and planting riparian stream buffers may benefit multiple plant communities and wildlife species. Coordinating actions across multiple habitats, such as protecting large patches of diverse forest habitats that also include rare rock outcrops or cliff and talus habitats. 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. Maintaining connections between patches of diverse forest habitat and with rare rock outcrops, cliff and talus enhances the resilience of these habitats and enables forest species to move to optimal sites 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 for development impacts to priority habitats and other priority areas for conservation action.

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## Appendix 1. SGCN in the Greater Greenbrier CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Amphibians	<i>Aneides aeneus</i>	Green Salamander	S3	G3G4	—	
Amphibians	<i>Cryptobranchus alleganiensis</i>	Eastern Hellbender	S2	G3G4	—	
Amphibians	<i>Plethodon wehrlei</i>	Wehrle's Salamander	S4	G4		
Amphibians	<i>Pseudotriton ruber ruber</i>	(northern) Red Salamander	S3	G5		
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	S3B	G5		At Risk-Cons
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse	S3B,S3N	G5	R	
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk	S3B	G5		
Birds	<i>Butorides virescens</i>	Green Heron	S3B	G5		
Birds	<i>Catharus fuscescens</i>	Veery	S3B	G5		
Birds	<i>Chaetura pelagica</i>	Chimney Swift	S3B	G5	—	
Birds	<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo	S2B	G5	—	
Birds	<i>Falco sparverius</i>	American Kestrel	S3B	G5	—	
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler	S3B	G5	R	

<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 at Risk</b>
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle	S3B,S3N	G5		
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler	S3B	G5	R	
Birds	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5	R	At Risk-Cons
Birds	<i>Icteria virens</i>	Yellow-breasted Chat	S3B	G5		
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush	S3B	G5		
Birds	<i>Petrochelidon pyrrhonota</i>	Cliff Swallow	S3B	G5		
Birds	<i>Piranga rubra</i>	Summer Tanager	S3B	G5	—	
Birds	<i>Pooecetes gramineus</i>	Vesper Sparrow	S2B, S2N	G5	—	
Birds	<i>Scolopax minor</i>	American Woodcock	S3B	G5	R	
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4	—	At Risk-Cons
Birds	<i>Setophaga discolor</i>	Prairie Warbler	S3B	G5	R	
Birds	<i>Spizella pusilla</i>	Field Sparrow	S3B, S3N	G5	R	
Birds	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5	R	
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5		

<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 at Risk</b>
Butterflies & Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper	S1	G4G5		
Butterflies & Moths	<i>Calephelis borealis</i>	Northern Metalmark	S2	G3G4		
Butterflies & Moths	<i>Calycopis cecrops</i>	Red-banded Hairstreak	S3	G5		
Butterflies & Moths	<i>Celastrina neglectamajor</i>	Appalachian Azure	SNR	G4		
Butterflies & Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr	S3	G4G5		
Butterflies & Moths	<i>Euphydryas phaeton</i>	Baltimore Checkerspot	S3S4	G4		
Butterflies & Moths	<i>Hesperia metea</i>	Cobweb Skipper	S2S3	G4G5		
Butterflies & Moths	<i>Parrhasius m-album</i>	White-m Hairstreak	S2	G5		
Butterflies & Moths	<i>Phyciodes cocyta selene</i>	Northern Crescent	S2	G5		
Butterflies & Moths	<i>Speyeria diana</i>	Diana Fritillary	S2S3	G3G4		
Crayfish	<i>Cambarus elkensis</i>	Elk River Crayfish	S1	G2		
Dragonflies and Damselflies	<i>Aeshna tuberculifera</i>	Black-tipped Darner	S3	G4		
Dragonflies and Damselflies	<i>Dromogomphus spoliatus</i>	Flag-tailed Spinyleg	SH	G4G5		
Dragonflies and Damselflies	<i>Epiaeschna heros</i>	Swamp Darner	S3	G5		

<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 at Risk</b>
Dragonflies and Damselflies	<i>Gomphus quadricolor</i>	Rapids Clubtail	S3	G3G4		
Dragonflies and Damselflies	<i>Macromia alleghaniensis</i>	Allegheny River Cruiser	S2S3	G4		
Dragonflies and Damselflies	<i>Macromia illinoensis</i>	Illinois River Cruiser	S3	G5		
Dragonflies and Damselflies	<i>Neurocordulia yamaskanensis</i>	Stygian Shadowdragon	S3	G5		
Dragonflies and Damselflies	<i>Progomphus obscurus</i>	Common Sanddragon	S2S3	G5		
Fish	<i>Ameiurus nebulosus</i>	Brown Bullhead	S2	G5		
Fish	<i>Etheostoma maculatum</i>	Spotted Darter	S1	G2	—	
Fish	<i>Ichthyomyzon bdellium</i>	Ohio Lamprey	S2S3	G3G4	—	
Fish	<i>Percina copelandi</i>	Channel Darter	S2S3	G4		
Fish	<i>Percina macrocephala</i>	Longhead Darter	S2	G3	—	
Fish	<i>Percina sciera</i>	Dusky Darter	S3	G5		
Mammals	<i>Erethizon dorsatum</i>	Porcupine	S3	G5		
Mammals	<i>Lasiurus borealis</i>	Eastern Red Bat	S4	G5	R	



Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat	S1	G3	—	
Mammals	<i>Myotis septentrionalis</i>	Northern Long-eared Bat	S2*	G2G3	T	
Mammals	<i>Sorex dispar</i>	Long-tailed Shrew	S2S3	G4		
Mammals	<i>Synaptomys cooperi</i>	Southern Bog Lemming	S3	G5		
Mussels	<i>Alasmidonta marginata</i>	Elktoe	S1	G4	—	
Mussels	<i>Amblema plicata</i>	Threeridge	S3	G5		
Mussels	<i>Cambarunia iris</i>	Rainbow	S2	G5Q		
Mussels	<i>Epioblasma triquetra</i>	Snuffbox	S2	G3	E	
Mussels	<i>Eurynia dilatata</i>	Spike	S3	G5		
Mussels	<i>Fusconaia flava</i>	Wabash Pigtoe	S1	G5		
Mussels	<i>Lampsilis cardium</i>	Plain Pocketbook	S3	G5		
Mussels	<i>Lampsilis fasciola</i>	Wavy-rayed Lampmussel	S3	G5		
Mussels	<i>Lasmigona costata</i>	Fluted-shell	S3	G5		
Mussels	<i>Ligumia recta</i>	Black Sandshell	S3	G5	—	
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut	S3	G4		
Mussels	<i>Paetulunio fabalis</i>	Rayed Bean	S1	G2	E	

<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 at Risk</b>
Mussels	<i>Pleurobema clava</i>	Clubshell	S1	G2	E	
Mussels	<i>Pleurobema sintoxia</i>	Round Pigtoe	S2	G4G5		
Mussels	<i>Potamilus fragilis</i>	Fragile Papershell	S3	G5		
Mussels	<i>Ptychobranhus fasciolaris</i>	Kidneyshell	S3	G4G5		
Mussels	<i>Pyganodon grandis</i>	Giant Floater	S3	G5		
Mussels	<i>Theliderma cylindrica</i>	Rabbitsfoot	SX	G3G4		
Mussels	<i>Theliderma metanevra</i>	Monkeyface	S2	G4		
Mussels	<i>Quadrula quadrula</i>	Mapleleaf	S3	G5		
Mussels	<i>Strophitus undulatus</i>	Squawfoot	S3	G5		
Mussels	<i>Tritogonia verrucosa</i>	Pistolgrip	S3	G4G5		
Mussels	<i>Utterbackia imbecillis</i>	Paper Pondshell	S2	G5		
Other Invertebrates	<i>Diploperla kanawholensis</i>	Little Kanawha Perlodid Stonefly	S1	G3		At Risk- Science
Other Invertebrates	<i>Sweltsa pocahontas</i>	A Stonefly	S2	G2		At Risk- Science
Plants	<i>Anemone quinquefolia</i> var. <i>minima</i>	Dwarf Anemone	S2	G5T3		

<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 at Risk</b>
Plants	Carex roanensis	Roan Mountain Sedge	S2	G3		
Plants	Carex seorsa	Weak Stellate Sedge	S2	G4		
Plants	Dichanthelium boreale	Panicgrass	S1	G5		
Plants	Drosera rotundifolia var. rotundifolia	Roundleaf Sundew	S3	G5T5		
Plants	Juglans cinerea	Butternut	S3	G4		
Plants	Lygodium palmatum	American Climbing Fern	S3	G4		
Plants	Myosotis macrosperma	Large-seed Forget-me-not	S3	G5		
Plants	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus	S2	G4		
Plants	Phacelia covillei	Phacelia	S1	G3		
Plants	Spiranthes tuberosa	Little Ladies'-tresses	S3	G5		
Plants	Triphora trianthophora	Threebirds	S2	G3G4		
Reptiles	Agkistrodon contortrix mokasen	Northern Copperhead	S5	G5T5		
Reptiles	Carphophis amoenus	Wormsnake	S3	G5		
Reptiles	Coluber constrictor constrictor	Northern Black Racer	SNR	G5T5		
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4	—	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Reptiles	<i>Plestiodon laticeps</i>	Broad-headed Skink	S2	G5	—	
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	S5	G5T5	R	
Reptiles	<i>Thamnophis sauritus</i>	Eastern Ribbonsnake	S2	G5	—	
Snails	<i>Euchemotrema leai</i>	Lowland Pillsnail	S3	G5		
Snails	<i>Glyphyalinia cumberlandiana</i>	Hill Glyph	S3	G4		
Snails	<i>Striatura exigua</i>	Ribbed Striate	S2	G5		
Snails	<i>Striatura ferrea</i>	Black Striate	S3	G5		
Snails	<i>Vallonia excentrica</i>	Iroquois Vallonia	S3	G5		
Snails	<i>Ventridens arcellus</i>	Golden Dome	S3	G4		
Snails	<i>Ventridens coelaxis</i>	Bidentate Dome	S1	G3		

