

Action Plan for the Gorges Conservation Focus Area



October 11, 2021

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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 Mountains Joint Venture	SFI- Sustainable Forestry Initiative
ARRI- Appalachian Regional Restoration Initiative	S Rank- State Rank
ATFS- American Tree Farm System	SWAP- State Wildlife Action Plan
BMPs- Best Management Practices	TNC- The Nature Conservancy
B-Rank- Biodiversity Rank	TCF- The Conservation Fund
CFA- Conservation Focus Area	TU- Trout Unlimited
CCV- Cave Conservancy of the Virginias	USACE- US Army Corps of Engineers
CCVI- Climate Change Vulnerability Index	USDA- United States Department of Agriculture
CERW- Cerulean Winged Warbler	USDOI -United States Department of Interior
CREP- Conservation Reserve Enhancement Program	USFWS- United States Fish and Wildlife Service
CRP- Conservation Reserve Program	USNPS- National Park Service
CSP- Conservation Stewardship Program	WMA- Wildlife Management Area
EQIP- Environmental Quality Improvement Program	WVACS- West Virginia Association of Cave Studies
FSA- Farm Service Agency	WVCA- West Virginia Conservation Agency
FSC- Forest Stewardship Council	WVCC- West Virginia Cave Conservancy
G Rank- Global Rank	WVDA- West Virginia Department of Agriculture
GWWA- Golden-winged Warbler	WVDEP- West Virginia Department of Environmental Protection
HUC- Hydrologic Unit Code	WVDHHR- Department of Health and Human Resources
NRCS- Natural Resources Conservation Service	WVDNR- West Virginia Division of Natural Resources
NWTF- National Wild Turkey Foundation	WVDOF- West Virginia Division of Forestry
OHCF- Outdoor Heritage Conservation Fund	WVDOH- West Virginia Division of Highways
OSMRE- Office of Surface Mining Reclamation and Enforcement	WVLT- West Virginia Last Trust
	WVU- West Virginia University

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, cave interest groups and other non-profit conservation organizations working in the area to develop this Action Plan for the Gorges 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 69 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.

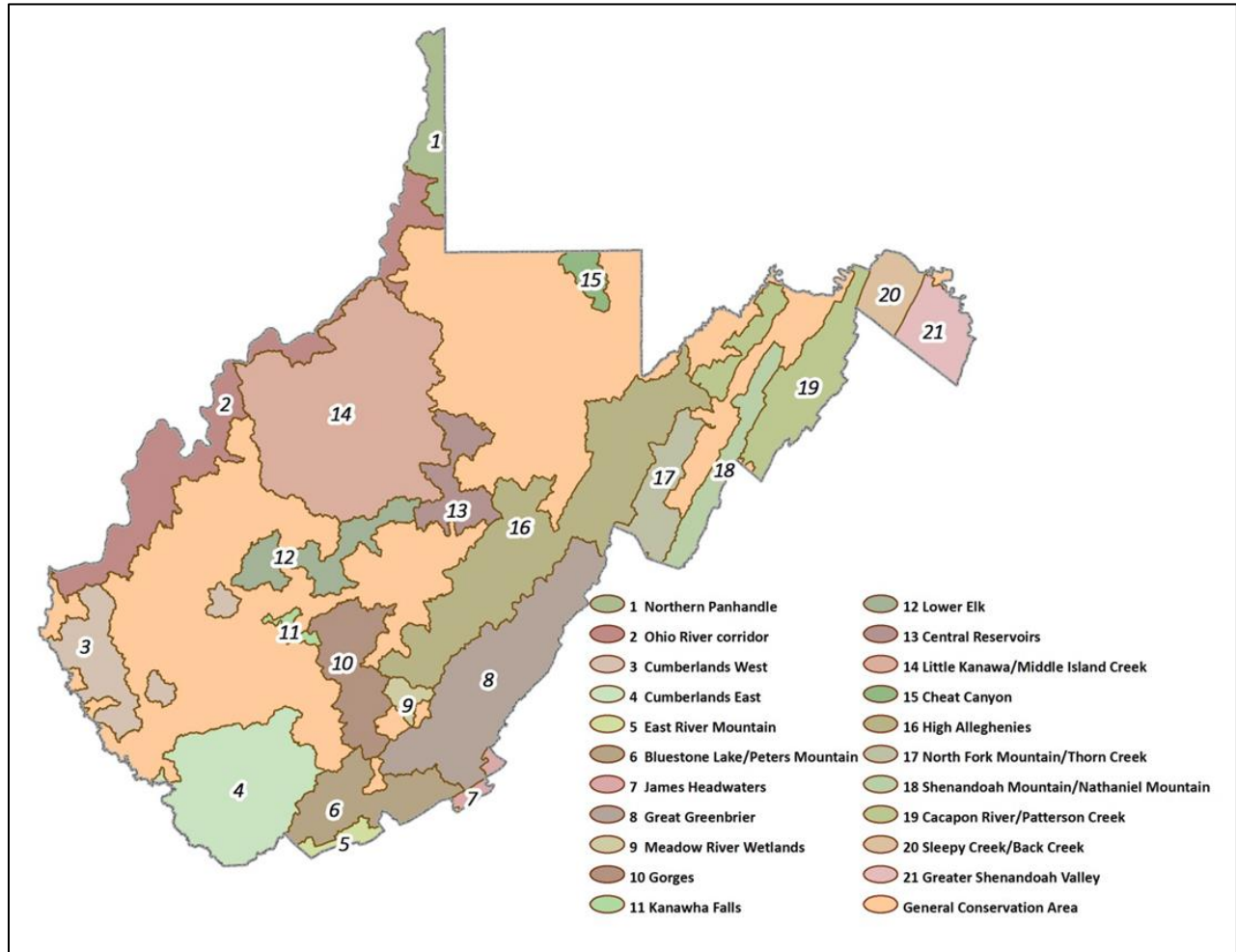
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve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

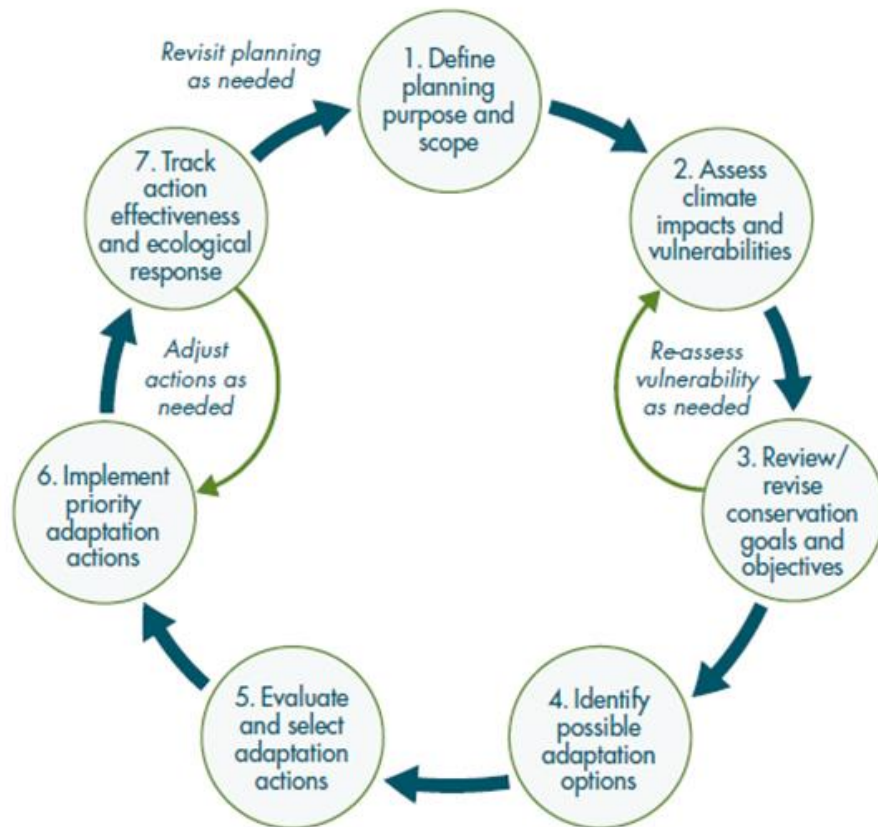
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach,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

Monitoring and Adaptive Management

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

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

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



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

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 Action 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 Action Plan is then divided by major habitat type, 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. For each major habitat type the Action Plan lists priority species, stresses effecting those species, and actions to alleviate those stresses. The Action Plan also identifies climate stresses impacting each major habitat type and lists potential actions to boost their resilience. The Action Plan provides a plan for implementation and monitoring of conservation actions for each major habitat type and a brief statement about other human benefits that may be generated by the proposed actions. The Action Plan also describes a regional network of resilient and connected landscapes spanning multiple habitat types to 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 actions for greater impact and 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 Action Plan is to provide local stakeholders with information, guidance, assistance and support to plan, 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 alleviate stresses on wildlife species in specific habitat, 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 their 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

Gorges Conservation Focus Area

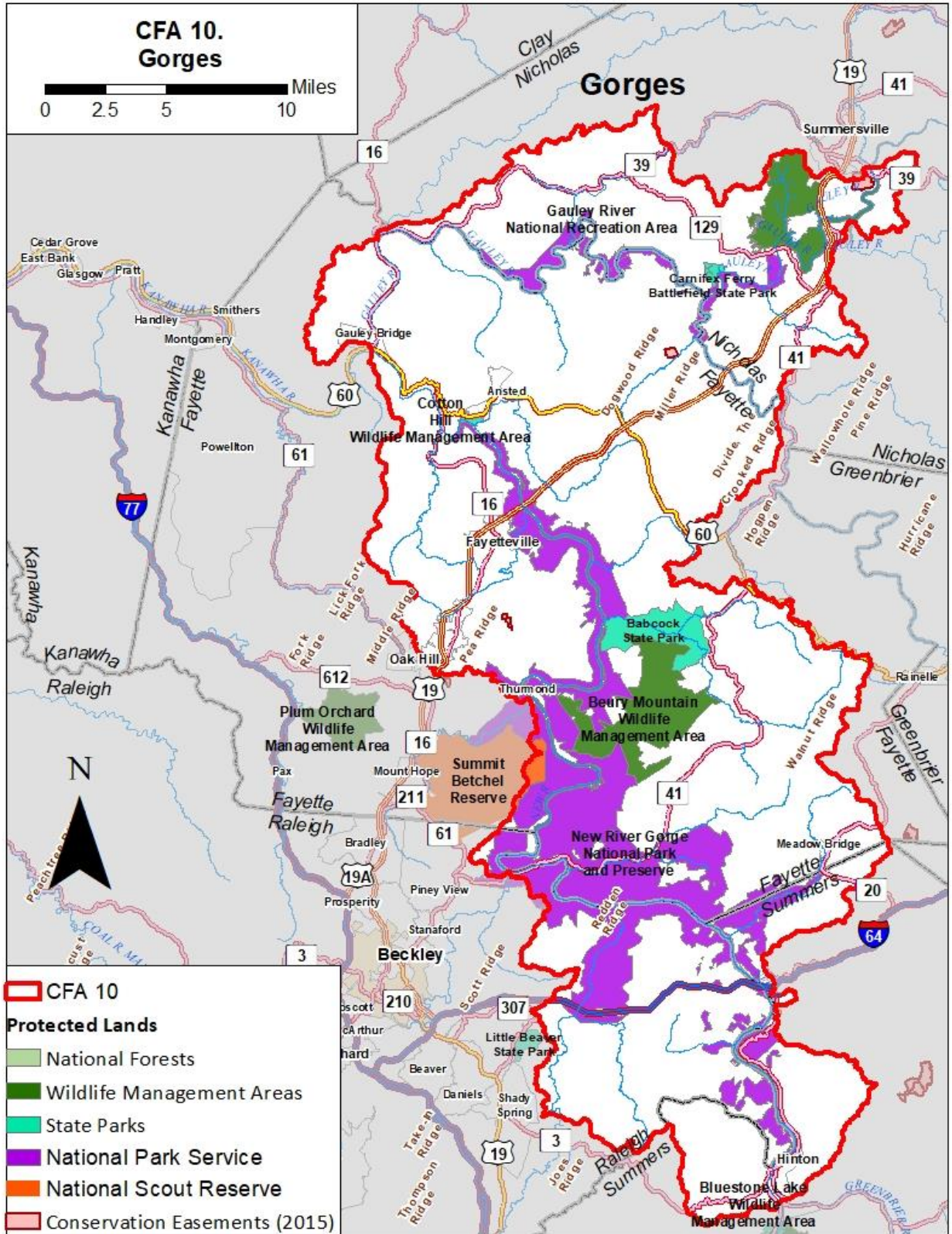
Overview

The Gorges Conservation Focus Area (CFA) is characterized by deep, forested gorges of the New, Gauley and Meadow Rivers and the surrounding mountainous uplands; the New River Gorge stretches more than 50 miles and is the largest gorge in eastern North America. The rivers are typically high gradient and have high gradient tributaries that plunge into the gorges to meet them. The steep slopes are covered by “Mixed Mesophytic” Forests – these are mixed oak and hardwood/hemlock forests.

Many areas of the gorges have talus (rock rubble) slopes, boulder fields and large sandstone cliffs. A rolling, moderate elevation sandstone plateau extends between the gorges. Some ridges rise over 3,000 feet in elevation. The uplands are largely forested and typically managed for timber production. There is a mix of small to medium, private non-industrial holdings and larger industrial timber holdings.

An extensive area along the US Route 19 Corridor is heavily developed for residential and commercial purposes including the Boy Scouts of America Bechtel/The Summit High Adventure Camp. Legacy deep mining and some surface mining occurs throughout most of the area. Residential and second home development has been episodic and mostly clustered along US Route 19 or adjacent to federal lands.

Map 2. Overview



Habitats

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

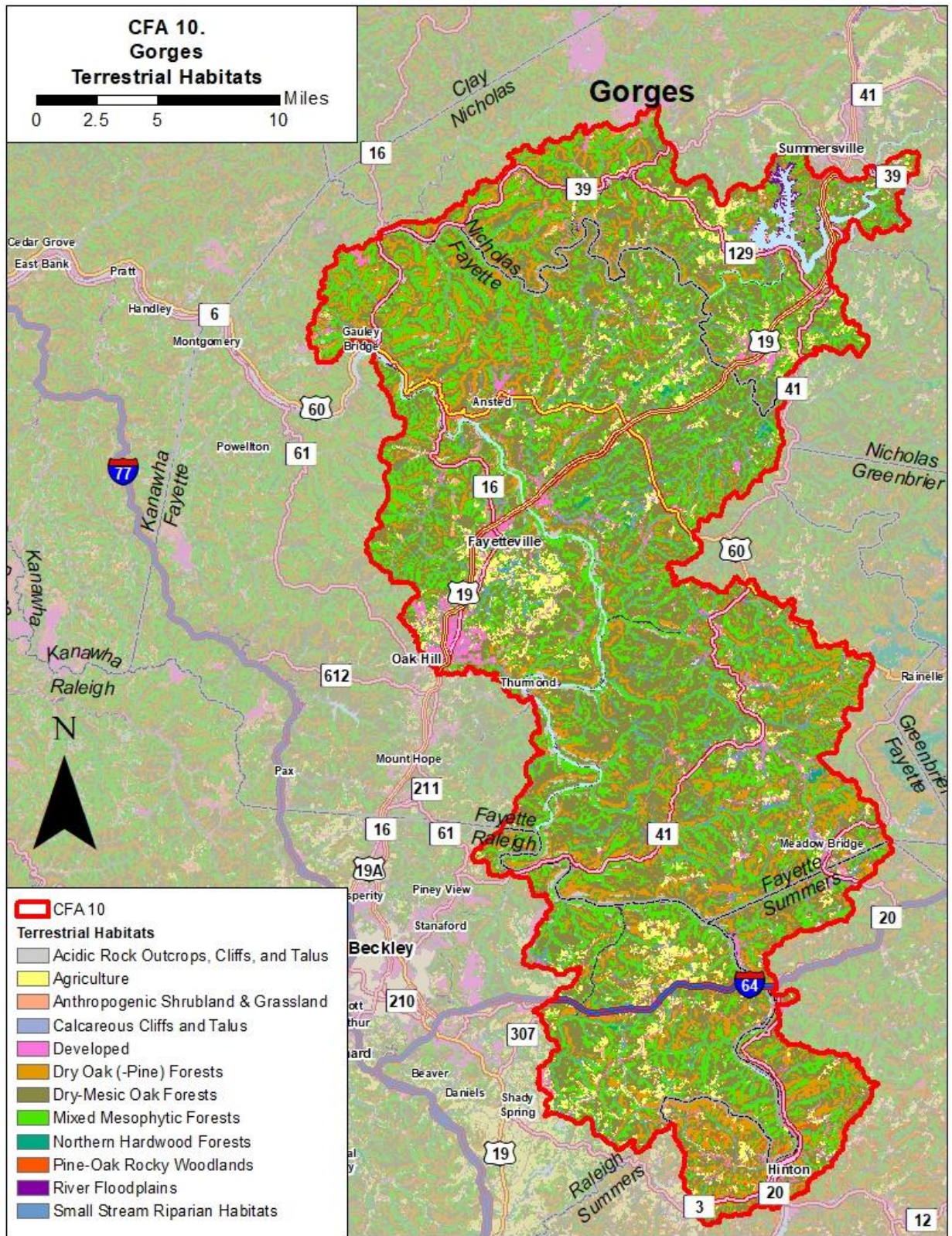
Terrestrial Habitats

Twelve of the terrestrial habitat types described in the SWAP are present in this CFA. While the most dominant habitat types within the CFA are Dry-Mesic Oak and Mixed Mesophytic Forests, they each only comprise around 3% of the state's total composition of those habitat types. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat Type	Acres In CFA	Percent of CFA Area	Percent of WV Total For Type
Acidic Rock Outcrops, Cliffs and Talus	4,393	1.10%	4.89%
Agriculture	22,569	5.66%	1.57%
Anthropogenic Shrubland & Grassland	2,750	0.69%	1.73%
Calcareous Cliffs and Talus	48	0.01%	0.53%
Developed	26,610	6.67%	2.34%
Dry Calcareous Forests, Woodlands and Glades	0	0.00%	0.00%
Dry Oak (-Pine) Forests	48,115	12.07%	1.95%
Dry-Mesic Oak Forests	157,917	39.60%	3.16%
Heath-Grass Barrens	0	0.00%	0.00%
High Allegheny Wetlands	0	0.00%	0.00%
Mixed Mesophytic Forests	105,675	26.50%	3.59%
Montane Red Oak Forests	0	0.00%	0.00%
Northern Hardwood Forests	631	0.16%	0.06%
Pine-Oak Rocky Woodlands	432	0.11%	0.57%
Red Spruce Forests	0	0.00%	0.00%
River Floodplains	2,721	0.68%	2.26%
Shale Barrens	0	0.00%	0.00%
Sinkhole and Depression Ponds	0	0.00%	0.00%
Small Stream Riparian Habitats	17,276	4.33%	3.50%
Unresolved	9,651	2.42%	8.27%
Totals	398,789	100.00%	

Map 3. Terrestrial Habitats



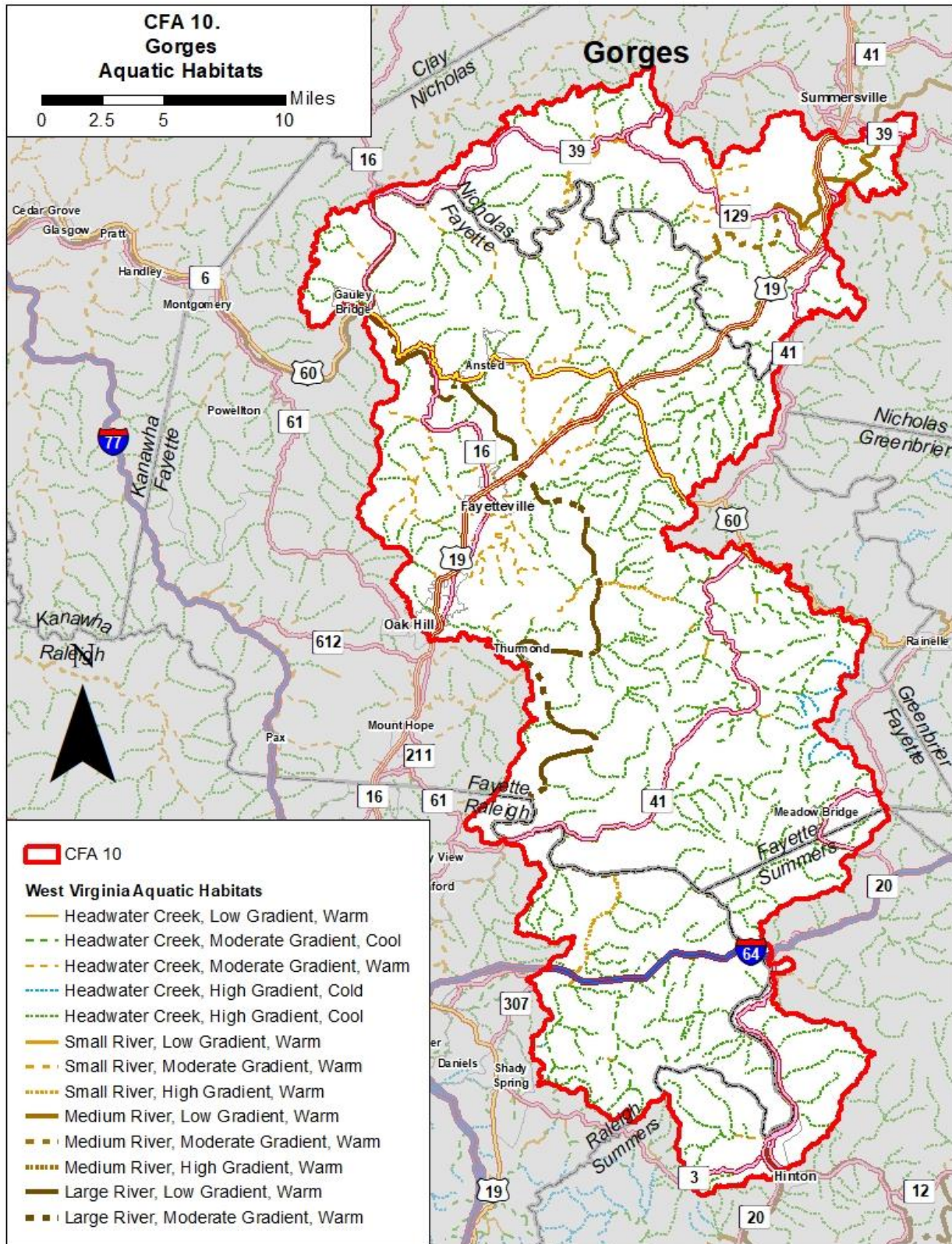
Aquatic Habitats

Thirteen of the aquatic habitat types described in the SWAP are present within the Gorges CFA. Cool, high gradient headwater creeks make up 482 miles of river flowing throughout the CFA and are the most abundant aquatic habitat type, yet only comprises 7% of the state’s total habitat of that type. Conversely, warm, high gradient medium sized rivers cover a far smaller portion of aquatic habitat, comprising just 3 miles of river in the CFA, yet make up over three quarters of that habitat type for the state. Aquatic Habitats are described in chapter 3 of the 2015 SWAP.