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, X = Extirpated, Q = Questionable Taxonomy, S#S# or G#G# indicates range of uncertainty.

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

USFWS Priority At Risk: Cons = 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>Road/collision mortality.</li> <li>Incompatible forest structure.</li> <li>Possible declines in high quality prey</li> </ul>	<ul style="list-style-type: none"> <li>Identify high density areas and install highway signage.</li> <li>Manage forests for interior gaps and edges.</li> <li>Long-term monitoring of insect populations</li> </ul>
Ruffed Grouse	<ul style="list-style-type: none"> <li>Insufficient habitat.</li> <li>West Nile virus</li> </ul>	<ul style="list-style-type: none"> <li>Create suitable habitat through established BMPs.</li> <li>Manage forests at landscape scale for mosaic of age classes and structure.</li> <li>Assess prevalence of WNV</li> </ul>
Broad-winged Hawk	<ul style="list-style-type: none"> <li>Poor forest structure</li> </ul>	<ul style="list-style-type: none"> <li>Forest management for gaps</li> </ul>
Kentucky Warbler	<ul style="list-style-type: none"> <li>Deer overherbivory.</li> <li>Incompatible forest structure</li> </ul>	<ul style="list-style-type: none"> <li>Reduce deer population.</li> <li>Manage forests for structural and spatial complexity</li> </ul>
Bald Eagle	<ul style="list-style-type: none"> <li>Lead poisoning</li> </ul>	<ul style="list-style-type: none"> <li>Encourage usage of non-lead shot</li> </ul>
Worm-eating Warbler	<ul style="list-style-type: none"> <li>Deer overherbivory.</li> <li>Incompatible forest structure.</li> <li>Residential development</li> </ul>	<ul style="list-style-type: none"> <li>Reduce deer population.</li> <li>Manage forests for structural and spatial complexity</li> </ul>
Wood Thrush	<ul style="list-style-type: none"> <li>Deer overherbivory.</li> <li>Incompatible forest structure.</li> <li>Residential development</li> </ul>	<ul style="list-style-type: none"> <li>Reduce deer population.</li> <li>Manage forests for structural and spatial complexity</li> </ul>
Yellow-breasted Chat	<ul style="list-style-type: none"> <li>Forest maturation.</li> <li>Herbicide use/veg mgmt in utility corridors</li> </ul>	<ul style="list-style-type: none"> <li>Manage forests to create early successional habitat.</li> <li>Manage utility corridors to maintain compatible habitat</li> </ul>
Cerulean Warbler	<ul style="list-style-type: none"> <li>Poor forest structure</li> </ul>	<ul style="list-style-type: none"> <li>Manage forests to create suitable habitat as per CERW guidelines</li> </ul>



Forests and Woodlands		
Common Name	Local Stress	Action
Prairie Warbler	<ul style="list-style-type: none"> <li>• Forest maturation. Herbicide use/veg mgmt in utility corridors</li> </ul>	<ul style="list-style-type: none"> <li>• Manage forests to create early successional habitat.</li> <li>• Manage utility corridors to maintain compatible habitat</li> </ul>
Blue-winged Warbler	<ul style="list-style-type: none"> <li>• Insufficient habitat.</li> <li>• Residential development</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce clean farming practices.</li> <li>• Create early successional habitat</li> </ul>
Northern Metalmark	<ul style="list-style-type: none"> <li>• Loss of nectar resources, development</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain open nature of forest stands.</li> <li>• Maintain/enhance nectar resources</li> </ul>
Dusted Skipper	<ul style="list-style-type: none"> <li>• Loss of fallow open areas to afforestation</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain open areas.</li> <li>• Enhance pollinator habitat</li> </ul>
Gemmed Satyr	<ul style="list-style-type: none"> <li>• Invasive species.</li> <li>• Loss of nectar resources</li> </ul>	<ul style="list-style-type: none"> <li>• Control invasive Microstegium.</li> <li>• Enhance pollinator habitat</li> </ul>
Cobweb Skipper	<ul style="list-style-type: none"> <li>• Reforestation.</li> <li>• Invasive species</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain open areas in xeric forest stands.</li> <li>• Enhance pollinator habitat</li> </ul>
Northern Crescent	<ul style="list-style-type: none"> <li>• Loss of nectar resources</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain forest roads in Stonecoal WMA with native wildflower communities</li> </ul>
Diana Fritillary	<ul style="list-style-type: none"> <li>• Loss of nectar resources</li> </ul>	<ul style="list-style-type: none"> <li>• Conservation and enhancement of open areas for pollinators adjacent to hardwood forests</li> </ul>
Roan Mountain Sedge	<ul style="list-style-type: none"> <li>• Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>• Field survey to determine species distribution and threats.</li> </ul>
American Climbing Fern	<ul style="list-style-type: none"> <li>• Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>• Field survey to determine species distribution and threats.</li> </ul>
Threebirds	<ul style="list-style-type: none"> <li>• Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>• Field survey to determine species distribution and threats.</li> </ul>

Forests and Woodlands		
Common Name	Local Stress	Action
Bidentate Dome	<ul style="list-style-type: none"> <li>Unknown- data deficient species</li> </ul>	<ul style="list-style-type: none"> <li>Data collection.</li> <li>Protections from foot traffic</li> </ul>
Timber Rattlesnake	<ul style="list-style-type: none"> <li>Persecution. Collection. Habitat destruction</li> </ul>	<ul style="list-style-type: none"> <li>Increased surveillance around susceptible den sites.</li> <li>Forest management to create canopy gaps.</li> <li>Reduce canopy over known gestation and basking sites.</li> <li>Develop basking structures to mitigate impacts to habitat.</li> <li>Buffer boulder fields, talus, and rocky outcrops</li> </ul>
Eastern Box Turtle	<ul style="list-style-type: none"> <li>Collection.</li> <li>Disease.</li> <li>Road Mortality.</li> <li>Habitat destruction.</li> <li>Artificial increase in mesocarnivores</li> </ul>	<ul style="list-style-type: none"> <li>Reduce illegal collection.</li> <li>Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease. Improve road conditions to reduce mortality at identified hot spots.</li> <li>Develop and distribute box turtle BMPs document for urban areas</li> </ul>

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
American Woodcock	<ul style="list-style-type: none"> <li>• Insufficient habitat.</li> <li>• Residential development</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce clean farming practices.</li> <li>• Create early successional habitat</li> </ul>
Bidentate Dove	<ul style="list-style-type: none"> <li>• Unknown- data deficient species</li> </ul>	<ul style="list-style-type: none"> <li>• Data collection.</li> <li>• Protections from foot traffic</li> </ul>
Eastern Box Turtle	<ul style="list-style-type: none"> <li>• Collection.</li> <li>• Disease.</li> <li>• Road Mortality.</li> <li>• Habitat destruction.</li> <li>• Artificial increase in mesocarnivores</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce illegal collection.</li> <li>• Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease. Improve road conditions to reduce mortality at identified hot spots.</li> <li>• Develop and distribute box turtle BMPs document for urban areas</li> </ul>
Kentucky Warbler	<ul style="list-style-type: none"> <li>• Deer overherbivory.</li> <li>• Incompatible forest structure</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce deer population.</li> <li>• Manage forests for structural and spatial complexity</li> </ul>
Bald Eagle	<ul style="list-style-type: none"> <li>• Lead poisoning</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage usage of non-lead shot</li> </ul>
Belted Kingfisher	<ul style="list-style-type: none"> <li>• Poor water quality.</li> <li>• Insufficient nest microhabitat</li> </ul>	<ul style="list-style-type: none"> <li>• Identify important waterways and improve water quality</li> </ul>
Louisiana Waterthrush	<ul style="list-style-type: none"> <li>• Loss of riparian forests.</li> <li>• Stream degradation.</li> <li>• Acid deposition.</li> <li>• Residential development</li> </ul>	<ul style="list-style-type: none"> <li>• Improve water quality.</li> <li>• Conserve riparian and upland stream valley forests.</li> <li>• Conservation easements</li> </ul>
Baltimore Checkerspot	<ul style="list-style-type: none"> <li>• Deer herbivory of host plant.</li> <li>• Wetland loss</li> </ul>	<ul style="list-style-type: none"> <li>• Target deer harvest near good turtlehead (<i>Chelone glabra</i>) populations.</li> <li>• Maintain wetland integrity</li> </ul>
Diana Fritillary	<ul style="list-style-type: none"> <li>• Loss of nectar resources</li> </ul>	<ul style="list-style-type: none"> <li>• Conservation and enhancement of open areas for pollinators adjacent to hardwood forests</li> </ul>