Table 2. Aquatic Habitat Summary

Habitat Type	Miles in CFA	Percent of CFA Miles	Percent of WV Total For Type
Headwater Creek, Low Gradient, Warm	7	0.85%	1.23%
Headwater Creek, Moderate Gradient, Cool	85	10.57%	3.89%
Headwater Creek, Moderate Gradient, Warm	88	10.87%	2.25%
Headwater Creek, High Gradient, Cold	8	0.95%	0.26%
Headwater Creek, High Gradient, Cool	482	59.71%	7.70%
Small River, Low Gradient, Warm	2	0.23%	0.41%
Small River, Moderate Gradient, Warm	7	0.86%	1.28%
Small River, High Gradient, Warm	9	1.16%	58.97%
Medium River, Low Gradient, Warm	14	1.68%	2.86%
Medium River, Moderate Gradient, Warm	8	1.01%	2.35%
Medium River, High Gradient, Warm	3	0.38%	78.27%
Large River, Low Gradient, Warm	55	6.81%	9.47%
Large River, Moderate Gradient, Warm	40	4.94%	36.37%
Totals	808	100.00%	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa in the Gorges CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	11
Birds	26
Butterflies and Moths	8
Cave Invertebrates	2
Dragonflies and Damselflies	8
Fish	7
Mammals	15
Mussels	12
Plants	126
Reptiles	12
Snails	8
Tiger Beetles	3
Total	238

The Conservation Focus Area includes some of the largest forest blocks in the West Virginia portion of the Cumberland Mountains Ecoregion. The forest of the New River Gorge is recognized as a globally significant example of the Appalachian cove hardwood/Mixed Mesophytic Forest type. The gorges and forest blocks along the New, Gauley and Meadow Rivers are home to populations of regionally endemic salamanders and forest interior nesting birds. Management and conservation are important to species such as:

- Broad-winged Hawk
- Wood Thrush
- Louisiana Waterthrush
- Worm-eating Warbler
- Cerulean Warbler
- Swainson's Warbler

Upland patch habitats and cliffs embedded in the forests (as described above) are important for many different species including:

- Allegheny Woodrat
- Virginia Big-eared Bat
- Eastern Small-footed Bat
- Indiana Bat
- Long-tailed Shrew
- Green Salamander
- Timber Rattlesnake
- Nesting Peregrine Falcon

Upland and riparian habitats also support 109 plant Species of Greatest Conservation Need. Floodplains along the New and Gauley rivers include some of the most extensive riverscour prairies

and woodlands in the eastern United States. Many rare and threatened plant species supported by this CFA include:

- Monongahela Barbara's-Buttons –globally threatened
- Virginia Spiraea – listed as threatened under the Endangered Species Act, occurs along the Gauley and Meadow Rivers

The New River in the Gorges Conservation Focus Area, along with the Kanawha Falls area just downstream, provides the last stronghold for the Purple Wartyback mussel in West Virginia.

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:

The Gauley River is historically a warm water stream. The stream is impounded by the Summersville Dam, from which water is released seasonally to accommodate recreational boating. This poses the following stresses:

- Cold water released from the dam impedes mussel reproduction in the river
- The Summersville Dam may limit delivery of substrates to downstream waters
- Dam releases may mimic floodwaters and create important scour dependent habitat, and may also remove river substrate and impact fish & other aquatic life

Other factors that affect the CFA include episodic development for second homes near/adjacent to federal lands and the resulting dramatic increase in forest fragmentation (the breaking up of large forested areas into smaller pieces).

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.

Land Protection - Develop cooperative agreements with public landowners to maintain large, intact forest blocks thus protecting many other special habitats with emphasis on those lands adjacent to and near existing public lands.

Terrestrial and Riparian Habitat Restoration - Implement a comprehensive plan to enhance climate change resiliency through reducing other stressors (such as invasive species), identifying, maintaining and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity.

Riparian Restoration - Assess opportunities for improving mussel, fish and riparian plant populations in the Gauley River gorge.

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 Division of Forestry
- WV Department of Environmental Protection
- U.S. Army Corps of Engineers
- National Park Service
- Boy Scouts of America
- The Nature Conservancy
- New River Conservancy
- Natural Resources Conservation Service
- Appalachian Mountains Joint Venture

With an established “constituency”, many conservation partners can provide direct outreach to landowners and key stakeholders interested in wildlife conservation. Some also play a direct role in managing habitat for SGCN. The WVDNR will engage with these and other partners in regular face-to-face meetings and planning workshops during CFA planning, planning and implementation of conservation actions and monitoring effectiveness. 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:

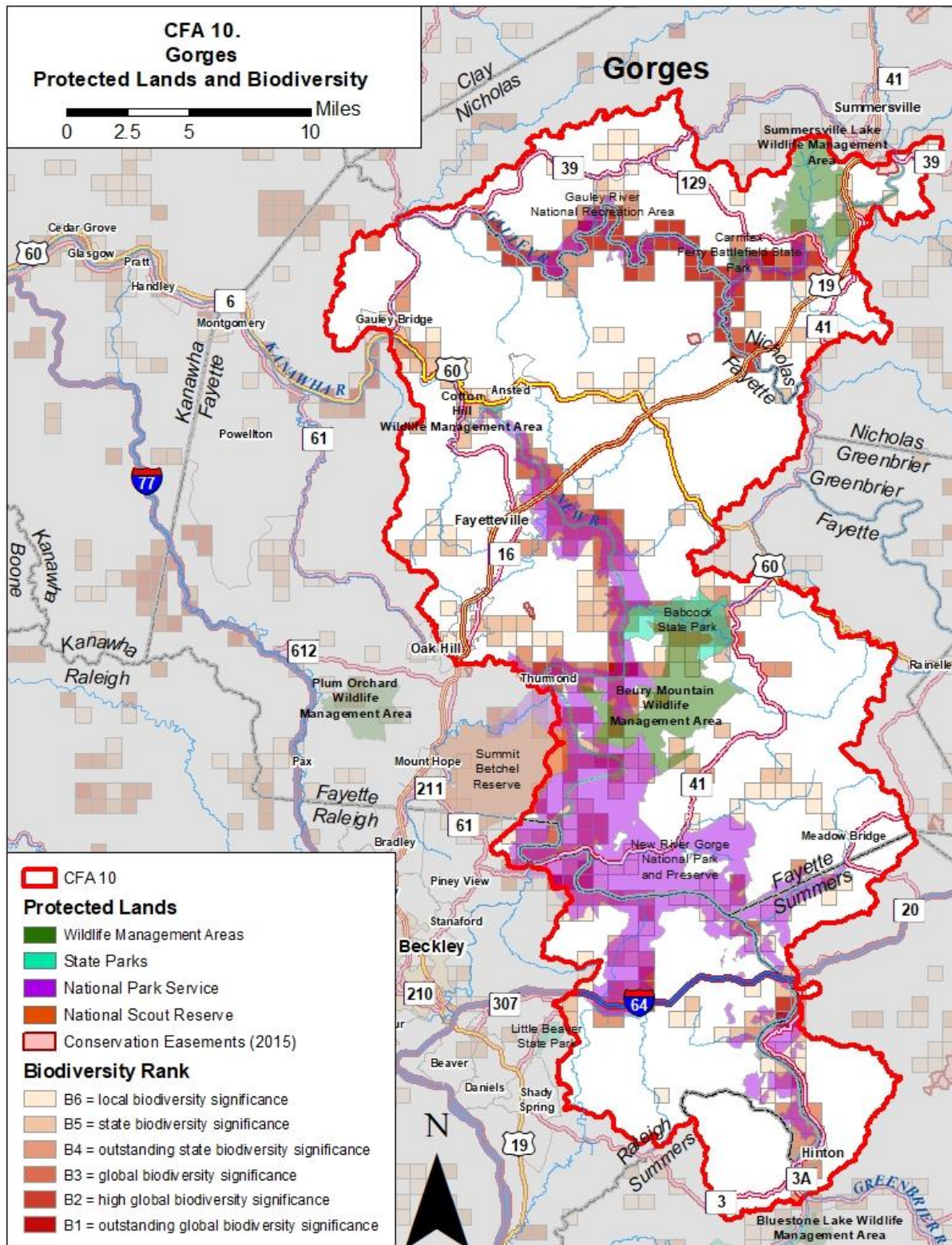
- New River Gorge National Park and Preserve
- Gauley River National Recreation Area
- Beury Mountain WMA
- Hawks Nest State Park
- Carnifex Ferry State Park
- Babcock State Park
- Summersville Lake WMA

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.

The West Virginia Land Trust (WVLT) holds a conservation easement on the Summit Bechtel National Scout Reserve, providing additional opportunities to protect important habitats and priority species. In addition, the Fayette and Nicholas County Farmland Protection Board and several other entities hold conservation easements that may protect important wildlife habitat and provide additional wildlife conservation opportunities.

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 1- square kilometer 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 conservation easements in the CFA, 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
Amphibians	<i>Aneides aeneus</i>	Green Salamander	S3	G3G4
Amphibians	<i>Desmognathus quadramaculatus</i>	Black-bellied Salamander	S3	G5
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander	S3	G5
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander	S3	G4
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
Birds	<i>Falco peregrinus</i>	Peregrine Falcon	S2B,S2N	G4
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>Limnothlypis swainsonii</i>	Swainson's Warbler	S3B	G4
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>Vermivora chrysoptera</i>	Golden-winged Warbler	S1B	G4
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5
Butterflies & Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper	S1	G4G5
Butterflies & Moths	<i>Erora laeta</i>	Early Hairstreak	S2	GU
Butterflies & Moths	<i>Pieris virginiensis</i>	West Virginia White	S3	G2
Butterflies & Moths	<i>Speyeria diana</i>	Diana Fritillary	S2S3	G3G4
Dragonflies & Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail	S3	G4
Fish	<i>Anguilla rostrata</i>	American Eel	S2	G4
Fish	<i>Cottus kanawhae</i>	Kanawha Sculpin	S2	G4
Fish	<i>Etheostoma osburni</i>	Candy Darter	S1	G3
Fish	<i>Notropis scabriceps</i>	New River Shiner	S2	G4
Mammals	<i>Corynorhinus townsendii virginianus</i>	Virginia Big-eared Bat	S2	G4T2
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat	S1	G3
Mammals	<i>Myotis lucifugus</i>	Little Brown Bat	S2	G3

Taxa	Scientific Name	Common Name	S Rank	G Rank
Mammals	<i>Myotis septentrionalis</i>	Northern Long-eared Bat	S2	G2G3
Mammals	<i>Myotis sodalis</i>	Indiana Bat	S1	G2
Mammal	<i>Neotoma magister</i>	Allegheny Woodrat	S3	G3G4
Mammals	<i>Ochrotomys nuttalli</i>	Golden Mouse	S2	G5
Mammals	<i>Perimyotis subflavus</i>	Tricolored Bat	S2	G3
Mammals	<i>Sorex hoyi winnemana</i>	Southern Pygmy Shrew	S2S3	G5T4
Mussels	<i>Lasmigona subviridis</i>	Green Floater	S2	G3
Plants	<i>Aristida purpurascens</i> var. <i>purpurascens</i>	Arrowfeather Three-awn	S1	G5T5
Plants	<i>Baptisia australis</i> var. <i>australis</i>	False Blue Indigo	S3	G5T3T4
Plants	<i>Cardamine flagellifera</i> var. <i>flagellifera</i>	Bittercress	S2	G3
Plants	<i>Carex careyana</i>	Carey's Sedge	S1	G4G5
Plants	<i>Carex cephaloidea</i>	Thinleaf Sedge	S1	G5
Plants	<i>Danthonia sericea</i>	Silky Oatgrass	S1?	G5?
Plants	<i>Dichanthelium acuminatum</i> ssp. <i>columbianum</i>	District Of Columbia Panicgrass	S1	G5T5
Plants	<i>Eleocharis compressa</i>	Flat-stem Spikerush	S2	G4
Plants	<i>Fimbristylis annua</i>	Annual Fimbry	S1	G5
Plants	<i>Gentiana austromontana</i>	Appalachian Gentian	S1	G3
Plants	<i>Gymnopogon ambiguus</i>	Bearded Skeleton Grass	S1	G4
Plants	<i>Helianthemum propinquum</i>	Low Frostweed	S1	G4
Plants	<i>Hypericum virgatum</i>	Sharpleaf St. John's-wort	S1	G4?
Plants	<i>Marshallia grandiflora</i>	Monongahela Barbara's-buttons	S2	G2
Plants	<i>Muhlenbergia capillaris</i> var. <i>capillaris</i>	Hair-awn Muhly	S1	G5T5?
Plants	<i>Prunus pumila</i> var. <i>depressa</i>	Sand Cherry	S1	G5T5
Plants	<i>Pycnanthemum beadleii</i>	Beadle's Mountainmint	S1	G2G4
Plants	<i>Pycnanthemum loomisii</i>	Loomis' Mountain-mint	S2	G4?
Plants	<i>Pycnanthemum torrei</i>	Torrey's Mountain-mint	S1	G2
Plants	<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland Meadowbeauty	S1	G5T5
Plants	<i>Saxifraga careyana</i>	Golden-eye Saxifrage	S3	G3
Plants	<i>Silphium perfoliatum</i> var. <i>connatum</i>	Cup-plant	S1	G5T3?
Plants	<i>Spiraea virginiana</i>	Virginia Spiraea	S1	G2
Plants	<i>Sporobolus clandestinus</i>	Secret Dropseed	S1	G5
Plants	<i>Vitis rupestris</i>	Sand Grape	S2	G3
Plants	<i>Woodwardia areolata</i>	Netted Chainfern	S2	G5
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4
Tiger Beetles	<i>Cicindela purpurea</i>	A Tiger Beetle	S3	G5

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

Forest and Woodland Habitats

Dry Mesic Oak Forests are the most abundant forest habitat type, covering almost 40% of the CFA, followed by Mixed Mesophytic Forests covering roughly 25% of the CFA. Dry oak (Pine), Northern Hardwood, and Pine-Oak Rocky Forests are also present within the CFA but comprise significantly smaller portions of area at 12.07%, 0.16%, and 0.11% respectively. Many of the dry forest types are threatened by development on private lands, invasive species, mesophication (gradual moistening), and lack of fire, while over browsing by deer reduces regeneration of oak and other palatable understory species.

Maps 6 and 7 display forest habitat types and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity within the CFA. The diversity of forest types across elevational gradients provides great opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches provide core habitat for 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. The largest expanses of intact forest patches within the CFA can be found primarily along the New River and Gauley River.

Priority Species

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

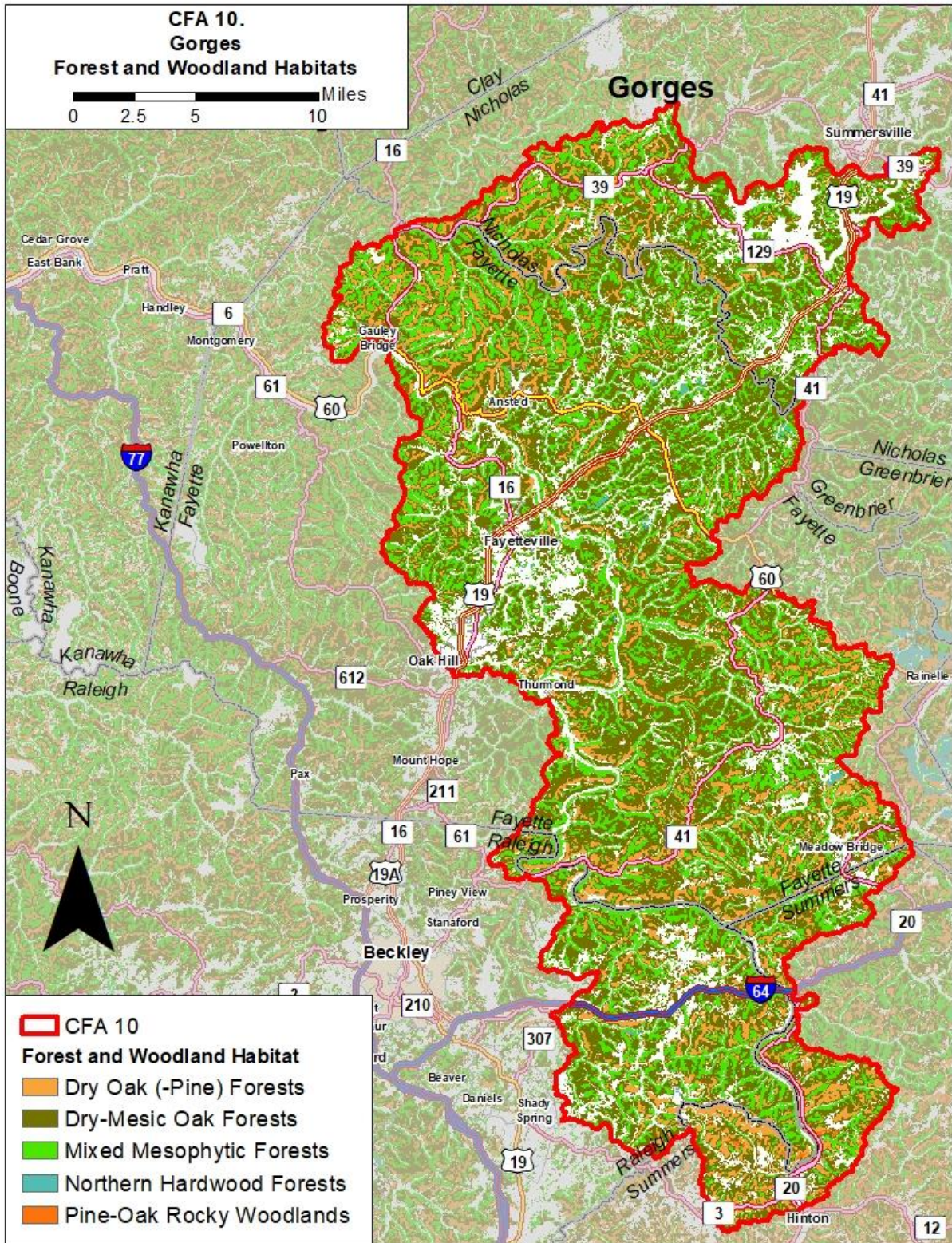
Table 5. Priority Species in Forest and Woodland Habitats.