<b>Floodplain, Riparian and Wetland Habitats</b>		
<b>Common Name</b>	<b>Local Stress</b>	<b>Action</b>
Weak Stellate Sedge	<ul style="list-style-type: none"> <li>Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>Field survey to determine species distribution and threats.</li> </ul>
American Climbing Fern	<ul style="list-style-type: none"> <li>Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>Field survey to determine species distribution and threats.</li> </ul>
Kidneyleaf Grass-of-parnassus	<ul style="list-style-type: none"> <li>Unknown status</li> </ul>	<ul style="list-style-type: none"> <li>Field survey to determine species distribution and threats.</li> </ul>
<b>Aquatic Habitats</b>		
<b>Common Name</b>	<b>Local Stress</b>	<b>Action</b>
Elk River Crayfish	<ul style="list-style-type: none"> <li>Sedimentation affecting instream habitat features.</li> <li>Degraded water quality and riparian conditions.</li> <li>Lack of connectivity</li> </ul>	<ul style="list-style-type: none"> <li>Sedimentation minimized through forestry BMPs and by identifying point/non-point sources.</li> <li>Maintain or increase instream water features and quality to allow population connectivity.</li> </ul>
Stygian Shadowdragon	<ul style="list-style-type: none"> <li>Poor water quality of streams.</li> <li>Loss of stream side vegetation</li> </ul>	<ul style="list-style-type: none"> <li>Improve municipal/household wastewater systems.</li> <li>Maintain vegetation along streams</li> </ul>
Spotted Darter	<ul style="list-style-type: none"> <li>Increased sedimentation.</li> <li>River channelization.</li> <li>Point &amp; nonpoint-source pollution</li> </ul>	<ul style="list-style-type: none"> <li>Prevent and restore causes of sedimentation.</li> </ul>
Longhead Darter	<ul style="list-style-type: none"> <li>Increased sedimentation. River channelization. Point &amp; nonpoint-source pollution</li> </ul>	<ul style="list-style-type: none"> <li>Riparian restoration</li> </ul>
Round Hickorynut	<ul style="list-style-type: none"> <li>Sedimentation and in-stream work</li> </ul>	<ul style="list-style-type: none"> <li>Erosion controls</li> </ul>
Clubshell	<ul style="list-style-type: none"> <li>Low connectivity within population. Sedimentation.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion controls. Potential stocking</li> </ul>
Little Kanawha Perlodid Stonefly	<ul style="list-style-type: none"> <li>Pollution.</li> <li>Development/deforestation.</li> <li>Climate change</li> </ul>	<ul style="list-style-type: none"> <li>Riparian BMPs.</li> <li>Benthic species data collection</li> </ul>

<b>Anthropogenic Shrublands and Grasslands, Agricultural and Developed Habitats</b>		
<b>Common Name</b>	<b>Local Stress</b>	<b>Action</b>
Chimney Swift	<ul style="list-style-type: none"> <li>• Chimney capping.</li> <li>• Turnover of older structures</li> </ul>	<ul style="list-style-type: none"> <li>• Landowner outreach and education.</li> <li>• Protect known significant migration roosts.</li> <li>• Uncap chimneys. Install swift towers</li> </ul>
Ruffed Grouse	<ul style="list-style-type: none"> <li>• Insufficient habitat.</li> <li>• West Nile virus</li> </ul>	<ul style="list-style-type: none"> <li>• Create suitable habitat through established BMPs.</li> <li>• Manage forests at landscape scale for mosaic of age classes and structure.</li> <li>• Assess prevalence of WNV</li> </ul>
American Woodcock	<ul style="list-style-type: none"> <li>• Insufficient habitat.</li> <li>• Residential development</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce clean farming practices.</li> <li>• Create early successional habitat</li> </ul>
Field Sparrow	<ul style="list-style-type: none"> <li>• Insufficient habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Create early successional habitat</li> </ul>
Eastern Meadowlark	<ul style="list-style-type: none"> <li>• Clean farming practices.</li> <li>• Nest failure from incompatible haying practice</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust timing of hay harvest.</li> <li>• Conservation easements</li> </ul>
Dusted Skipper	<ul style="list-style-type: none"> <li>• Loss of fallow open areas to afforestation</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain open areas.</li> <li>• Enhance pollinator habitat</li> </ul>



### Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
Burnsville Lake 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>Rock Outcrops, Cliffs and Talus, and Shale Barrens</b> <ul style="list-style-type: none"> <li>• Acidic Rock Outcrops, Cliffs, and Talus</li> </ul> </li> <li>• <b>Aquatic, Floodplain, and Riparian</b> <ul style="list-style-type: none"> <li>• Open Water</li> <li>• River Floodplains</li> <li>• Small Stream Riparian Habitats</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, Warm</li> <li>• Headwater Creek, High Gradient, Cool</li> <li>• Small River, Low Gradient, Warm</li> <li>• Small River, Moderate Gradient, Warm</li> </ul>
Elk 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>Rock Outcrops, Cliffs and Talus, and Shale Barrens</b> <ul style="list-style-type: none"> <li>• Acidic Rock Outcrops, Cliffs, and Talus</li> </ul> </li> <li>• <b>Aquatic, Floodplain, and Riparian</b> <ul style="list-style-type: none"> <li>• Open Water</li> <li>• River Floodplains</li> <li>• Small Stream Riparian Habitats</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, Warm</li> <li>• Headwater Creek, High Gradient, Cool</li> <li>• Small River, Low Gradient, Warm</li> <li>• Small River, Moderate Gradient, Warm</li> <li>• Medium River, Low Gradient, Warm</li> <li>• Medium River, High Gradient, Warm</li> </ul>

Public Land	Terrestrial Habitat	Aquatic Habitat
Stonecoal Lake 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>• Open Water</li> <li>• Small Stream Riparian Habitats</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, Warm</li> <li>• Headwater Creek, High Gradient, Cool</li> </ul>
Stonewall Jackson Lake 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>• Open Water</li> <li>• River Floodplains</li> <li>• Small Stream Riparian Habitats</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, Warm</li> <li>• Headwater Creek, High Gradient, Cool</li> <li>• Small River, Low Gradient, Warm</li> <li>• Small River, Moderate Gradient, Warm</li> </ul>
Holly River State Park	<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> <li>• Northern Hardwood Forests</li> </ul> </li> <li>• <b>Rock Outcrops, Cliffs and Talus, and Shale Barrens</b> <ul style="list-style-type: none"> <li>• Acidic Rock Outcrops, Cliffs, and Talus</li> </ul> </li> <li>• <b>Aquatic, Floodplain, and Riparian</b> <ul style="list-style-type: none"> <li>• Small Stream Riparian Habitats</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, Moderate Gradient, Cool</li> <li>• Headwater Creek, High Gradient, Cool</li> </ul>

Public Land	Terrestrial Habitat	Aquatic Habitat
Stonewall Resort State Park	<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>• Open Water</li> <li>• River Floodplains</li> <li>• Small Stream Riparian Habitats</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, Moderate Gradient, Warm</li> <li>• Headwater Creek, High Gradient, Cool</li> <li>• Small River, Low Gradient, Warm</li> <li>• Small River, Moderate, Warm</li> </ul>

## Appendix 4. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05020002000581	WVMW-54_00	AbramsRun	Fecal, Iron
05030203008262	WVLK-(L1)_00	BurnsvilleLake	Methylmerc
05020002000570	WVMW-49_00	CanoeRun	Fecal, Iron
05020002000554	WVMW-39-B_00	DryFork	Bio, Fecal, Iron
05020002000608	WVMW-50-A_00	DunkinRun	Iron
05020002000636	WVMW-38-G-7-A_00	FallRun	Bio, Fecal, Iron
05020002000629	WVMW-46-B_00	GladyFork	Fecal, Iron
05020002000197	WVMW-38-G-7_00	GladyFork	Bio, Fecal, Iron,
05020002000654	WVMW-38-E_00	GrassRun	Bio, Fecal, Iron,
05020002000656	WVMW-38-C_00	HillyUplandRun	Bio, Fecal, Iron,
05020002000618	WVMW-46-G_00	HughesFork	Bio, Iron,
05020002000552	WVMW-39-A_00	KeithFork	Iron,
05020002000614	WVMW-46-I_00	KeithFork	Iron,
05050007000420	WVKE-98-C_01	LeftFork/HollyRiver	Bio,
05020002000560	WVMW-41-C_00	LimestoneRun	Iron,
05020002000624	WVMW-46-C-6_00	LingerRun	Fecal,
05030203000397	WVLK_01	LittleKanawhaRiver	Fecal, Iron,
05030203000407	WVLK_02.2	LittleKanawhaRiver	Bio,
05020002000562	WVMW-42_00	MiddleRun	Iron,
05020002002315	WVMW-38-B_00	MudLick	Iron,
05020002000136	WVMW-41_00	MurphyCreek	Fecal, Iron,
05020002000129	WVMW-39_01	PolkCreek	Bio, Fecal, Iron,
05020002000134	WVMW-39_02	PolkCreek	Bio, Fecal, Iron,
05020002000640	WVMW-38-G-3_01	PringleFork	Fecal, Iron,
05020002000641	WVMW-38-G-3_02	PringleFork	Fecal, Iron,
050500070006042	WVKE-98-B_01_r	RightFork/HollyRiver	Bio,
05030203001788	WVLK-115_02	RightFork/LittleKanawhaRiver	Ph,
05020002003872	WVMW-38-G_01	RightFork/StonecoalCreek	Bio,
05020002000196	WVMW-38-G_03	RightFork/StonecoalCreek	Fecal, Iron,
05020002000196	WVMW-38-G_02	RightFork/StonecoalCreek	Bio, Fecal, Iron,
05020002000342	WVMW-55_00	RightFork/WestForkRiver	Bio, Fecal, Iron,
05020002000563	WVMW-43_00	RushRun	Fecal, Iron,
05030203000381	WVLK-95_00	SaltlickCreek	Iron,
05020002000604	WVMW-50-E_00	SammyRun	Fecal, Iron,
05020002000165	WVMW-50_00	SandFork	Bio, Iron,
05020002001958	WVMW-41-A_00	SandRun	Iron,
05020002000558	WVMW-39-C_00	SassafrasRun	Fecal,
05020002000171	WVMW-46_01	SkinCreek	Iron,
05020002000183	WVMW-46_02	SkinCreek	Bio, Fecal, Iron,
05020002000659	WVMW-38-A_00	SmithRun	Iron,
05020002000637	WVMW-38-G-6_00	SpruceFork	Bio, Fecal, Iron,
05020002000631	WVMW-44_00	StoneLick	Fecal,
05020002001959	WVMW-38_02	StonecoalCreek	Bio, Fecal,
05020002000184	WVMW-38_01	StonecoalCreek	Bio, Fecal, Iron,
05020002000153	WVMW-(L1)_02	StonewallJacksonLake	Methylmerc,
05020002000144	WVMW-(L1)_01	StonewallJacksonLake	Methylmerc,
050500070006062	WVKE-(L1)_00	SuttonLake	Methylmerc,

05020002000199	WVMW-38-G-7-D_00	UNT/GladyForkRM1.45	Iron,
05020002000616	WVMW-46-M_00	UNT/SkinCreekRM12.34	Iron,
05020002000658	WVMW-38-A.6_00	UNT/StonecoalCreekRM2.43	Bio, Fecal, Iron,
05020002001999	WVMW-45_00	WashburnRun	Bio, Iron,
05020002000155	WVMW_02	WestForkRiver	Fecal,
05020002000135	WVMW_01	WestForkRiver	Bio, Fecal, Iron,
05020002000617	WVMW-46-K_00	WheelerFork	Iron,
05020002000615	WVMW-46-L_00	WildcatRun	Iron,
05020002000364	WVMW-46-A_00	WolfFork	Fecal,



## Appendix 5. 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
<p>American Forest Foundation (AFF)</p> <p><a href="https://www.forestfoundation.org/">https://www.forestfoundation.org/</a></p> <p><a href="https://www.familyforestcarbon.org/">https://www.familyforestcarbon.org/</a></p>	<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>
<p>Appalachian Mountains Joint Venture (AMJV)</p> <p><a href="https://amjv.org/">https://amjv.org/</a></p>	<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>
<p>Consulting Foresters</p> <p><a href="https://wvforestry.com/forestry-consultants/">https://wvforestry.com/forestry-consultants/</a></p>	<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</p> <p><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>County Planning Commissions</p>	<ul style="list-style-type: none"> <li>• Planning to manage floodplains and guide new development</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>

Partner	Role/Assistance Provided
<p>Master Naturalists Program</p> <p><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)</p> <p><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)</p> <p><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>
<p>Ruffed Grouse Society/American Woodcock Society (RGS)</p> <p><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 impacts.</li> </ul> <p><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></p>
<p>The Conservation Fund (TCF)</p> <p><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>