Taxa	Scientific Name	Common Name
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander
Amphibians	<i>Aneides aeneus</i>	Green Salamander
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>Limnithlypis swainsonii</i>	Swainson's Warbler
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler
Birds	<i>Setophaga discolor</i>	Prairie Warbler

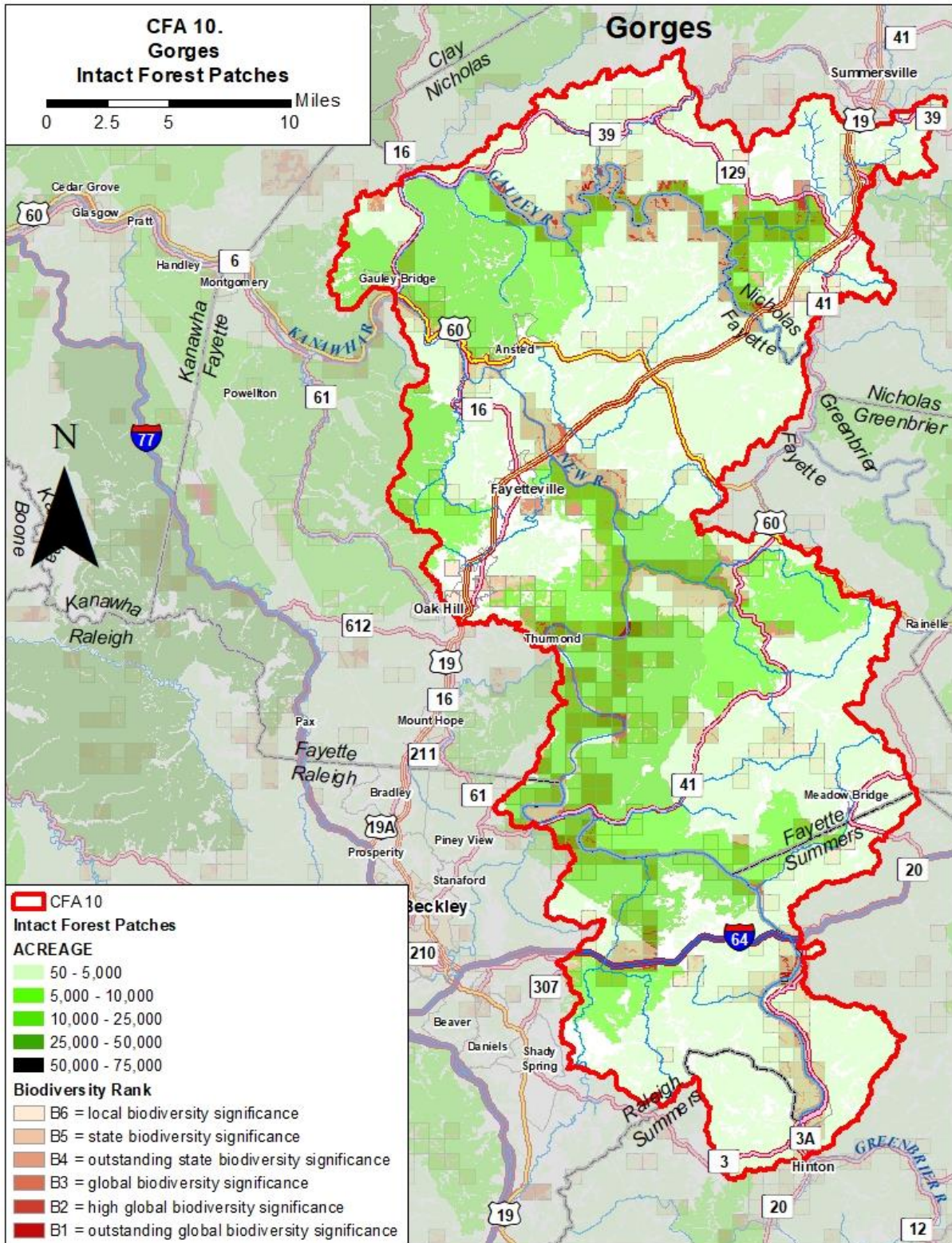
Taxa	Scientific Name	Common Name
Birds	<i>Vermivora chrysoptera</i>	Golden-winged Warbler
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler
Butterflies and Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper
Butterflies and Moths	<i>Erora laeta</i>	Early Hairstreak
Butterflies and Moths	<i>Pieris virginiensis</i>	West Virginia White
Butterflies and Moths	<i>Speyeria diana</i>	Diana Fritillary
Mammals	<i>Corynorhinus townsendii virginianus</i>	Virginia Big-eared Bat
Mammals	<i>Myotis septentrionalis</i>	Northern Long-eared Bat
Mammals	<i>Myotis sodalis</i>	Indiana Bat
Mammal	<i>Neotoma magister</i>	Allegheny Woodrat
Mammals	<i>Sorex hoyi winnemana</i>	Southern Pygmy Shrew
Plants	<i>Carex careyana</i>	Carey's Sedge
Plants	<i>Carex cephaloidea</i>	Thinleaf Sedge
Plants	<i>Danthonia sericea</i>	Silky Oatgrass
Plants	<i>Dichanthelium acuminatum</i> ssp. <i>columbianum</i>	District of Columbia Panicgrass
Plants	<i>Gentiana austromontana</i>	Appalachian Gentian
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake
Tiger Beetles	<i>Cicindela purpurea</i>	A Tiger Beetle

Large, intact forest blocks support many forest interior breeding birds, including Broad-winged Hawk, Wood Thrush, Cerulean Warbler and Worm-eating Warbler. Early successional forest habitats support Prairie Warbler and Golden-winged Warbler. The New River Gorge forms part of the core breeding range for Cerulean Warbler, but several of these species are in decline due to forest fragmentation (Mahan and Young, 2018). 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.

Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



Rare Plant Communities

The following rare plant communities are found in Forest and Woodland habitats in this CFA. Relative abundance means the percent of statewide occurrences of the community in this CFA. Note that all of the state’s Virginia Pine – Eastern Red-cedar Bedrock Terrace Woodland, Black Willow Slackwater Woodland, and Cliff Top Virginia Pine Forest are located here. These communities are vulnerable to disturbance by logging and grazing activities and the spread of nonnative invasive species. While some communities may be sensitive to disturbance, others require natural disturbance such as floods or fire to maintain habitat. Control of nonnative invasive plants should be considered especially where there are infestations due to lack of natural disturbance.

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

Common Name	Relative Abundance	G Rank	S Rank
Cliff Top Virginia Pine Forest	100%	G3	S2
Chestnut Oak (- Hemlock) / Catawba Rosebay Forest	93%	G4	S2
Yellow Birch – (Hemlock, Tuliptree) Cold Cove Forest, Upside Down Northern Hardwoods Forest	81%	G3	S2
Red Maple – White Oak Forest Seep	75%	G2	S2
Western Plateaus Pitch Pine Woodland	75%	G4Q	S1
Western Plateaus Hemlock – Hardwood Forest	44%	G3?	S3
Chinquapin Oak – Bitternut Hickory Limestone Forest	15%	G3G4	S3

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Habitat Stresses and Conservation Actions

Table 7 lists 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

Habitat Stress	Conservation Action
Forest fragmentation from development, fossil fuel extraction, transportation corridors and trails	Maintain and protect contiguous forest cover and interior forest habitat, and restore forest on disturbed lands

Habitat Stress	Conservation Action
Timber harvesting and disturbance of rare habitats and hydrological features, increased runoff, altered light regime and introduction of invasive plants	Follow or exceed forestry BMPs and protect forest cover and hydrology, especially around seeps, streams, bogs, cliffs, talus, rocky substrates and other rare habitat features
Development, deforestation, poor habitat quality & water quality degradation around caves	Promote and protect contiguous, diverse forest habitat and natural hydrology around caves; follow forestry BMPs for bats developed by White-Nose Syndrome Response team
Forest pests and pathogens including Hemlock Woolly Adelgid, Emerald Ash Borer	Monitoring and treatment of target tree species in select priority areas
Invasive weeds: forest fragmentation, climate change	Maintain forest cover and control invasive weeds, especially garlic mustard for lepidoptera, and around rare habitat features
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management to promote early successional habitat and structural complexity, including gaps and edges
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity
Decline of xeric plant communities including oak and rimrock pine in New River Gorge	Maintain fire and disturbance regimes in priority sites
Lack of habitat diversity	Manage forests at landscape scale for mosaic of age classes, structural and spatial complexity; create suitable forest habitats through BMPs
Deer browse impacting forest regeneration, species composition and 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 dens
Loss of nectar resources for Lepidoptera and loss of pollinator services	Create, maintain and protect pollinator habitat

Habitat Stress	Conservation Action
Incompatible utility corridor management	Improve vegetation management practices and their timing in utility corridors; reduce broadcast herbicide applications
Uncontrolled ORV use, soil compaction, erosion, sedimentation	Careful management of ORV trails and use

Maintaining a diverse population of forest birds requires dynamic forest landscapes with mosaics of age classes, structural and spatial complexity. Efforts to manage and restore both early successional and interior forest habitat are needed for priority SGCN. In the Gorges CFA, early successional forest habitat restoration may be most appropriate in small patches of forest and along forest edges, on disturbed areas and lands under active timber management.

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 storms, pests and pathogens, and increased extent and abundance of invasive plants. Habitat for northern species is likely to decline, although some 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. 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, altered precipitation patterns 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, altered patterns of temperature and precipitation 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, altered precipitation patterns 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. Altered temperature and precipitation regimes, including drought or warmer and wetter winters, 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 of northern hardwood forests may be particularly impacted by climate change. Increased heat and moisture stress in summer and fall may interact with acid deposition as well as increases in insect pests and pathogens, storm disturbance and wildfires to stress these forests, reducing species diversity and coverage. Cool, moist sites within areas of complex topography may provide some refuge and buffer the effects of climate change.

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

Table 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 Forest and Woodland Habitats

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

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

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

Action	Partners	Effectiveness Measures
Forest Habitat, Reserve and Corridor Protection: <ul style="list-style-type: none"> • Incentive Programs • Forest Carbon projects 	<ul style="list-style-type: none"> • Consulting Foresters • AFF, TNC • USDA NRCS 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Manage forests at landscape scale for, structural and spatial complexity appropriate for the forest type	<ul style="list-style-type: none"> • AMJV • Consulting Foresters • Forest Certification Programs: ATFS, FSC, SFI • NWTF and RGS • Public Land Managers • Summit Bechtel Reserve • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Create or maintain early successional habitat to benefit targeted wildlife species through forest management on appropriate sites	<ul style="list-style-type: none"> • Consulting Foresters • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Forest management to prevent woody encroachment or avoid disturbance of rare plants and habitats	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species

Action	Partners	Effectiveness Measures
Restore native forest vegetation on mined and degraded lands through planting, silviculture and Forest Reclamation Approach	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • Summit Bechtel Reserve • USDA NRCS • USDOJ OSRME • WVU Extension • WVDOF • WVDEP DMR 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Maintain fire and disturbance regimes in oak and rimrock pine communities	<ul style="list-style-type: none"> • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat maintained for priority species • Before and after comparison: abundance, diversity and distribution of priority species
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"> • Public Land Managers • WVDA 	<ul style="list-style-type: none"> • Acres of habitat maintained for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Monitor and control invasive weeds, promptly revegetate disturbed sites	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS WVCA and Conservation Districts • WVDOF 	<ul style="list-style-type: none"> • Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Manage deer populations where abundant	<ul style="list-style-type: none"> • Private landowners • Public Land Managers • WVDNR 	<ul style="list-style-type: none"> • Change in deer population or forest structure • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
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"> • Public Land Managers • Landowners, partners and utility companies 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Provide guidance on timber rattlesnake den avoidance	<ul style="list-style-type: none"> • Public Land Managers • WVDNR • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Careful management of ORV trails and use	<ul style="list-style-type: none"> • Public Land Managers • Private Landowners 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species
Create, maintain and protect pollinator habitat in appropriate locations	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS • USFWS • WVCA and Conservation Districts • WVDOP • WVDNR • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species

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.

Rock Outcrops, Cliffs and Talus Habitats

Acidic rock outcrops, cliffs and talus occur within the CFA primarily along the New and Gauley Rivers and their tributaries. Small clumps of calcareous cliffs and talus can also be found in the southern section of the CFA along the southern stretches of the New River. These habitats are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Map 8 illustrates the location of these rare habitat types, many of which are correlated with biodiversity occurrences.

Priority Species

Table 10 lists priority species in the CFA associated with Rock Outcrops, Cliff and Talus Habitats. In addition, there is a robust, nationally significant population of Allegheny woodrat in the New River Gorge that appears to be declining (Mahan and Young, 2018).

Table 10. Priority Species in Rock Outcrops, Cliffs and Talus Habitats

Taxa	Scientific Name	Common Name
Amphibians	<i>Aneides aeneus</i>	Green Salamander
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander
Birds	<i>Falco peregrinus</i>	Peregrine Falcon
Mammal	<i>Neotoma magister</i>	Allegheny Woodrat
Plants	<i>Danthonia sericea</i>	Silky Oatgrass
Plants	<i>Dichanthelium acuminatum</i> ssp. <i>columbianum</i>	District of Columbia Panicgrass
Plants	<i>Saxifraga careyana</i>	Golden-eye Saxifrage
Reptile	<i>Crotalus horridus</i>	Timber Rattlesnake

Protected rocky outcrops, cliffs and talus support many unique species, including the Cave Salamander, Peregrine Falcon and Golden-eye Saxifrage. While the majority of rocky habitat species have evolved adaptations to disturbance events; climate change and the increasing occurrence of disturbances could lead to further endangerment of rare species.

Rare Plant Communities

These habitats are home to several rare plant communities.

Table 11. Rare Plant Communities in Rock Outcrops, Cliffs and Talus Habitats

Common Name	Relative Abundance	G Rank	S Rank
Western Plateaus Dry Sandstone Cliff	36%	G4Q	S2
Common Rocktripe Acidic Rock Outcrop	22%	G4?	S3

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

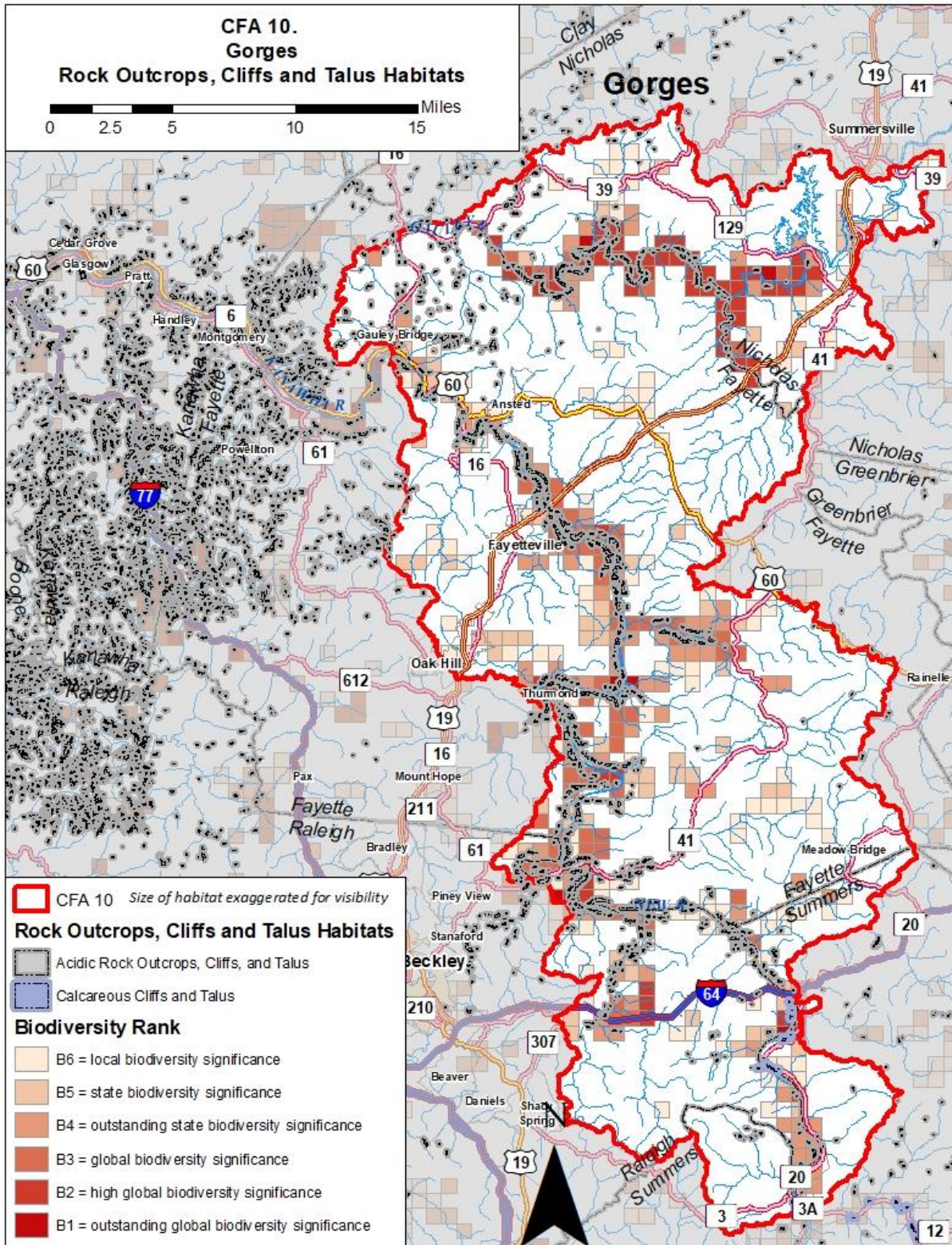
Habitat Stresses and Conservation Actions

The following stresses to these sensitive habitats may be addressed through the actions below.

Table 12. Habitat Stresses and Conservation Actions in Rock Outcrops, Cliffs and Talus Habitats

Habitat Stress	Conservation Action
Deforestation and fragmentation of forest habitats between and around rocky habitat (Allegheny Woodrat)	Maintain forest habitat between and around rock outcrops, cliffs and talus slopes
Rock climbing and recreation (trampling of non-vascular and rare plants)	Manage recreational use to protect cliff habitat from recreational impacts
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 dens

Map 8. Rock Outcrop, Cliff & Talus Habitats



Climate Change and Habitat Resilience

As described in The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et al., 2015), ecosystems that are limited by geological features 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, storms and 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 13. Climate Stresses and Resilience Actions in Rock Outcrop, Cliff and Talus Habitats

Climate Stresses	Habitat Resilience Actions
<ul style="list-style-type: none"> Increased risk of drought and wildfire Increased frequency and severity of storms Increased competition from nonnative invasive species, pests and pathogens 	<ul style="list-style-type: none"> Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species Protect rare habitats and refugia for rare plant communities Maintain intact, resilient forest habitat in surrounding areas

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 rock outcrops, cliffs and talus.

Table 14. Implementation Plan for Rock Outcrop, Cliffs and Talus Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <ul style="list-style-type: none"> Conservation Easements Land Acquisition Natural Area Designation 	<ul style="list-style-type: none"> County Farmland Protection Boards New River Conservancy OHCF, TCF, TNC, WVLT Public Land Managers WVDNR WVDOF Forest Legacy 	<ul style="list-style-type: none"> Acres of habitat protected for priority species Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <ul style="list-style-type: none"> Land use planning 	<ul style="list-style-type: none"> County Planning Commissions 	<ul style="list-style-type: none"> Acres of habitat protected through land use planning for development around cliffs, steep slopes and fragile soils
Habitat Protection <ul style="list-style-type: none"> Incentive Programs 	<ul style="list-style-type: none"> USDA FSA 	<ul style="list-style-type: none"> Acres of habitat protected for priority species Abundance and diversity of priority species and habitats
Maintain and protect forest habitat around rock outcrops, cliffs and talus slopes	<ul style="list-style-type: none"> Consulting Foresters Public Land Managers USDA NRCS WVU Extension WVDOF 	<ul style="list-style-type: none"> Acres of habitat protected for priority species Abundance and diversity of priority species and habitats
Re-vegetate sites after disturbance, prevent the introduction and establishment of invasive plant species and remove existing invasive species	<ul style="list-style-type: none"> Public Land Managers USDA NRCS WVCA and Conservation Districts WVDOF 	<ul style="list-style-type: none"> Acres of habitat restored for priority species Before and after comparison: abundance, diversity and distribution of priority species
Manage recreation on sensitive cliff sites and provide education and outreach to climbing community	<ul style="list-style-type: none"> New River Alliance of Climbers Public Land Managers 	<ul style="list-style-type: none"> Acres of habitat restored for priority species Before and after comparison: abundance, diversity and distribution of priority species
Provide guidance on timber rattlesnake den avoidance	<ul style="list-style-type: none"> WVU Extension 	<ul style="list-style-type: none"> Provide guidance on timber rattlesnake den avoidance

Human Benefits

Actions to restore rock outcrop, cliffs and talus may provide human health and economic benefits for local residents and communities, including hunting, wildlife viewing, tourism and recreational opportunities.

Subterranean Habitats

Karst and Cave Habitats

Areas with karst geology and subterranean caves provide unique habitats that may be influenced by human activities, surface land use, and surface and underground hydrology in the surrounding landscape. Caves provide important habitat for bats that move in and out, as well as a diverse group of vertebrate and invertebrate animals that have evolved specialized adaptations to permanent underground living. Common traits exhibited by permanent cave dwellers (troglodites) include blindness (or complete loss of eyes) and reduced pigmentation. Map 9 illustrates one biologically significant cave that hosts rare bat or endemic cave species, or exceptional biological diversity, with a 3-mile buffers random offset buffer that overlaps the western edge of the CFA. It also illustrates karst feature density, including several karst features with 3-kilometer random offset buffers. This data was provided by the West Virginia Speleological Survey, with offset buffers developed by WVDNR. Buffers around karst features and biologically significant caves are found primarily in the southern stretches of the CFA with a small clumping of karst features in the northern corner. These areas require careful management to minimize disturbance on priority species.

Abandoned Mine Portals

Abandoned mine portals are more numerous in this CFA than cave and karst features and provide important subterranean habitat for bats and other priority species. The National Park Service has surveyed 50 open mine portals out of 178 that have been identified since 2009, and gated most of those surveyed. Map 10 shows numerous, overlapping 5-km buffers around known mine portals, offset randomly. Protecting and carefully managing biologically significant mine portals would also benefit these species. Many of the stresses and actions targeting cave and karst habitats also apply to abandoned mine portals. They are also vulnerable to erosion, collapse and flooding.

Priority Species

Subterranean habitats in this CFA host the following priority species, all of which are rare and dependent on specific cave habitats for their survival. Ten species of bats are known to occur in the New River Gorge and the seven species that hibernate in caves and mine portals are threatened by white-nose syndrome, a fatal fungal disease. Recent data shows significant declines in abundance of little brown bat, Northern long-eared bat, Eastern small-footed bat and tri-colored bat (Mahan and Young, 2018).

Table 15. Priority Species in Subterranean Habitats

Taxa	Scientific Name	Common Name
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander
Mammals	<i>Corynorhinus townsendii virginianus</i>	Virginia Big-eared Bat
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat
Mammals	<i>Myotis lucifugus</i>	Little Brown Bat

Mammals	Myotis septentrionalis	Northern Long-eared Bat
Mammals	Myotis sodalis	Indiana Bat
Mammals	Perimyotis subflavus	Tricolored Bat

Habitat Stresses and Conservation Actions

Caves and subterranean habitats, particularly in porous karst geology, are closely tied to and impacted by changes to water quality and land use in adjacent areas. The following table lists stresses affecting wildlife in caves and subterranean habitats, and conservation actions landowners and partners can take to address them.

Table 16. Habitat Stresses and Conservation Actions in Subterranean Habitats

Habitat Stress	Conservation Action
Deforestation, stormwater runoff, water quality degradation around caves	Reduce non-point source pollution, restore and maintain forested buffers around caves and riparian corridors. Follow forestry BMPs developed by White-Nose Syndrome Response Team
Cave disturbance, passage alteration, excessive visitation	Use signage and fencing to limit recreational access to caves and mine portals with known hibernacula.

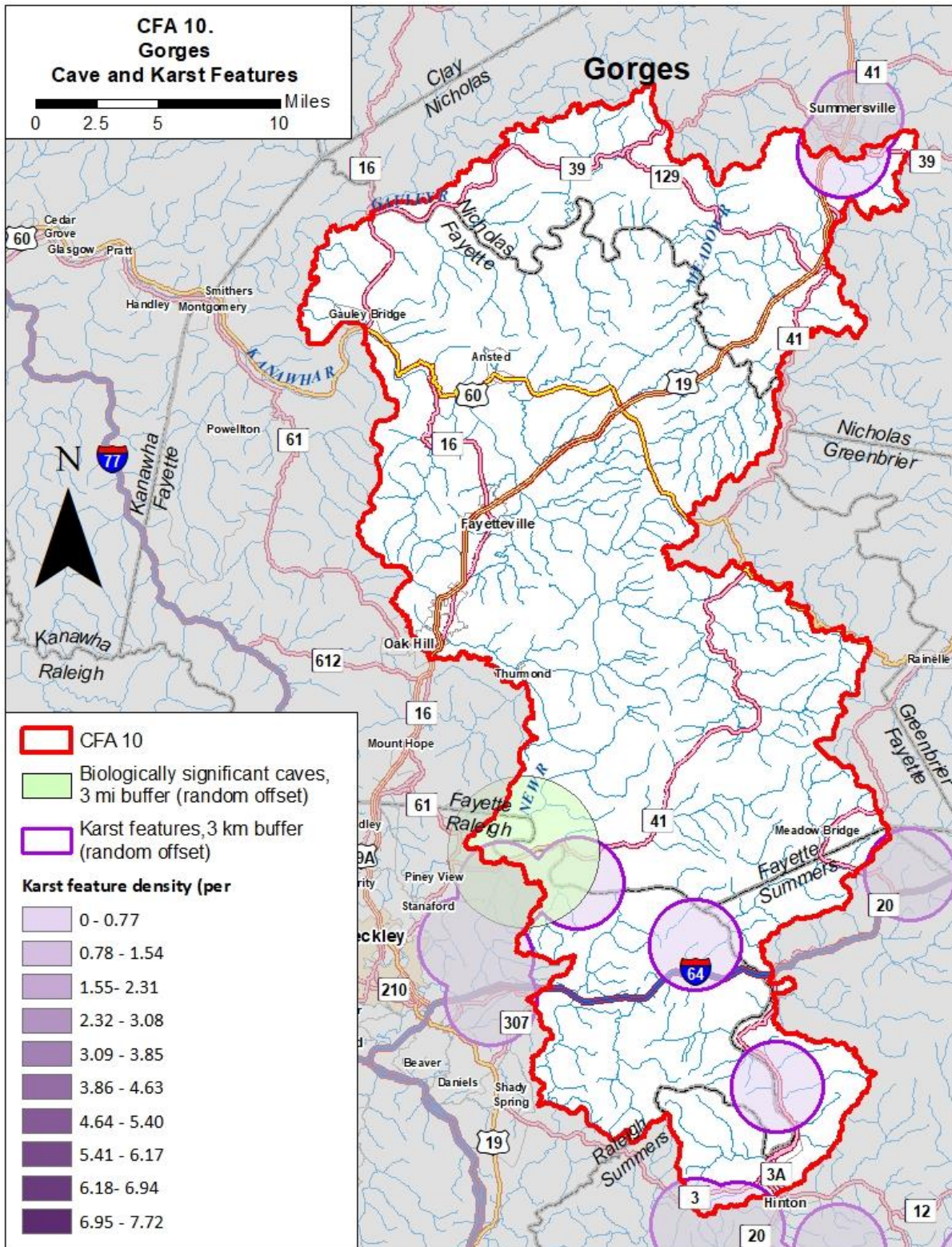
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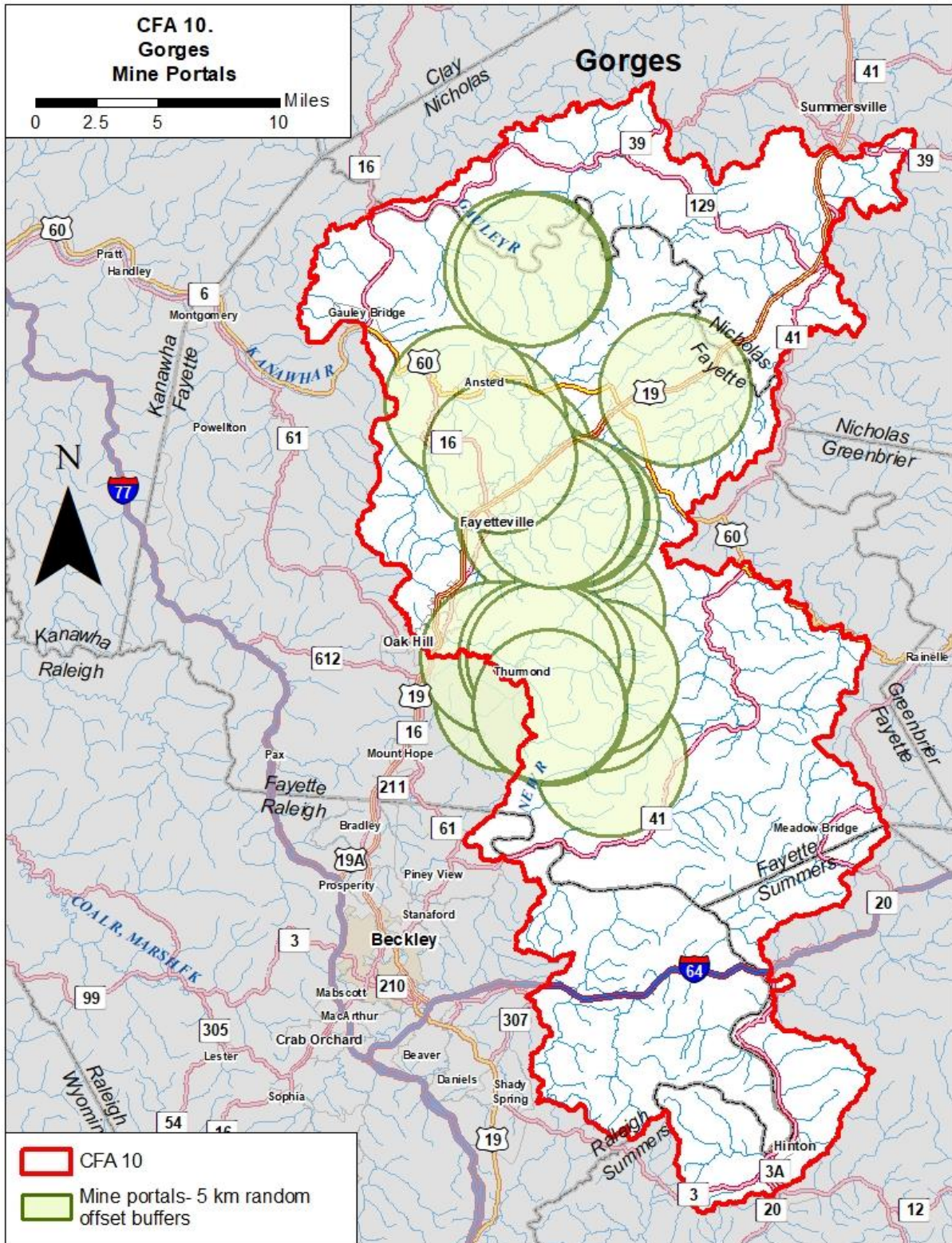
Table 16. Habitat Stresses and Conservation Actions in Subterranean Habitats

Habitat Stress	Conservation Action
Deforestation, stormwater runoff, water quality degradation around caves	Reduce non-point source pollution, restore and maintain forested buffers around caves and riparian corridors. Follow forestry BMPs developed by White-Nose Syndrome Response Team
Cave disturbance, passage alteration, excessive visitation	Use signage and fencing to limit recreational access to caves and mine portals with known hibernacula.

Map 9. Cave and Karst Features



Map 10. Mine Portals



Climate Change and Habitat Resilience

The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et al., 2015), noted that ecosystems that are limited by geological or hydrological features, such as cave and karst habitats, may be restricted from shifting across the landscape in response to climate change. However, caves that are connected more closely with groundwater inputs than surface water may be buffered by the impacts of climate change, and caves and karst areas may be buffered from increasing surface temperatures. But caves and karst areas may be vulnerable to groundwater extraction during droughts as well as changes in surface water flow regimes, nutrient inputs and contaminants carried by floods. Restoring and maintaining water quality and natural flow regimes in areas upstream and above caves and karst may boost the resilience of cave ecosystems. Some cave dwelling species also rely on adjacent forest, riparian and aquatic habitats. Maintaining the resilience of adjacent ecosystems could further buffer cave species from the impacts of climate change.

Following is a summary of climate stresses on cave and karst habitats and actions to boost their resilience. Although climate stresses are listed separately, subterranean habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Some of these actions repeat previously listed conservation actions to reduce stress on priority species and could benefit priority species while also boosting habitat resilience. 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 in Subterranean Habitats

Climate Stress:	Habitat Resilience Action:
<ul style="list-style-type: none"> • Increased flood frequency and severity, nutrient inputs and contaminants • Increased surface water temperatures, low-flow events and ground water withdrawals • Impacts to adjacent forest, riparian and aquatic habitat 	<ul style="list-style-type: none"> • Restore and protect surface water quality and hydrology • Limit impervious cover • Maintain ground water quality and quantity • Maintain resilient forests, riparian and aquatic habitat around cave ecosystems

Implementation Plan

WVDNR will work with landowners and the following partners and programs to implement and measure the impact of conservation actions around caves and karst habitat.

Table 18. Implementation Plan for Subterranean Habitats

Action	Partners	Effectiveness Measures
Land protection around subterranean habitats: <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition • Natural Area Designation 	<ul style="list-style-type: none"> • County Farmland Protection Boards • New River Conservancy • OHCF, TCF, TNC, WVLT • Public Land Managers • USDA NRCS • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected around caves and karst habitat • Abundance and diversity of priority species and habitats
Land protection around subterranean habitats <ul style="list-style-type: none"> • Incentive Programs 	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of habitat protected • Abundance and diversity of priority species and habitats
Land use planning around subterranean habitats	<ul style="list-style-type: none"> • County Planning Commissions 	<ul style="list-style-type: none"> • Acres of cave, karst and buffer habitat protected for public health and safety through land use planning ordinances
Stream buffer fencing and riparian plantings around caves	<ul style="list-style-type: none"> • USDA FSA & NRCS • Trout Unlimited • USFWS • WVCA and Conservation Districts • WVDEP 	<ul style="list-style-type: none"> • Acres or linear feet of stream buffer zones planted and fenced • Before and after comparison: abundance and diversity of priority species
Gate openings to caves and mine portals to protect hibernacula from disturbance	<ul style="list-style-type: none"> • Public Land Managers • CCV, WVACS, WVCC • USFWS 	<ul style="list-style-type: none"> • # of hibernacula protected • Before and after comparison: abundance and diversity of priority species
Land management around caves and mine portals	<ul style="list-style-type: none"> • Public Land Managers • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife • WVDNR, WVDOF • WVDEP DMR 	<ul style="list-style-type: none"> • Acres of habitat managed • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Cave and mine portal research and mapping, protection and landowner outreach	<ul style="list-style-type: none"> • CCV, WVACS, WVCC • Public Land Managers • WVDEP DMR 	<ul style="list-style-type: none"> • # of cave/karst resources protected or restored • # landowners participating in cave/karst protection and restoration activities
Improved wastewater treatment around subterranean habitats	<ul style="list-style-type: none"> • WVDEP • WVDHHR 	<ul style="list-style-type: none"> • # systems installed or improved • Change in fecal and other water quality • Before and after comparison: abundance and diversity of priority species

Human Benefits

Actions to restore and protect subterranean habitat may benefit human health and economies in surrounding communities, mainly through the protection of water quality and drinking water sources.

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from warm, low-gradient headwater streams such as the Coal Run, Meadow Creek and Smoky Branch tributaries, to warm, moderate gradient, large sized rivers such as the New River and Gauley River. A map of aquatic habitat types is included in the introduction to the CFA. These streams, river and wetland 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

Table 19 lists priority aquatic species in the CFA that occur in streams and rivers, and table 20 lists priority species in floodplain, riparian and wetland habitats.

Table 19. Priority Species in Aquatic Habitats

Taxa	Scientific Name	Common Name
Fish	<i>Anguilla rostrata</i>	American Eel
Fish	<i>Cottus kanawhae</i>	Kanawha Sculpin
Fish	<i>Etheostoma osburni</i>	Candy Darter
Fish	<i>Notropis scabriceps</i>	New River Shiner
Mussels	<i>Lasmigona subviridis</i>	Green Floater

Table 20. Priority Species in Floodplains, Riparian and Wetland Habitats

Taxa	Scientific Name	Common Name
Amphibians	<i>Desmognathus quadramaculatus</i>	Black-bellied Salamander
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle
Birds	<i>Limnothlypis swainsonii</i>	Swainson's Warbler
Birds	<i>Megaceryle alcyon</i>	Belted Kingfisher
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush
Birds	<i>Scolopax minor</i>	American Woodcock

Taxa	Scientific Name	Common Name
Butterflies and Moths	<i>Speyeria diana</i>	Diana Fritillary
Dragonflies and Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail
Mammals	<i>Corynorhinus townsendii virginianus</i>	Virginia Big-eared Bat
Mammals	<i>Myotis septentrionalis</i>	Northern Long-eared Bat
Mammals	<i>Myotis sodalis</i>	Indiana Bat
Mammals	<i>Ochrotomys nuttalli</i>	Golden Mouse
Mammals	<i>Sorex hoyi winnemana</i>	Southern Pygmy Shrew
Plants	<i>Aristida purpurascens</i> var. <i>purpurascens</i>	Arrowfeather Three-awn
Plants	<i>Baptisia australis</i> var. <i>australis</i>	False Blue Indigo
Plants	<i>Cardamine flagellifera</i> var. <i>flagellifera</i>	Bittercress
Plants	<i>Eleocharis compressa</i>	Flat-stem Spikerush
Plants	<i>Fimbristylis annua</i>	Annual Fimbry
Plants	<i>Gymnopogon ambiguus</i>	Bearded Skeleton Grass
Plants	<i>Helianthemum propinquum</i>	Low Frostweed
Plants	<i>Hypericum virgatum</i>	Sharpleaf St. John's-wort
Plants	<i>Marshallia grandiflora</i>	Monongahela Barbara's-buttons
Plants	<i>Muhlenbergia capillaris</i> var. <i>capillaris</i>	Hair-awn Muhly
Plants	<i>Prunus pumila</i> var. <i>depressa</i>	Sand Cherry
Plants	<i>Pycnanthemum beadleii</i>	Beadle's Mountainmint
Plants	<i>Pycnanthemum loomisii</i>	Loomis' Mountain-mint
Plants	<i>Pycnanthemum torrei</i>	Torrey's Mountain-mint
Plants	<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland Meadowbeauty
Plants	<i>Saxifraga careyana</i>	Golden-eye Saxifrage
Plants	<i>Silphium perfoliatum</i> var. <i>connatum</i>	Cup-plant
Plants	<i>Spiraea virginiana</i>	Virginia Spiraea
Plants	<i>Sporobolus clandestinus</i>	Secret Dropseed

Taxa	Scientific Name	Common Name
Plants	Vitis rupestris	Sand Grape
Plants	Woodwardia areolata	Netted Chainfern
Reptiles	Crotalus horridus	Timber Rattlesnake

Rare Plant Communities

Table 21 lists rare plant communities may be found in aquatic, floodplain and riparian habitats in this CFA. Note that all occurrences of the state’s Sweetgum – Tuliptree/Muscletree Floodplain Forest is found within this CFA, as well as significant portions of the state’s New River Sycamore – River Birch Riverscour Woodland and Sycamore – Ash Floodplain Forest. While riverscour communities depend on natural disturbance from flooding to maintain their habitat, others may be vulnerable to disturbance and the spread of nonnative invasive plants, pests and pathogens. Periodic active management may be required to maintain riverscour communities. Disturbance should be avoided for most other sensitive plant communities. Nonnative invasive plants, pests and pathogens should be treated as appropriate.

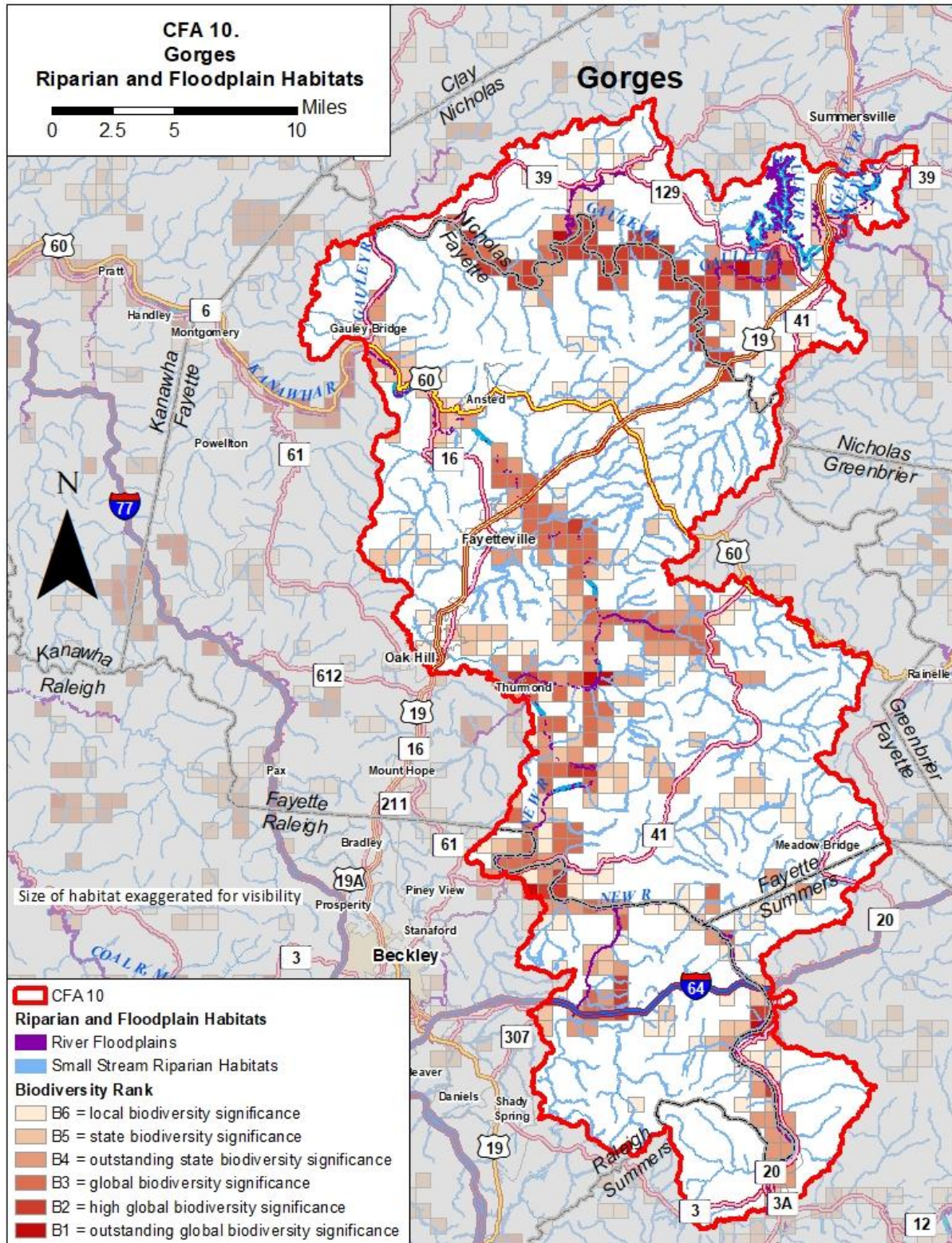
Table 21. Rare Plant Communities in Aquatic, Floodplain and Riparian Habitats.

Common Name	Relative Abundance	G Rank	S Rank
Virginia Pine – Eastern Red-cedar Bedrock Terrace Woodland	100%	G1	S1
Black Willow Slackwater Woodland	100%	G1?	S1
New River Sycamore - River Birch Riverscour Woodland	83%	G3	S3
Sweetgum - Tuliptree / Muscletree Floodplain Forest	100%	G4	S1
Sycamore - Ash Floodplain Forest	96%	G3Q	S2
Red Maple - White Oak Forest Seep	75%	G2	S2
Oak - Muscletree Floodplain Forest	67%	G1	S1
Big Bluestem - Blue Wild Indigo Riverscour Prairie	65%	G3	S1
Lizard's Tail Backwater Slough	61%	G3	S2
Virginia Pine Riverscour Woodland	58%	GNR	S1
Acidic Sandstone Riverscour Shrub-Prairie	57%	G2	S2
Hemlock Floodplain Forest	41%	GNR	S2
Low Herb Drawdown Rivershore	33%	G3	S1
American Bur-Reed Marsh	22%	G3?	S2
Tall Herb Rivershore	14%	GNR	S2
Eelgrass Riverbed	33%	G3G4	S3
Pondweed - Mixed Aquatic Riverbed	15%	G4?	S2

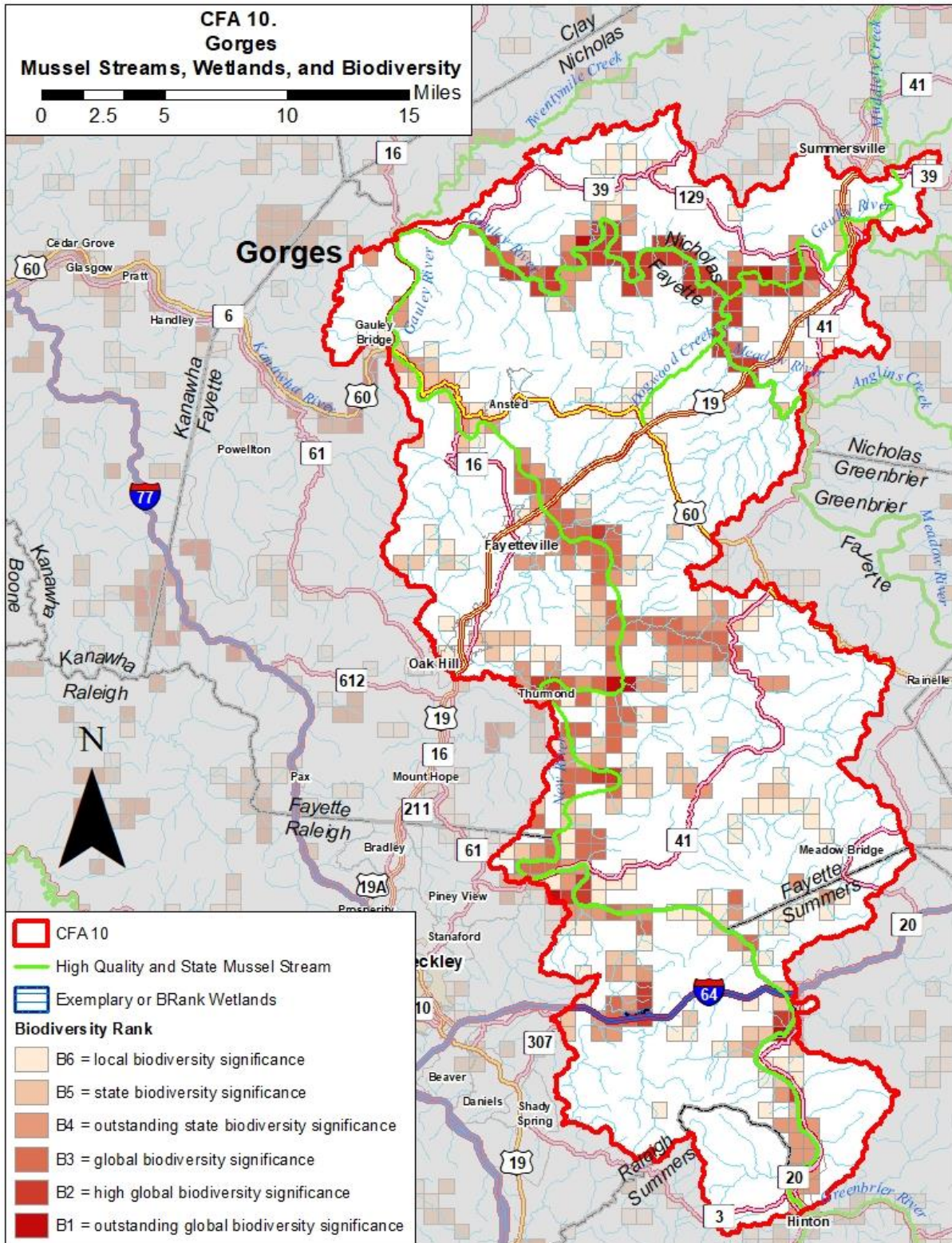
S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1=Critically Imperiled, 2=Imperiled, 3=Vulnerable, 4=Apparently Secure, 5=Secure, NR=Not Ranked, T=Subspecies or Varieties, B=Breeding, N=Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

Map 11 illustrates riparian and floodplain habitats and Map 12 shows mussel streams (mapped by WVDNR in 2018), exemplary wetlands (as assembled by WVDNR in 2015) 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. River floodplain habitats occur in the northern portion of the CFA along the Gauley and Meadow Rivers and major tributaries, along with stretches of the New River and major tributaries in the southern portion. Small stream riparian habitats occur along numerous smaller streams throughout the CFA. There is a small, exemplary wetland along Kates Branch Creek north of interstate 64 and another important wetland on Highland Mountain along Dowdy Creek. The New River, Meadow River and Gauley River, as well as Dogwood Creek are designated State Mussel Streams.

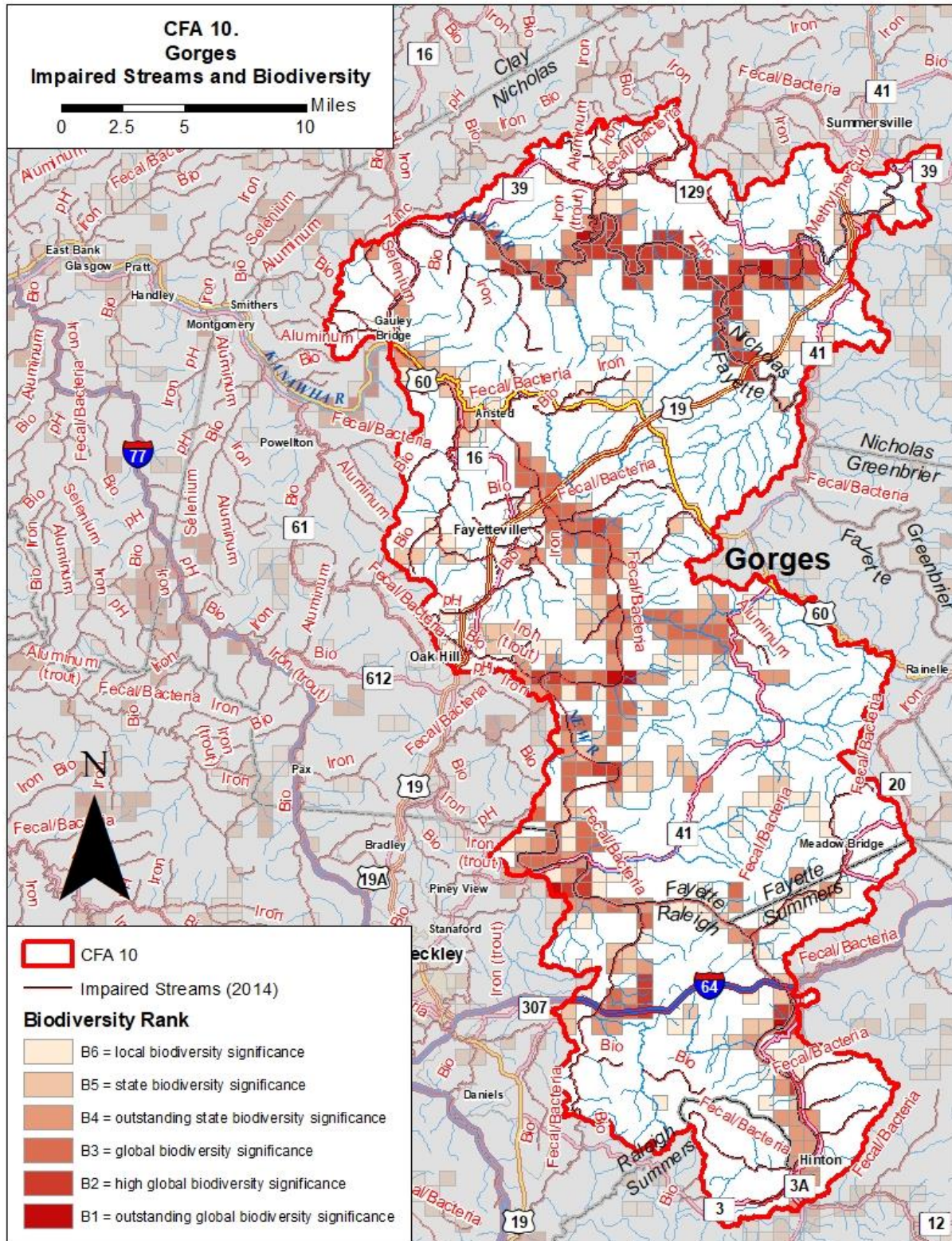
Map 11. Riparian and Floodplain Habitats



Map 12. Mussel Streams, Wetlands and Biodiversity



Map 13. Impaired Streams and Biodiversity



Habitat Stresses and Conservation Actions

Map 13 shows stream impairments, along with biodiversity. Numerous streams and rivers within the CFA suffer from various forms of impairment, the most common of which being fecal/bacteria, along with acid mine runoff and associated turbidity, trace metals, chemical elements and specific conductance (WVDEP, 2014; Mahan and Young, 2018; Nadeau, Allen, Hutchins and Roberson, 2019). Notable rivers and streams suffering from impairments include portions of the Greenbrier, Meadow and Gauley Rivers, as well as Meadow Creek, Glade Creek, Peters Creek and Coal Run (WVDEP, 2014) as well as Little Laurel Creek, Richlick Branch and Dowdy Creek (Mahan and Young, 2018). A table showing a complete list of impaired streams and their causes can be found in appendix 4. Many of these impaired streams host clusters of biodiversity and provide habitat for priority species. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present.

Additional threats to aquatic wildlife documented by Mahan and Young (2018) in the New River Gorge include declining populations of native mussels due to water pollution, sedimentation and competition from nonnative molluscs. The three species of native crayfish are also in decline and nonnative crayfish, which now make up the vast majority of crayfish collected in the New River Gorge, are the primary threat. About half of the fish species in the New River Gorge are nonnative and were introduced for sport fishing. Stream salamanders in the New River Gorge and Gauley River are threatened by bait collectors, water pollution and disease (Mahan and Young, 2018; Nadeau, Allen, Hutchins and Roberson, 2019). Boat traffic in the Gauley River has led to the spread of nonnative mussels and nonnative invasive plants, including hydrilla (*Hydrilla verticillata*), which forms dense aquatic mats (Nadeau, Allen, Hutchins and Roberson, 2019).

Ash and Hemlock trees play important ecological roles in riparian ecosystems and are threatened by invasive pests and pathogens. Riverscours plant communities are stressed by altered flooding regimes, natural succession and invasive plants (Mahan and Young, 2018; Nadeau, Allen, Hutchins and Roberson, 2019). In addition, some species also suffer direct human impacts, such as being used as fish bait, which could be addressed by ending use of live bait. Salamanders would benefit from use of appropriate decontamination procedures to reduce the spread of chytrid fungus. Bald Eagles suffer from lead poisoning and would benefit from the use of non-lead shot ammunition.

Table 22. Habitat Stresses and Conservation Actions in Aquatic, Floodplain and Riparian Habitat

Habitat Stress	Conservation Action
Lack of protected floodplain, wetland and riparian habitat	Habitat protection through land use planning, conservation easements and other programs and activities

Habitat Stress	Conservation Action
Water quality impairments from wastewater and other pollution sources, impacts on native species and diminished macroinvertebrate communities	Pollution control, improved sewage treatment, storm water management, sediment load reductions, plant and protect riparian buffers, mine restoration
Riparian habitat disturbance/recreation, road crossings, altered hydrology, increased runoff and stream temperatures, climate change	Landowner outreach, recreation and access management. Plant, fence, maintain forested riparian corridors. Implement forestry BMPs and Streamside Management Zones, even on ephemeral streams. Minimize disturbance
Altered water temperatures, flow and scour regimes from dam releases	Ecological dam releases to optimize habitat benefits
Moderated flow and decreased flooding, natural succession and invasive plants threaten rare scour-dependent plant communities in dam-controlled rivers	Ecological dam releases. Monitoring and active management to maintain rare plant communities in priority locations
Aquatic passage barriers	Modify or remove barriers; install eel ladders
Forest pests and pathogens including Hemlock Woolly Adelgid, Emerald Ash Borer in riparian areas	Monitoring and treatment of target tree species in select priority areas
Nonnative invasive plant species in rare plant communities	Careful monitoring and control of exotic invasive plant species in priority sites
Collection and use of native species for live bait/release of nonnative species as live bait and competition or predation by nonnative molluscs, fish and crayfish	Discourage or prohibit use of live bait
Boat traffic and transportation of exotic, invasive species	Proper cleaning of boats when moved between sites

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

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

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 24. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
<p>Habitat Protection:</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition • Natural Area Designation 	<ul style="list-style-type: none"> • County Farmland Protection Boards • New River Conservancy • OHCF, TCF, TNC, WVLT • Public Land Managers • USDA NRCS • WVDEP • WVDNR • WVDOF Forest Legacy 	<ul style="list-style-type: none"> • Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Habitat Protection <ul style="list-style-type: none"> • Incentive Programs 	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection: <ul style="list-style-type: none"> • Land Use Planning 	<ul style="list-style-type: none"> • County Planning Commissions 	<ul style="list-style-type: none"> • Acres of habitat protected through land use planning, floodplain and stormwater regulations
In-stream, riparian and wetland habitat restoration	<ul style="list-style-type: none"> • Public Land Managers • Summit-Bechtel Reserve • Trout Unlimited • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife • WVDEP • WVDNR 	<ul style="list-style-type: none"> • Acres or linear feet of in-stream and riparian habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Planting and fencing stream buffer zones	<ul style="list-style-type: none"> • Trout Unlimited • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife • WVCA & Conservation Districts • WVDEP 	<ul style="list-style-type: none"> • Acres or linear feet of stream buffer zones planted and fenced to protect priority species • Before and after comparison: abundance and diversity of priority species
Provide ecological dam releases to optimize habitat benefits (flow, scour, temperature)	<ul style="list-style-type: none"> • ACOE • Public Land Managers • USFWS • WVDNR 	<ul style="list-style-type: none"> • Before and after comparison: abundance and diversity of priority species
Remove or enlarge aquatic passage barriers	<ul style="list-style-type: none"> • Public Land Managers • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOH 	<ul style="list-style-type: none"> • # barriers enlarged or removed • # miles stream opened • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Improved wastewater and stormwater treatment	<ul style="list-style-type: none"> • County governments • WVDEP • WVDHHR 	<ul style="list-style-type: none"> • # wastewater and stormwater systems installed or improved • Change in fecal, sediment and other water quality measurements • Before and after comparison: abundance & distribution of priority species
Improve water quality and mine reclamation	<ul style="list-style-type: none"> • USDA FSA & NRCS • USDA FSA • USDOJ OSRME • WVCA and Conservation Districts • WVDEP 	<ul style="list-style-type: none"> • Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Monitor and treat pests and pathogens targeting specific trees and plant communities in priority sites, including ash and hemlock in riparian areas	<ul style="list-style-type: none"> • Public Land Managers • WVDA 	<ul style="list-style-type: none"> • Acres of habitat maintained for priority species • Abundance, diversity and distribution of priority species
Discourage or prohibit use of live bait	<ul style="list-style-type: none"> • Public Land Managers • WVDNR 	<ul style="list-style-type: none"> • Before and after comparison: abundance and diversity of priority species
Encourage proper cleaning of boats	<ul style="list-style-type: none"> • Public Land Managers • WVDNR 	<ul style="list-style-type: none"> • Before and after comparison: abundance and diversity of priority species

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

Agricultural areas can be found scattered throughout the CFA while developed areas are most heavily concentrated around Oak Hill and Fayetteville in the west central portion of the CFA. 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 14 shows the location of agricultural and developed habitats and illustrates many examples of biodiversity occurrences in and around these areas. Maintaining pastures, fallow fields, woody vegetation, wetlands and riparian corridors is a priority for SGCN in agricultural habitats.

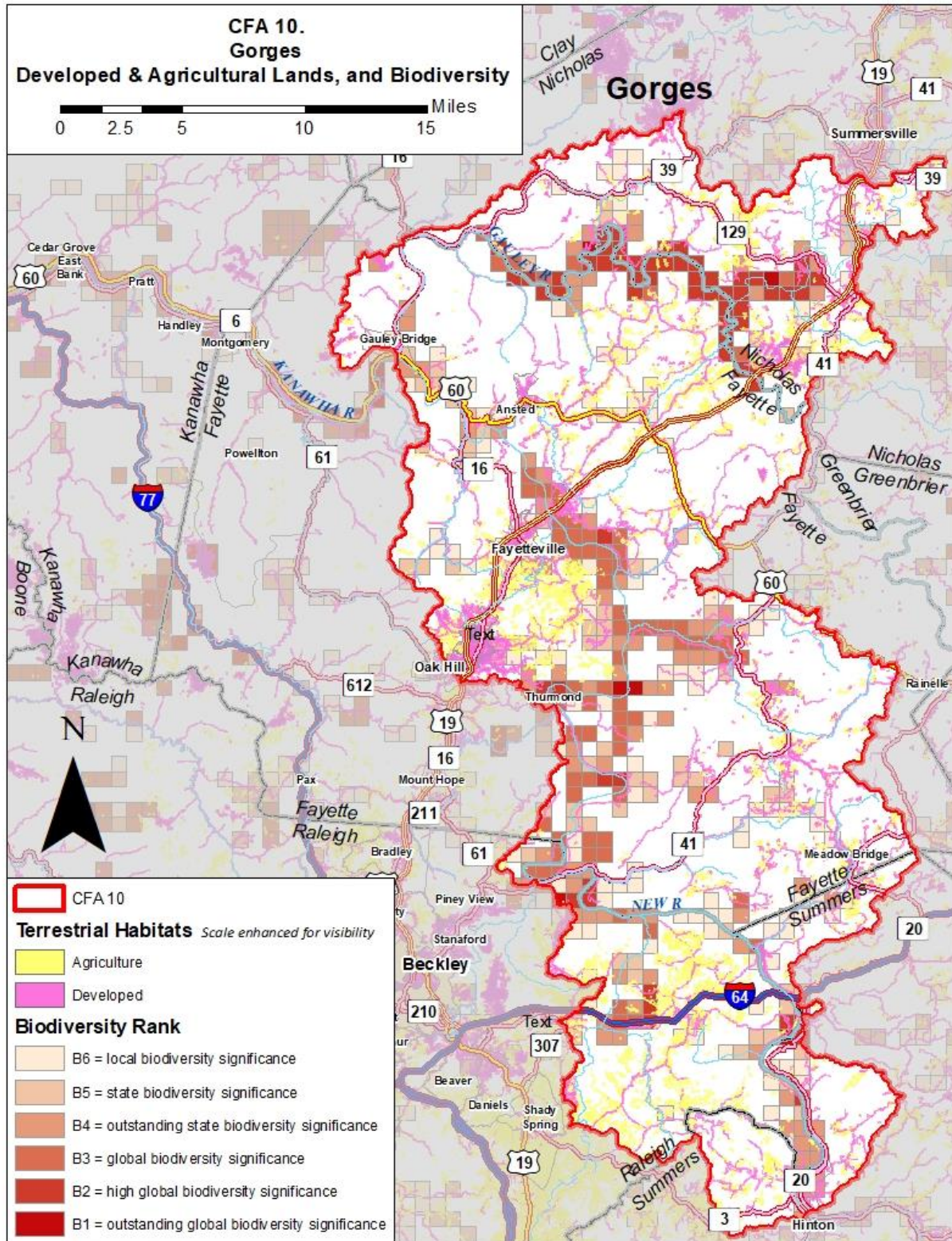
Priority Species

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. The following is a list of priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habitat, most notably for the Chimney Swift and Peregrine Falcon.

Table 25. Priority Species in Agricultural and Developed Habitats

Taxa	Scientific Name	Common Name
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse
Birds	<i>Chaetura pelagica</i>	Chimney Swift
Birds	<i>Falco peregrinus</i>	Peregrine Falcon
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Spizella pusilla</i>	Field Sparrow
Butterflies and Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper
Mammals	<i>Ochrotomys nuttalli</i>	Golden Mouse
Tiger Beetles	<i>Cicindela purpurea</i>	A Tiger Beetle

Map 14. 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. Table 26 lists stresses to priority species in agricultural and developed habitats and conservation actions to address them.

Table 26. Habitat Stresses and Conservation Actions in Agricultural and 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 pollinator habitat	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
Loss of early successional habitat in and around agricultural land, overgrazing	Create and maintain early successional habitat
Overgrazing	Apply grazing best management practices
Forest clearing at mine sites	Reclaim using Forest Reclamation Approach with pollinator habitat and reduce impacts from ATV recreation
Chimney capping (Chimney Swifts)	Uncap chimneys, install towers for chimney swifts, retain hollow snags and logs
Disturbance on bridges: maintenance or construction activities (Peregrine Falcon)	Coordinate with bridge owners to avoid disturbance to nest sites. Install and monitor nest boxes where appropriate.
Loss of bird habitat and nesting sites	Landowner outreach and education; minimize nest disturbance

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, forested woodlots 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.

Table 27 provides a summary of climate stresses on wildlife habitat in agricultural and developed areas, and actions to boost their resilience. Climate stresses are listed separately, but agricultural habitats are often impacted by multiple climate stresses occurring simultaneously. Therefore, actions to boost habitat resilience are intended to address multiple climate stresses. These actions reinforce conservation actions to reduce stress on priority species in agricultural and developed habitats. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Table 27. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

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

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 28. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
<p>Habitat Protection:</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition 	<ul style="list-style-type: none"> • County Farmland Protection Boards • New River Conservancy • OHCF, TCF, TNC, WVLT • Public Land Managers • USDA NRCS • WVDEP • WVDNR • WVDOF Forest Legacy 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Habitat Protection</p> <ul style="list-style-type: none"> • Incentive Programs 	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants	<ul style="list-style-type: none"> • USDA FSA & NRCS • WVU Extension 	<ul style="list-style-type: none"> • Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Prevent conversion of grasslands to croplands, apply grazing BMPs	<ul style="list-style-type: none"> • USDA FSA • WVCA & Conservation Districts • WVU Extension 	<ul style="list-style-type: none"> • Acres of grasslands planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Adjust timing and interval of hay harvest	<ul style="list-style-type: none"> • USDA FSA • WVU Extension 	<ul style="list-style-type: none"> • Acres of hay fields under adjusted harvest management
Adapt farm practices, infrastructure and land uses to changing conditions	<ul style="list-style-type: none"> • Public Land Managers • USDA FSA & NRCS • WVU Extension 	<ul style="list-style-type: none"> • # practices or acres adapted • Change in abundance, diversity and distribution of priority species
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"> • Public Land Managers • USDA FSA & NRCS • USFWS • WVCA and Conservation Districts • WVDEP • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Convert disturbed lands to native early successional habitat; retain existing native early successional habitat	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS 	<ul style="list-style-type: none"> • Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats
Reclaim mined lands using Forest Reclamation Approach with pollinator habitat. Reduce impacts from ATV recreation	<ul style="list-style-type: none"> • USDO I OSMRE & ARRI • WVDEP DMR 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats

Action	Partners	Effectiveness Measures
Create and maintain pollinator habitat and nectar resources along field edges, woodlots, water bodies, roads, on fallow fields and other appropriate sites	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS • USFWS Partners for Wildlife Program • WVDNR • WVDOH 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Avoid disturbance to nest sites on bridges. Install and monitor nest boxes.	<ul style="list-style-type: none"> • Public Land Managers • WVDNR • WVDOH, Bridge Owners 	<ul style="list-style-type: none"> • # nest sites avoided • # nest boxes installed • Change in abundance of Peregrine Falcon
Landowner outreach, uncapping chimneys, install swift towers	<ul style="list-style-type: none"> • Landowners and volunteer groups • Summit Bechtel Reserve 	<ul style="list-style-type: none"> • # chimneys uncapped • # swift towers installed • Change in abundance, diversity and distribution of chimney swifts

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

For the Gorges CFA, the SWAP included the following conservation actions:

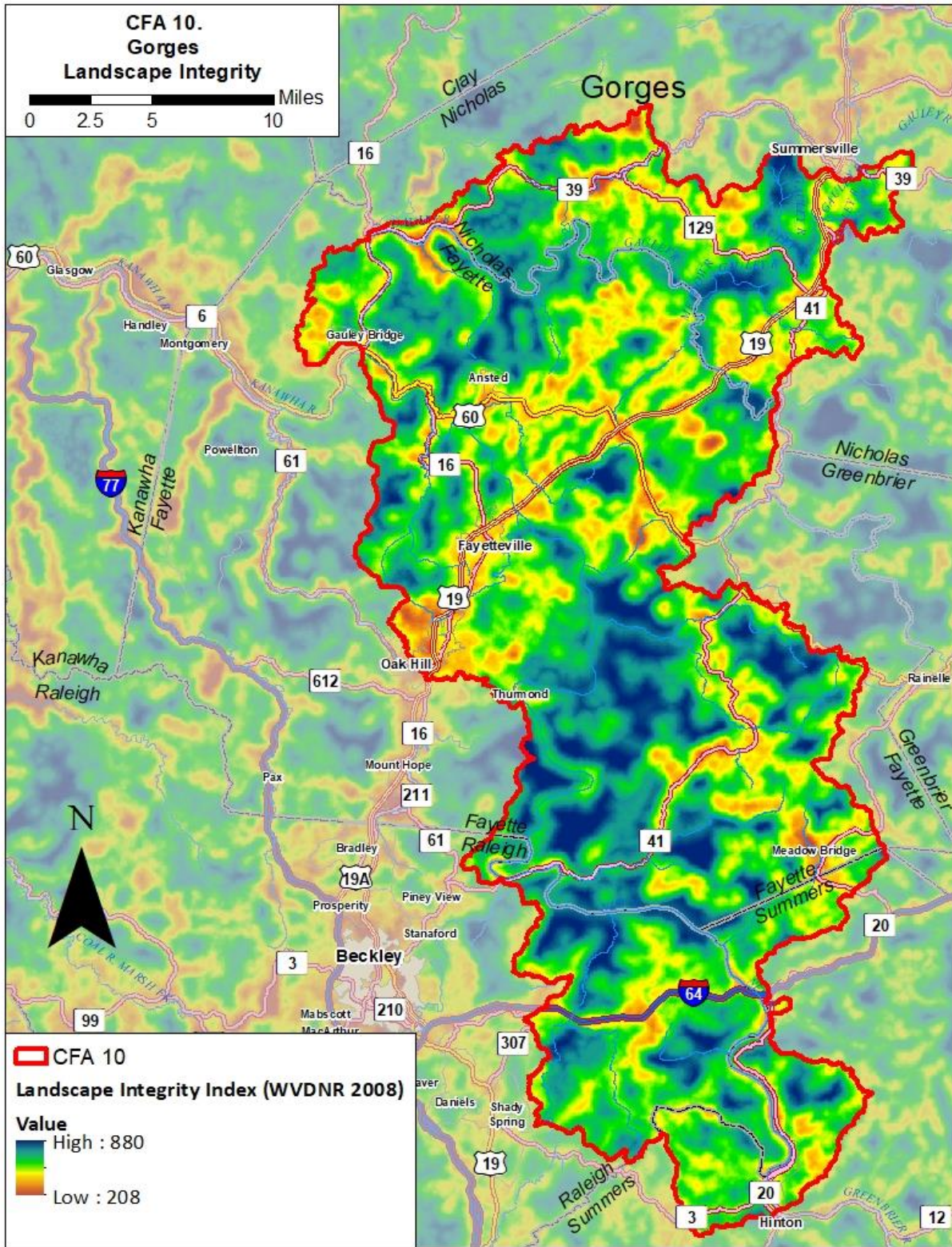
- Implement a comprehensive plan to enhance climate change resiliency through reducing other stressors (such as invasive species), identifying, maintaining and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity.

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. The map on the subsequent page 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 within public lands including the New River Gorge National River, Gauley River National Recreation Area, State Parks and Wildlife Management Areas protecting large forest patches along the northern and central portions of the CFA. 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.

Map 15. Landscape Integrity



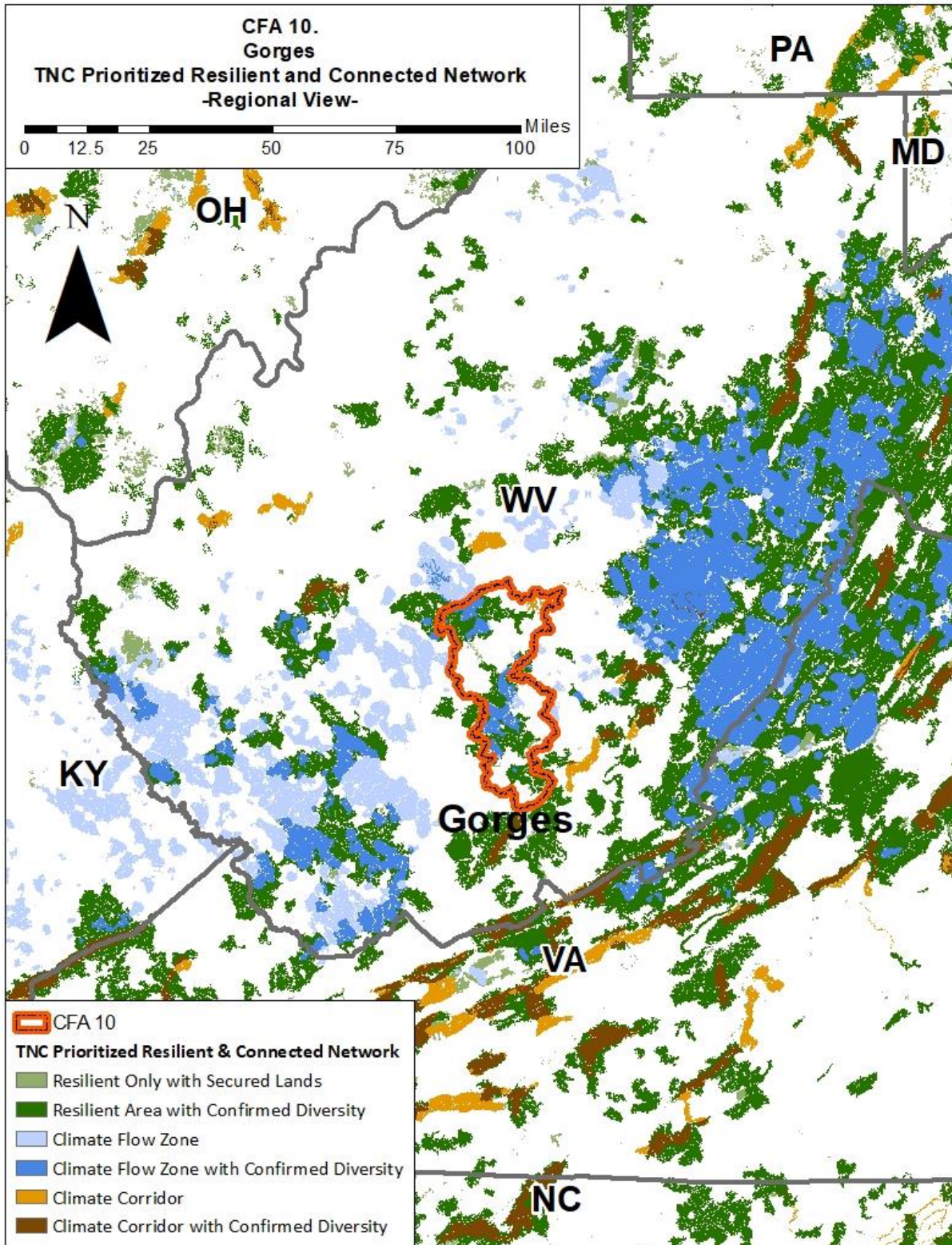
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites with topographic and elevation diversity that offer a range of habitat types and microclimates for species and ecosystems to adapt to climate change, along with high landscape integrity or local connectedness where species could move locally and disperse in response to climate change, and where natural processes like fire and floods could continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the movement or 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. Lastly, the team developed models that integrated landscape resilience, connectivity and the flow of species and populations across the landscape. They used these models to identify 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 a subset of places that are 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:

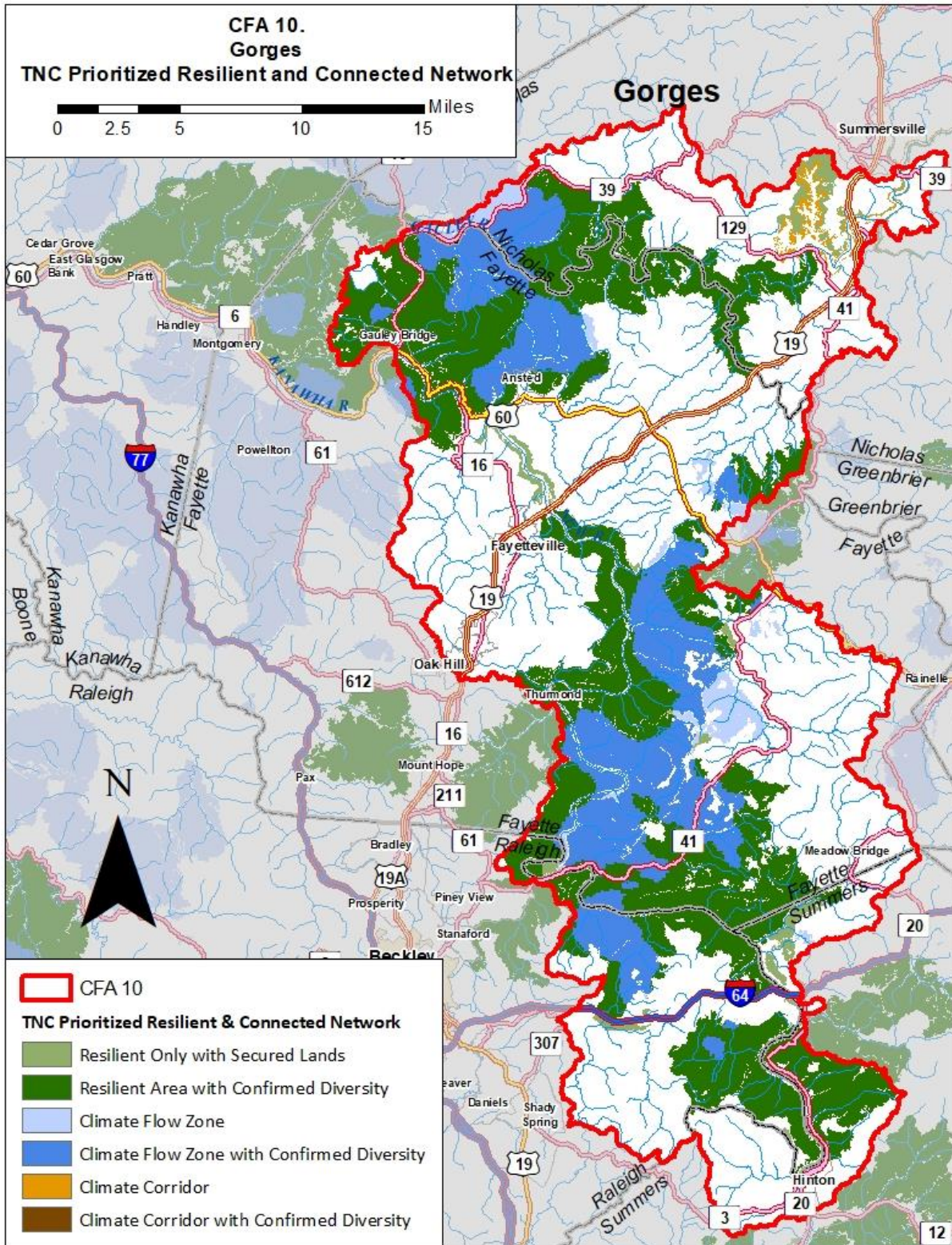
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes 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

On the following page, Map 16 provides a regional map of priority resilient and connected landscapes. The map illustrates that the resilient, connected landscapes within the CFA are connected to a network 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 16. Priority Resilient and Connected Network – Regional View



Map 17. Priority Resilient and Connected Network – Detailed View



Map 17 is a detailed view of the resilient, connected landscapes in the Gorges CFA. Large zones of resilient areas with climate flow zones contained within can be found in the northern and central portions of the CFA, primarily following the course of the New and Gauley Rivers. These priority resilient and connected landscapes contain much of the CFA’s large forest patches, high integrity areas and known biodiversity. Development patterns, transportation corridors and forest fragmentation around the Gorges limit landscape resilience and connectivity (Mahan and Young, 2018).

Protecting and maintaining these areas of high landscape integrity and the resilient areas, climate corridors and 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 29. Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	Conservation Action
<ul style="list-style-type: none"> • Changing conditions exacerbating existing stresses on species and habitat • Species responding to climate change by shifting locally as well as across the landscape • Landscape fragmentation that prevents or constrains species movement 	<ul style="list-style-type: none"> • 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

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 30. Implementation Plan for Landscape Resilience and Connectivity

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

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 on disturbed areas and lands under active timber management
- Pollinator habitat including diverse native and non-invasive forbs and flowering plants along field edges, woodlots, water bodies, roads, on fallow fields and other appropriate sites
- Unique, geologically derived habitat including:
 - Acidic rock outcrops, cliffs and talus, especially along the New and Gauley Rivers
 - Calcareous cliffs and talus
- Biologically significant caves, their watersheds and buffer areas
- Special aquatic habitats, such as mussel streams and wetlands
- 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, enlarging stream crossings 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 shale barrens, rock outcrops or cliff and talus habitats, or improving water quality and

planting riparian corridors in karst landscapes or cave watersheds, may benefit additional species. Private landowners, public land managers and conservation partners are encouraged to focus resources across priority habitats to maximize benefits to multiple species.

Connecting Conservation Actions for Climate Resilience

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

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 shale barrens, rock outcrops, cliff and talus, karst or cave habitat buffers enhances the resilience of these habitats and enables forest species to move to optimal sites as conditions change. Conservation of riparian 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 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 Gorges CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Amphibians	<i>Ambystoma jeffersonianum</i>	Jefferson Salamander	S2	G4		
Amphibians	<i>Aneides aeneus</i>	Green Salamander	S3	G3		
Amphibians	<i>Cryptobranchus alleganiensis</i>	Eastern Hellbender	S2	G3		
Amphibians	<i>Desmognathus quadramaculatus</i>	Black-bellied Salamander	S3	G5		
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander	S3	G5		
Amphibians	<i>Lithobates pipiens</i> (R. pipiens)	Northern Leopard Frog	S1	G5		
Amphibians	<i>Necturus maculosus</i>	Mudpuppy	S4	G5		
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander	S3	G4		
Amphibians	<i>Plethodon wehrlei</i>	Wehrle's Salamander	S4	G4		
Amphibians	<i>Pseudotriton montanus diastictus</i>	Midland Mud Salamander	S1	G5		
Amphibians	<i>Pseudotriton ruber ruber</i>	(northern) Red Salamander	S3	G5		
Birds	<i>Actitis macularius</i>	Spotted Sandpiper	S2B	G5		
Birds	<i>Ammodramus savannarum</i>	Grasshopper Sparrow	S3B	G5		
Birds	<i>Anas rubripes</i>	American Black Duck	S2B,S2N	G5		
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	S3B	G5		At Risk-Conserv
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse	S3B,S3N	G5		
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk	S3B	G5		
Birds	<i>Butorides virescens</i>	Green Heron	S3B			
Birds	<i>Chaetura pelagica</i>	Chimney Swift	S3B	G5		
Birds	<i>Colinus virginianus</i>	Northern Bobwhite	S1B, S1N	G5		
Birds	<i>Falco peregrinus</i>	Peregrine Falcon	S2B,S2N	G4		
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		At Risk-Conserv

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Birds	<i>Icteria virens</i>	Yellow-breasted Chat	S3B	G5		
Birds	<i>Limnothlypis swainsonii</i>	Swainson's Warbler	S3B	G4		
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>Scolopax minor</i>	American Woodcock	S3B	G5		
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4		At Risk- Conserv
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 chrysoptera</i>	Golden-winged Warbler	S1B	G4		At Risk- Conserv
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5		
Butterflies & Moths	<i>Atrytonopsis hianna</i>	Dusted Skipper	S1	G4		
Butterflies & Moths	<i>Celastrina neglectamajor</i>	Appalachian Azure	SNR	G4		
Butterflies & Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr	S3	G4		
Butterflies & Moths	<i>Eryia laeta</i>	Early Hairstreak	S2	GU		
Butterflies & Moths	<i>Parrhasius m-album</i>	White-m Hairstreak	S2	G5		
Butterflies & Moths	<i>Pieris virginiensis</i>	West Virginia White	S3	G3		
Butterflies & Moths	<i>Polytonia faunus smythi</i>	Smyth's Green Comma	S1	T3		
Butterflies & Moths	<i>Speyeria diana</i>	Diana Fritillary	S2S3	G3		
Cave Invertebrates	<i>Conotyla vista</i>	A Cave Millipede	SH	G1		
Cave Invertebrates	<i>Litocampa fieldingi</i>	Diplura	S2	G3		
Dragonflies & Damselflies	<i>Aeshna verticalis</i>	Green-striped Darner	S2S3	G5		
Dragonflies & Damselflies	<i>Celithemis fasciata</i>	Banded Pennant	S3	G5		
Dragonflies & Damselflies	<i>Gomphus vastus</i>	Cobra Clubtail	S2	G5		
Dragonflies & Damselflies	<i>Gomphus viridifrons</i>	Green-faced Clubtail	S3	G3		
Dragonflies & Damselflies	<i>Ladona deplanata</i>	Blue Corporal	S3	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Dragonflies & Damselflies	<i>Lestes forcipatus</i>	Sweetflag Spreadwing	S3	G5		
Dragonflies & Damselflies	<i>Macromia illinoiensis</i>	Illinois River Cruiser	S3	G5		
Dragonflies & Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail	S3	G4		
Fish	<i>Ameiurus melas</i>	Black Bullhead	S1	G5		
Fish	<i>Anguilla rostrata</i>	American Eel	S2	G4		
Fish	<i>Chrosomus erythrogaster</i>	Southern Redbelly Dace	S2S3	G5		
Fish	<i>Cottus kanawhae</i>	Kanawha Sculpin	S2	G4		
Fish	<i>Etheostoma osburni</i>	Candy Darter	S1	G3	E	
Fish	<i>Notropis scabriceps</i>	New River Shiner	S2	G4		
Fish	<i>Percina phoxocephala</i>	Slenderhead Darter	S1	G5		
Mammals	<i>Corynorhinus rafinesquii</i>	Eastern Big-eared Bat	S1	G3		
Mammals	<i>Corynorhinus townsendii virginianus</i>	Virginia Big-eared Bat	S2	G2	E	
Mammals	<i>Cryptotis parva</i>	Least Shrew	S2	G5		
Mammals	<i>Lasiurus borealis</i>	Eastern Red Bat	S4	G5		
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat	S1	G3		
Mammals	<i>Myotis lucifugus</i>	Little Brown Myotis	S2*	G3		
Mammals	<i>Myotis septentrionalis</i>	Northern Long-eared Bat	S2*	G2	T	
Mammals	<i>Myotis sodalis</i>	Indiana Bat	S1	G2	E	
Mammals	<i>Neotoma magister</i>	Allegheny Woodrat	S3	G3		
Mammals	<i>Ochrotomys nuttalli</i>	Golden Mouse	S2	G5		
Mammals	<i>Perimyotis subflavus</i>	Tricolored Bat	S2*	G3		
Mammals	<i>Sorex dispar</i>	Long-tailed Shrew	S2S3	G4		
Mammals	<i>Sorex hoyi winnemana</i>	Southern Pygmy Shrew	S2S3	G4		
Mammals	<i>Spilogale putorius</i>	Eastern Spotted Skunk	S1	G5		
Mammals	<i>Zapus hudsonius</i>	Meadow Jumping Mouse	S3	G5		
Mussels	<i>Actinonaias ligamentina</i>	Mucket	S3	G5		
Mussels	<i>Alasmidonta marginata</i>	Elktoe	S1	G4		
Mussels	<i>Cyclonaias tuberculata</i>	Purple Wartback	S1	G5		
Mussels	<i>Elliptio dilatata</i>	Spike	S3	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Mussels	<i>Lampsilis cardium</i>	Plain Pocketbook	S3	G5		
Mussels	<i>Lampsilis fasciola</i>	Wavy-rayed Lamppussel	S3	G5		
Mussels	<i>Lampsilis ovata</i>	Pocketbook	S3	G5		
Mussels	<i>Lasmigona subviridis</i>	Green Floater	S2	G3		At Risk-Conserv
Mussels	<i>Pyganodon grandis</i>	Giant Floater	S3	G5		
Mussels	<i>Quadrula quadrula</i>	Mapleleaf	S3	G5		
Mussels	<i>Toxolasma parvus</i>	Lilliput	S2	G5		
Mussels	<i>Tritogonia verrucosa</i>	Pistolgrip	S3	G4		
Plants	<i>Adlumia fungosa</i>	Allegheny-vine	S2?	G4		
Plants	<i>Agrimonia microcarpa</i>	Small-fruit Groovebur	S1	G5		
Plants	<i>Ampelopsis cordata</i>	Heartleaf Peppervine	S1	G5		
Plants	<i>Anemone quinquefolia</i> var. <i>minima</i>	Dwarf Anemone	S2	T3		
Plants	<i>Arabis hirsuta</i> ssp. <i>pycnocarpa</i>	Hairy Rockcress	S2	T5		
Plants	<i>Aristida purpurascens</i> var. <i>purpurascens</i>	Arrowfeather Three-awn	S1	T5		
Plants	<i>Baptisia australis</i> var. <i>australis</i>	False Blue Indigo	S3	T3		
Plants	<i>Calopogon tuberosus</i> var. <i>tuberosus</i>	Tuberous Grass-pink	S1	T5		
Plants	<i>Cardamine flagellifera</i> var. <i>flagellifera</i>	Bittercress	S2	G3		
Plants	<i>Carex bromoides</i> ssp. <i>bromoides</i>	Brome-like Sedge	S3	T5		
Plants	<i>Carex careyana</i>	Carey's Sedge	S1	G4		
Plants	<i>Carex cephaloidea</i>	Thinleaf Sedge	S1	G5		
Plants	<i>Carex comosa</i>	Longhair Sedge	S2	G5		
Plants	<i>Carex emoryi</i>	Emory's Sedge	S2	G5		
Plants	<i>Carex hirtifolia</i>	Pubescent Sedge	S3	G5		
Plants	<i>Carex laxiculmis</i> var. <i>copulata</i>	Spreading Sedge	S2	T4		
Plants	<i>Carex mesochorea</i>	Midland Sedge	S2	G4		
Plants	<i>Carex molesta</i>	Troublesome Sedge	S3	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Plants	<i>Carex normalis</i>	Greater Straw Sedge	S3	G5		
Plants	<i>Carex planispicata</i>	Flat-spiked Sedge	S2	G4		
Plants	<i>Carex seorsa</i>	Weak Stellate Sedge	S2	G4		
Plants	<i>Carex styloflexa</i>	Bent Sedge	S1	G4		
Plants	<i>Carex suberecta</i>	Prairie Straw Sedge	S1	G4		
Plants	<i>Carex tonsa</i> var. <i>rugosperma</i>	Parachute Sedge	S2S3	T5		
Plants	<i>Carex typhina</i>	Cattail Sedge	S2	G5		
Plants	<i>Commelina erecta</i>	Slender Dayflower	S2	T5		
Plants	<i>Corallorhiza wisteriana</i>	Wister's Coralroot, Spring Coralroot	S2	G5		
Plants	<i>Coreopsis pubescens</i>	Star Tickseed	S2	G5		
Plants	<i>Cornus rugosa</i>	Roundleaf Dogwood	S1	G5		
Plants	<i>Croton glandulosus</i> var. <i>septentrionalis</i>	Vente-conmigo	S3	T5		
Plants	<i>Cuscuta indecora</i> var. <i>neuropetala</i>	Dodder	S1	T5		
Plants	<i>Cymophyllus fraserianus</i>	Fraser's Sedge	S3	G4		
Plants	<i>Cyperus refractus</i>	Reflexed Flatsedge	S3	G5		
Plants	<i>Cyperus squarrosus</i>	Awned Flatsedge	S3	G5		
Plants	<i>Danthonia sericea</i>	Silky Oatgrass	S1?	G5		
Plants	<i>Desmodium lineatum</i>	Tick-trefoil	S1	G5		
Plants	<i>Desmodium pauciflorum</i>	Few-flower Tick-trefoil	S1	G5		
Plants	<i>Dichanthelium acuminatum</i> ssp. <i>columbianum</i>	District Of Columbia Panicgrass	S1	T5		
Plants	<i>Dichanthelium meridionale</i>	Matting Witchgrass	S3	G5		
Plants	<i>Digitaria filiformis</i>	Slender Crabgrass	S1	G5		
Plants	<i>Eleocharis compressa</i>	Flat-stem Spikerush	S2	G4		
Plants	<i>Eleocharis intermedia</i>	Spikerush	S1	G5		
Plants	<i>Eragrostis hirsuta</i>	Big-top Lovegrass	SH	G5		
Plants	<i>Eriogonum allenii</i>	Shalebarren Wild Buckwheat	S2	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Plants	<i>Eupatorium godfreyanum</i>	Godfrey's Thoroughwort	S2S3	G4		
Plants	<i>Eupatorium pilosum</i>	Rough Boneset	S2	G5		
Plants	<i>Fimbristylis annua</i>	Annual Fimbry	S1	G5		
Plants	<i>Galactia volubilis</i>	Downy Milkpea	S2	G5		
Plants	<i>Gaylussacia dumosa</i>	Dwarf Huckleberry	S1	G5		
Plants	<i>Gentiana austromontana</i>	Appalachian Gentian	S1	G3		
Plants	<i>Gymnocarpium dryopteris</i>	Northern Oak Fern	S1	G5		
Plants	<i>Gymnopogon ambiguus</i>	Bearded Skeleton Grass	S1	G4		
Plants	<i>Helianthemum canadense</i>	Long-branch Frostweed	S2	G5		
Plants	<i>Helianthemum propinquum</i>	Low Frostweed	S1	G4		
Plants	<i>Helianthus laevigatus</i>	Smooth Sunflower	S2	G4		
Plants	<i>Helianthus occidentalis</i> ssp. <i>occidentalis</i>	Western Sunflower	S2	T5		
Plants	<i>Heteranthera reniformis</i>	Kidneyleaf Mud-plantain	S1	G5		
Plants	<i>Hibiscus laevis</i>	Halberd-leaf Rosemallow	S2	G5		
Plants	<i>Hypericum virgatum</i>	Sharpleaf St. John's-wort	S1	G4		
Plants	<i>Juglans cinerea</i>	Butternut	S3	G4		
Plants	<i>Juncus dichotomus</i>	Forked Rush	S1	G5		
Plants	<i>Lechea pulchella</i> var. <i>pulchella</i>	Pinweed	SH	T4		
Plants	<i>Lechea tenuifolia</i>	Narrowleaf Pinweed	S1	G5		
Plants	<i>Leucothoe recurva</i>	Red-twig Doghobble	S1	G4		
Plants	<i>Liatris scariosa</i> var. <i>nieuwlandii</i>	Devil's-bite	S1	T4		
Plants	<i>Liatris squarrulosa</i>	Appalachian Gayfeather	S1	G4		
Plants	<i>Lygodium palmatum</i>	American Climbing Fern	S3	G4		
Plants	<i>Lythrum alatum</i> var. <i>alatum</i>	Winged Loosestrife	S2	T5		
Plants	<i>Maianthemum stellatum</i>	Starflower False Solomon's-seal	S2	G5		
Plants	<i>Marshallia grandiflora</i>	Monongahela Barbara's-buttons	S2	G2		At Risk- Science
Plants	<i>Melica mutica</i>	Two-flower Melicgrass	S2	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Plants	<i>Monarda fistulosa</i> ssp. <i>brevis</i>	Smoke Hole Bergamot	S1	T1		
Plants	<i>Muhlenbergia capillaris</i> var. <i>capillaris</i>	Hair-awn Muhly	S1	T5		
Plants	<i>Myosotis macrosperma</i>	Large-seed Forget-me-not	S3	G5		
Plants	<i>Najas gracillima</i>	Slender Waternymph	S2	G5		
Plants	<i>Oenothera argillicola</i>	Shalebarren Evening-primrose	S3	G3		
Plants	<i>Oenothera pilosella</i> ssp. <i>pilosella</i>	Meadow Sundrops	S2	T5		
Plants	<i>Packera paupercula</i>	Balsam Ragwort	S2	G5		
Plants	<i>Parnassia asarifolia</i>	Kidneyleaf Grass-of-parnassus	S2	G4		
Plants	<i>Pellaea glabella</i> ssp. <i>glabella</i>	Smooth Cliffbrake	S2	T5		
Plants	<i>Piptochaetium avenaceum</i>	Eastern Speargrass	S2	G5		
Plants	<i>Platanthera ciliaris</i>	Yellow-fringe Orchid	S3	G5		
Plants	<i>Platanthera psycodes</i>	Lesser Purple Fringed Orchid	S1	G5		
Plants	<i>Poa saltuensis</i>	Old-pasture Bluegrass	S1	G5		
Plants	<i>Pogonia ophioglossoides</i>	Rose Pogonia	S2	G5		
Plants	<i>Polygala curtissii</i>	Curtiss' Milkwort	S2	G5		
Plants	<i>Prunus pumila</i> var. <i>depressa</i>	Sand Cherry	S1	T5		
Plants	<i>Pycnanthemum beadleii</i>	Beadle's Mountainmint	S1	G3		
Plants	<i>Pycnanthemum clinopodioides</i>	Basil Mountain-mint	SH	G2		
Plants	<i>Pycnanthemum loomisii</i>	Loomis' Mountain-mint	S2	G4		
Plants	<i>Pycnanthemum muticum</i>	Clustered Mountainmint	S1	G5		
Plants	<i>Pycnanthemum torrei</i>	Torrey's Mountain-mint	S1	G2		
Plants	<i>Ranunculus pusillus</i> var. <i>pusillus</i>	Low Spearwort	S1	T4		
Plants	<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland Meadowbeauty	S1	T5		
Plants	<i>Rhododendron viscosum</i>	Swamp Azalea	S1	G5		
Plants	<i>Rhynchospora recognita</i>	Beaked Rush	S2	G5		
Plants	<i>Rudbeckia fulgida</i> var. <i>fulgida</i>	Orange Coneflower	S2	T4		
Plants	<i>Salix discolor</i>	Pussy Willow	S2	G5		
Plants	<i>Salix lucida</i> ssp. <i>lucida</i>	Shining Willow	S1	T5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Plants	<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	Seaside Brookweed	S2	T5		
Plants	<i>Saxifraga careyana</i>	Golden-eye Saxifrage	S3	G3		
Plants	<i>Schoenoplectus purshianus</i>	Clubrush, Bulrush	S3	G4		
Plants	<i>Scleria triglomerata</i>	Whip Nutrush	S2	G5		
Plants	<i>Scutellaria saxatilis</i>	Rock Skullcap	S2	G3		
Plants	<i>Sida hermaphrodita</i>	Virginia Mallow	S3	G3		
Plants	<i>Silene nivea</i>	Snowy Catchfly	S1	G4		
Plants	<i>Silphium perfoliatum</i> var. <i>connatum</i>	Cup-plant	S1	T3		
Plants	<i>Solidago simplex</i> ssp. <i>randii</i>	Rand's Goldenrod	S2	T4		
Plants	<i>Sparganium androcladum</i>	Branched Bur-reed	S2S3	G4		
Plants	<i>Spiraea virginiana</i>	Virginia Spiraea	S1	G2	T	
Plants	<i>Spiranthes lucida</i>	Shining Ladies'-tresses	S1S2	G5		
Plants	<i>Spiranthes tuberosa</i>	Little Ladies'-tresses	S3	G5		
Plants	<i>Sporobolus clandestinus</i>	Secret Dropseed	S1	G5		
Plants	<i>Stachys tenuifolia</i>	Smooth Hedge-nettle	S3	G5		
Plants	<i>Symphotrichum laeve</i> var. <i>concinnum</i>	Smooth Blue American-aster	S2	T4		
Plants	<i>Thalictrum clavatum</i>	Mountain Meadowrue	S2	G4		
Plants	<i>Thuja occidentalis</i>	Northern White-cedar	S2	G5		
Plants	<i>Trifolium stoloniferum</i>	Running Buffalo Clover	S3	G3	E	
Plants	<i>Triphora trianthophora</i>	Threebirds	S2	G3		
Plants	<i>Utricularia gibba</i>	Humped Bladderwort	S2	G5		
Plants	<i>Vernonia glauca</i>	Broad-leaved Ironweed	S1	G5		
Plants	<i>Viola blanda</i> var. <i>palustriformis</i>	Violet	SH	T4		
Plants	<i>Vitis rupestris</i>	Sand Grape	S2	G3		
Plants	<i>Woodsia appalachiana</i>	Allegheny Cliff Fern	S2	G4		
Plants	<i>Woodwardia areolata</i>	Netted Chainfern	S2	G5		
Plants	<i>Xyris torta</i>	Slender Yellow-eyed-grass	S2	G5		
Reptiles	<i>Agkistrodon contortrix mokasen</i>	Northern Copperhead	S5	T5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS At Risk
Reptiles	<i>Carphophis amoenus</i>	Wormsnake	S3	G5		
Reptiles	<i>Coluber constrictor constrictor</i>	Northern Black Racer	SNR	T5		
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4		
Reptiles	<i>Graptemys geographica</i>	Northern Map Turtle	S1	G5		
Reptiles	<i>Lampropeltis getula</i>	Eastern Kingsnake	S2	G5		
Reptiles	<i>Opheodrys aestivus</i>	Rough Greensnake	S2	G5		
Reptiles	<i>Plestiodon anthracinus anthracinus</i>	Northern Coal Skink	S2	G5		
Reptiles	<i>Plestiodon laticeps</i>	Broad-headed Skink	S2	G5		
Reptiles	<i>Pseudemys concinna</i>	River Cooter	S2	G5		
Reptiles	<i>Regina septemvittata</i>	Queen Snake	S4	G5		
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	S5	T5		
Snails	<i>Helicodiscus triodus</i>	Talus Coil	SH			
Snails	<i>Hendersonia occulta</i>	Cherrystone Drop	S3			
Snails	<i>Mesodon mitchellianus</i>	Sealed Globelet	S3			
Snails	<i>Paravitrea seradens</i>	Barred Supercoil	S2			
Snails	<i>Stenotrema edwardsi</i>	Ridge-and-valley Slitmouth	S3			
Snails	<i>Striatura ferrea</i>	Black Striate	S3			
Snails	<i>Ventridens arcellus</i>	Golden Dome	S3			
Snails	<i>Ventridens collisella</i>	Sculptured Dome	S3			
Tiger Beetles	<i>Cicindela ancocisconensis</i>	Appalachian Tiger Beetle	S3	G3		
Tiger Beetles	<i>Cicindela purpurea</i>	A Tiger Beetle	S3	G5		
Tiger Beetles	<i>Cicindela unipunctata</i>	A Tiger Beetle	S3	G4		

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

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

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

Appendix 2. Priority SGCN, Known Stresses and Actions

Forests and Woodlands		
Common Name	Local Stress	Action
Cumberland Plateau Salamander	<ul style="list-style-type: none"> • Timber harvest. • Data gaps 	<ul style="list-style-type: none"> • Research and surveys to fill critical data gaps. • Follow or exceed Forestry BMPS
Green Salamander	<ul style="list-style-type: none"> • Climate change. • Recreational climbing. • Loss of forested buffer surrounding outcrops 	<ul style="list-style-type: none"> • Maintain and protect forested buffer surround all rocky outcrops. • Limit recreational use in priority habitat.
Eastern Whip-poor-will	<ul style="list-style-type: none"> • Road/collision mortality. Incompatible forest structure. Possible declines in high quality prey 	<ul style="list-style-type: none"> • Identify high density areas and install highway signage. Manage forests for interior gaps and edges. Long-term monitoring of insect populations
Ruffed Grouse	<ul style="list-style-type: none"> • Insufficient habitat. West Nile virus 	<ul style="list-style-type: none"> • Create suitable habitat through established BMPs, manage forests at landscape scale for mosaic of age classes and structure, assess prevalence of WNV
Broad-winged Hawk	<ul style="list-style-type: none"> • Poor forest structure 	<ul style="list-style-type: none"> • Forest management for gaps
Kentucky Warbler	<ul style="list-style-type: none"> • Deer overherbivory. Incompatible forest structure 	<ul style="list-style-type: none"> • Reduce deer population. Manage forests for structural and spatial complexity
Bald Eagle	<ul style="list-style-type: none"> • Lead poisoning 	<ul style="list-style-type: none"> • Encourage usage of non-lead shot
Worm-eating Warbler	<ul style="list-style-type: none"> • Deer overherbivory. Incompatible forest structure. Residential development 	<ul style="list-style-type: none"> • Reduce deer population. Manage forests for structural and spatial complexity
Wood Thrush	<ul style="list-style-type: none"> • Deer overherbivory. Incompatible forest structure. Residential development 	<ul style="list-style-type: none"> • Reduce deer population. Manage forests for structural and spatial complexity

Forests and Woodlands		
Common Name	Local Stress	Action
Yellow-breasted Chat	<ul style="list-style-type: none"> Forest maturation. Herbicide use/veg mgmt in utility corridors 	<ul style="list-style-type: none"> Manage forests to create early successional habitat. Manage utility corridors to maintain compatible habitat
Swainson's Warbler	<ul style="list-style-type: none"> Riparian habitat loss and degradation 	<ul style="list-style-type: none"> Research to assess productivity and survival in novel breeding habitat dominated by invasive species. Protect floodplain forests with suitable habitat
Cerulean Warbler	<ul style="list-style-type: none"> Poor forest structure 	<ul style="list-style-type: none"> Manage forests to create suitable habitat as per CERW guidelines
Prairie Warbler	<ul style="list-style-type: none"> Forest maturation. Herbicide use/veg mgmt in utility corridors 	<ul style="list-style-type: none"> Manage forests to create early successional habitat. Manage utility corridors to maintain compatible habitat
Golden-winged Warbler	<ul style="list-style-type: none"> Insufficient habitat. Clean farming practices 	<ul style="list-style-type: none"> Create early successional habitat per GWWA management guidelines
Blue-winged Warbler	<ul style="list-style-type: none"> Insufficient habitat. Residential development 	<ul style="list-style-type: none"> Reduce clean farming practices. Create early successional habitat
Dusted Skipper	<ul style="list-style-type: none"> Aforestation. Agricultural intensification. Development 	<ul style="list-style-type: none"> Conservation and enhancement of open areas for pollinators
Early Hairstreak	<ul style="list-style-type: none"> Loss of beech. Mowing of nectar resources 	<ul style="list-style-type: none"> Maintain resilience of forest types. Maintain nectar resources along roadsides and adjacent areas
West Virginia White	<ul style="list-style-type: none"> Expansion of invasive garlic mustard 	<ul style="list-style-type: none"> Pull garlic mustard. Education for landowners about garlic mustard

Forests and Woodlands		
Common Name	Local Stress	Action
Diana Fritillary	<ul style="list-style-type: none"> MTR mining. Excessive mowing that removes nectar resources. Unregulated ATV recreation 	<ul style="list-style-type: none"> Mine reclamation with FRA approach including native wildflowers where possible. Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
Virginia Big-eared Bat	<ul style="list-style-type: none"> Deforestation, agriculture, industry 	<ul style="list-style-type: none"> Follow Forestry BMPs developed by White-Nose Syndrome Response team. Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Indiana Bat	<ul style="list-style-type: none"> Deforestation, agriculture, industry 	<ul style="list-style-type: none"> Maintain forest cover USFWS requires management actions within 10 miles of "Priority 1/2" Indiana Bat caves.
Northern Myotis	<ul style="list-style-type: none"> Development, agriculture. Lack of complexity in forest stand (i.e. snags/early-successional trees). 	<ul style="list-style-type: none"> This species needs mature forest habitat arguably more than any other bat. Continue to protect any hibernacula, benefiting all bats. Maintain large intact forest blocks.
Southern Pygmy Shrew	<ul style="list-style-type: none"> Unknown- data deficient species 	<ul style="list-style-type: none"> Current distribution assessment. Study potential effects of gypsy moth spraying on insects and invertivores
Carey's Sedge	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Thinleaf Sedge	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.

Forests and Woodlands		
Common Name	Local Stress	Action
Silky Oatgrass	<ul style="list-style-type: none"> Rock climbing, recreational trampling 	<ul style="list-style-type: none"> Designate cliff habitat with climbing prohibited.
District of Columbia Panicgrass	<ul style="list-style-type: none"> Rock climbing, recreational trampling 	<ul style="list-style-type: none"> Designate cliff habitat with climbing prohibited.
Appalachian Gentian	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Timber Rattlesnake	<ul style="list-style-type: none"> Persecution. Collection. Habitat destruction 	<ul style="list-style-type: none"> Increased surveillance around susceptible den sites. Forest management to create canopy gaps. Reduce canopy over known gestation and basking sites. Develop basking structures to mitigate impacts to habitat. Buffer boulder fields, talus and rocky outcrops
A Tiger Beetle	<ul style="list-style-type: none"> Unknown- data deficient species 	<ul style="list-style-type: none"> Citizen science surveys

Rock Outcrop, Cliff, Talus and Barren Habitats		
Common Name	Local Stress	Action
Cave Salamander	<ul style="list-style-type: none"> Recreational cavers/ climbers. Loss of forested buffers surrounding outcrops and caves 	<ul style="list-style-type: none"> Gate caves and restrict recreational access. Limit use of rocky outcrops for recreational purposes (climbing, hiking, ORV, etc.). Protect and maintain forested habitat adjacent to rocky outcrops
Green Salamander	<ul style="list-style-type: none"> Climate change. Recreational climbing. Loss of forested buffer surrounding outcrops 	<ul style="list-style-type: none"> Maintain and protect forested buffer surround all rocky outcrops. Limit recreational use in priority habitat

Rock Outcrop, Cliff, Talus and Barren Habitats		
Common Name	Local Stress	Action
Peregrine Falcon	<ul style="list-style-type: none"> • Disturbance at nest sites. • Collision risk 	<ul style="list-style-type: none"> • Prevent climber/recreational user access to cliff nest sites. • Minimize nest disturbance on bridges
Allegheny Woodrat	<ul style="list-style-type: none"> • Agriculture. • Forest fragmentation. • Poor mast sources. 	<ul style="list-style-type: none"> • Buffer and protect rocky outcrops/talus slope habitats to allow for metapopulation dispersal.
Silky Oatgrass	<ul style="list-style-type: none"> • Rock climbing & recreational trampling 	<ul style="list-style-type: none"> • Designate cliff habitat with climbing prohibited.
District of Columbia Panicgrass	<ul style="list-style-type: none"> • Rock climbing & recreational trampling 	<ul style="list-style-type: none"> • Designate cliff habitat with climbing prohibited.
Golden-eye Saxifrage	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Timber Rattlesnake	<ul style="list-style-type: none"> • Persecution. • Collection. • Loss of basking, gestation, denning habitat 	<ul style="list-style-type: none"> • Increased surveillance around susceptible den sites. • Forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus and rocky outcrops

Cave and Karst Habitats		
Common Name	Local Stress	Action
Cave Salamander	<ul style="list-style-type: none"> • Recreational cavers/ climbers. • Loss of forested buffers surrounding outcrops and caves 	<ul style="list-style-type: none"> • Gate caves and restricted recreational access. • Limit use of rocky outcrops for recreational purposes (climbing, hiking, ORVs, etc.). • Protect forested habitat adjacent to rocky outcrops and caves. • Maintain forested buffer surround all rocky outcrops and caves
Bats: Indiana Bat, Virginia Big-eared Bat, Little Brown Bat, Northern Long-eared Bat, Eastern Small-footed Bat and Tri-colored bat	<ul style="list-style-type: none"> • Deforestation, agriculture, industry, cave disturbance 	<ul style="list-style-type: none"> • Protect hibernacula • Protect and maintain forest cover • Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Reduce nonpoint source pollution. • Restore riparian corridors. • USFWS requires management actions within 10 miles of "Priority 1/2" Indiana Bat caves.

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Black-bellied Salamander	<ul style="list-style-type: none"> • Collection. • Disease. • Stream acidification. • Timber harvest 	<ul style="list-style-type: none"> • Reduce use as bait. • Educate land managers, biologists and researchers about appropriate decontamination procedures to reduce the spread of disease (chytrid fungus). • Follow or exceed forestry BMPs and Streamside Management Zone standards at ephemeral streams
American Woodcock	<ul style="list-style-type: none"> • Insufficient habitat. • Residential development 	<ul style="list-style-type: none"> • Reduce clean farming practices. • Create early successional habitat

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Kentucky Warbler	<ul style="list-style-type: none"> • Deer over herbivory. • Incompatible forest structure 	<ul style="list-style-type: none"> • Reduce deer population. • Manage forests for structural and spatial complexity
Bald Eagle	<ul style="list-style-type: none"> • Lead poisoning 	<ul style="list-style-type: none"> • Encourage usage of non-lead shot
Swainson's Warbler	<ul style="list-style-type: none"> • Riparian habitat loss and degradation 	<ul style="list-style-type: none"> • Research to assess productivity and survival in novel breeding habitat dominated by invasive species. • Protect floodplain forests with suitable habitat
Belted Kingfisher	<ul style="list-style-type: none"> • Poor water quality. • Insufficient nest microhabitat 	<ul style="list-style-type: none"> • Identify important waterways and improve water quality
Louisiana Waterthrush	<ul style="list-style-type: none"> • Loss of riparian forests. • Stream degradation. • Acid deposition. • Residential development 	<ul style="list-style-type: none"> • Improve water quality. • Conserve riparian and upland stream valley forests. • Conservation easements
Diana Fritillary	<ul style="list-style-type: none"> • MTR mining. • Mowing of nectar resources. • Development 	<ul style="list-style-type: none"> • Mine reclamation with Forest Reclamation Approach including native wildflowers where possible. • Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
Gray Petaltail	<ul style="list-style-type: none"> • Development 	<ul style="list-style-type: none"> • Plant and protect vegetation buffer areas around small seeps and streamlets

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Virginia Big-eared Bat	<ul style="list-style-type: none"> Deforestation, agriculture, industry 	<ul style="list-style-type: none"> Follow Forestry BMPs developed by White-Nose Syndrome Response team. Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Indiana Bat	<ul style="list-style-type: none"> Deforestation, agriculture, industry 	<ul style="list-style-type: none"> Promote intact and healthy riparian corridors USFWS requires management actions within 10 miles of "Priority 1/2" Indiana Bat caves.
Northern Myotis	<ul style="list-style-type: none"> Development, agriculture. Lack of complexity in forest stand (i.e. snags/early-successional trees). 	<ul style="list-style-type: none"> This species needs mature forest habitat arguably more than any other bat. Continue to protect any hibernacula, benefiting all bats. Maintain large intact forest blocks.
Southern Pygmy Shrew	<ul style="list-style-type: none"> Unknown- data deficient species 	<ul style="list-style-type: none"> Current distribution assessment. Study potential effects of gypsy moth spraying on insects and invertivores
Golden Mouse	<ul style="list-style-type: none"> Unknown- data deficient species 	<ul style="list-style-type: none"> Current distribution assessment
Arrowfeather Three-awn	<ul style="list-style-type: none"> Altered hydrology Unknown status 	<ul style="list-style-type: none"> Monitor populations. Field survey to determine species distribution and threats.
False Blue Indigo	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations.
Bittercress	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations. Discuss ecological dam releases.
Flat-stem Spikerush	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations.

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Annual Fimbry	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Bearded Skeleton Grass	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Low Frostweed	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Sharpleaf St. John's-wort	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Monongahela Barbara's-buttons	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations.
Hair-awn Muhly	<ul style="list-style-type: none"> Altered hydrology. Unknown status 	<ul style="list-style-type: none"> Monitor populations. Field survey to determine species distribution and threats.
Sand Cherry	<ul style="list-style-type: none"> Altered hydrology. Extremely small populations 	<ul style="list-style-type: none"> Monitor populations.
Loomis' Mountain-mint	<ul style="list-style-type: none"> Unknown status. Woody encroachment 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Torrey's Mountain-mint	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Maryland Meadowbeauty	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Golden-eye Saxifrage	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.
Cup-plant	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations.
Virginia Spiraea	<ul style="list-style-type: none"> Altered hydrology 	<ul style="list-style-type: none"> Monitor populations. Discuss ecological dam releases.
Secret Dropseed	<ul style="list-style-type: none"> Unknown status 	<ul style="list-style-type: none"> Field survey to determine species distribution and threats.

Floodplain, Riparian and Wetland Habitats		
Common Name	Local Stress	Action
Sand Grape	<ul style="list-style-type: none"> • Altered hydrology 	<ul style="list-style-type: none"> • Monitor populations.
Netted Chainfern	<ul style="list-style-type: none"> • Altered hydrology 	<ul style="list-style-type: none"> • Monitor populations.
Timber Rattlesnake	<ul style="list-style-type: none"> • Persecution. • Collection. • Habitat destruction 	<ul style="list-style-type: none"> • Increased surveillance around susceptible den sites. • Forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus and rocky outcrops

Aquatic Habitats		
Common Name	Local Stress	Action
American Eel	<ul style="list-style-type: none"> • Stream passage barriers 	<ul style="list-style-type: none"> • Install Eel ladders
Kanawha Sculpin	<ul style="list-style-type: none"> • Increasing stream temperatures. • Increased stream sedimentation. • Interspecific competition 	<ul style="list-style-type: none"> • Restore riparian area. • Mitigate causes of sedimentation. • Ban live bait use
Candy Darter	<ul style="list-style-type: none"> • Increased sedimentation. • Hybridization Variegate Darters. • Increased stream temperatures. • Point & nonpoint-source pollution 	<ul style="list-style-type: none"> • Restore riparian habitat. • Logging BMPs. • Restore & mitigate effects of legacy mining
New River Shiner	<ul style="list-style-type: none"> • Increased sedimentation. • Increased stream temperatures 	<ul style="list-style-type: none"> • Riparian restoration
Green Floater	<ul style="list-style-type: none"> • Hydroelectric dam. • Water quality 	<ul style="list-style-type: none"> • Sediment control and water quality improvement

Agricultural and Developed Habitats		
Common Name	Local Stress	Action
Chimney Swift	<ul style="list-style-type: none"> • Chimney capping. • Turnover of older structures 	<ul style="list-style-type: none"> • Landowner outreach and education. Protect known significant migration roosts. Uncap chimneys. Install swift towers
Ruffed Grouse	<ul style="list-style-type: none"> • Insufficient habitat. • West Nile virus 	<ul style="list-style-type: none"> • Create suitable habitat through established BMPs. Manage forests at landscape scale for mosaic of age classes and structure. Assess prevalence of WNV
American Woodcock	<ul style="list-style-type: none"> • Insufficient habitat. • Residential development 	<ul style="list-style-type: none"> • Reduce clean farming practices. Create early successional habitat
Field Sparrow	<ul style="list-style-type: none"> • Insufficient habitat 	<ul style="list-style-type: none"> • Create early successional habitat
Peregrine Falcon	<ul style="list-style-type: none"> • Disturbance at nest sites. • Collision risk 	<ul style="list-style-type: none"> • Prevent climber/recreational user access to cliff nest sites. • Minimize nest disturbance on bridges
Golden Mouse	<ul style="list-style-type: none"> • Unknown- data deficient species 	<ul style="list-style-type: none"> • Current distribution assessment
Dusted Skipper	<ul style="list-style-type: none"> • Afforestation. 	<ul style="list-style-type: none"> • Dusted Skipper
A Tiger Beetle	<ul style="list-style-type: none"> • Unknown- data deficient species 	<ul style="list-style-type: none"> • Citizen science surveys

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
Beury Mountain Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cool
Cotton Hill Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • N/A

Public Land	Terrestrial Habitat	Aquatic Habitat
Summersville Lake Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Medium River, Low Gradient, Warm
Babcock State Park	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cool • Small River, High Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
Carnifex Ferry Battlefield State Park	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • River Floodplains • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • N/A
Hawk's Nest State Park	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Large River, Low Gradient, Warm • Large River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
Gauley River National Recreation Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Warm • Small River, High Gradient, Warm • Medium River, Low Gradient, Warm • Medium River, Moderate Gradient, Warm • Medium River, High Gradient, Warm • Large River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
New River Gorge National Park and Preserve	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Calcareous Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Warm • Small River, High Gradient, Warm • Large River, Low Gradient, Warm • Large River, Moderate Gradient, Warm
Summit Betchel Reserve	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs and Talus • Aquatic, Floodplain and Riparian <ul style="list-style-type: none"> • Open Water • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool

Appendix 4. Impaired Streams

Stream Name	Cause
Arbuckle Creek	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria • Iron (trout)
Beech Run	<ul style="list-style-type: none"> • Fecal/Bacteria
Big Creek	<ul style="list-style-type: none"> • Selenium
Bridge Fork	<ul style="list-style-type: none"> • Iron
Brooks Branch	<ul style="list-style-type: none"> • Fecal/Bacteria
Coal Run	<ul style="list-style-type: none"> • Fecal/Bacteria
Crooked Run	<ul style="list-style-type: none"> • Fecal/Bacteria
Dempsey Branch	<ul style="list-style-type: none"> • Biological
Dunloup Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron (trout)
Fern Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • pH
Floyd Creek	<ul style="list-style-type: none"> • Aluminum • Biological • Iron • pH
Gauley River	<ul style="list-style-type: none"> • Zinc
Glade Creek	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria
Greenbrier River	<ul style="list-style-type: none"> • Fecal/Bacteria
House Branch	<ul style="list-style-type: none"> • Fecal/Bacteria
Jerry Fork	<ul style="list-style-type: none"> • Iron
Keeney Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Kelly Fork	<ul style="list-style-type: none"> • Fecal/Bacteria
Laurel