Partner	Role/Assistance Provided
<p>The Nature Conservancy</p> <p><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 land conservation organizations with forest and land protection and restoration</li> <li>• Assist landowners with protection and improved management of large forest tracts through conservation easements and forest carbon projects</li> </ul>
<p>Trout Unlimited</p> <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>	<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>
<p>US Army Corps of Engineers (USACE): Great Lakes and Ohio River Division</p> <p><a href="https://www.lrd.usace.army.mil/">https://www.lrd.usace.army.mil/</a></p> <ul style="list-style-type: none"> <li>• Environmental Stewardship <a href="https://www.lrd.usace.army.mil/Missions/Environmental/">https://www.lrd.usace.army.mil/Missions/Environmental/</a></li> <li>• Flood Risk Management: <a href="https://www.lrd.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/">https://www.lrd.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/</a></li> </ul>	<ul style="list-style-type: none"> <li>• The Great Lakes and Ohio River Division civil works missions provide navigation, flood risk management, environmental, emergency response, recreation, hydropower, water supply and regulatory permits.</li> <li>• Through Environmental Stewardship, ACOE works to restore degraded ecosystem structure, function and dynamic processes to a more natural condition through large-scale ecosystem restoration projects</li> <li>• Flood risk management includes operation of dams, reservoirs and levees along the Ohio River and its tributaries</li> </ul>
<p>US Fish and Wildlife Service (USFWS)</p> <p>Partners for Fish and Wildlife Program</p> <p><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>USDA Farm Service Agency</p> <p><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 from being converted into cropland or urban development.</li> </ul>



Partner	Role/Assistance Provided
<p>USDA Natural Resources Conservation Service:</p> <p><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></p> <ul style="list-style-type: none"> <li>• Environmental Quality Incentive Program (EQIP)</li> <li>• Conservation Stewardship Program (CSP)</li> <li>• Agricultural Management and Assistance Program (AMA)</li> <li>• Agricultural Conservation Easement Program (ACEP)</li> <li>• Climate Smart Agriculture and Forestry Activities</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.</li> <li>• 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>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>

Partner	Role/Assistance Provided
<p>West Virginia University Extension Service (WVU Extension):</p> <ul style="list-style-type: none"> <li>• Forestry <a href="https://extension.wvu.edu/natural-resources/forestry">https://extension.wvu.edu/natural-resources/forestry</a></li> <li>• Wildlife <a href="https://extension.wvu.edu/natural-resources/wildlife">https://extension.wvu.edu/natural-resources/wildlife</a></li> </ul>	<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>
<p>WV Conservation Agency (WVCA) and 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>

Partner	Role/Assistance Provided
<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>• 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>• 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>
<p>WV Department of Health and Human Resources (WVDHHR)</p> <ul style="list-style-type: none"> <li>• On-Site Sewage Program <a href="https://www.wvdhhr.org/phs/sewage/index.asp">https://www.wvdhhr.org/phs/sewage/index.asp</a></li> </ul>	<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>

Partner	Role/Assistance Provided
<p>WV Division of Forestry (WVD OF)</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="https://wvdnr.gov/">https://wvdnr.gov/</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>

## Appendix 6. Resources

The following resources may provide additional information to landowners and partners seeking to manage habitat for priority SGCN in this CFA.

Long Range Plans for the Elk and West Fork Conservation Districts

Summarize natural resources conditions and resource concerns that could be addressed through NRCS technical and financial assistance. Available at:

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/eqip/?cid=nrcseprd1167606>

National Wild Turkey Foundation- Landowner's Toolbox

[https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide\\_to\\_Respcaving\\_2016.pdf-tool-box](https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Respcaving_2016.pdf-tool-box)

Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests

[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)

Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners.

[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)



West Virginia Pollinator Handbook – A Field Office Technical Guide Reference to management of pollinators and their habitats. Developed by WV NRCS Ecological Sciences in conjunction with WV Division of Natural Resources and the Xerces Society for Invertebrate Conservation.

<http://xerces.org/sites/default/files/publications/12-049.pdf>

Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors:

<https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf>

West Virginia Invasive Species Strategic Plan and Voluntary Guidelines, 2014

[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)

Fighting Invasive Plants in West Virginia

<http://www.wvnps.org/FightingInvasives.pdf>

Brochures about Aquatic Invasive Species, Forest Pests and Pathogens, and Invasive Plant Species

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/>

American Forest Foundation: Woodland owners planning tool for forest management

<https://mylandplan.org/>

The Nature Conservancy Resilient Land Mapping Tool and Documents:

<http://maps.tnc.org/resilientland/>

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

<https://www.fs.fed.us/nrs/atlas/>

Rudnick, D.A. et al. 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America.

<https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities>

Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science:

<https://adaptationworkbook.org/>

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.

<https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice>

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

<https://www.nrs.fs.fed.us/pubs/52760>

Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture.

<https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf>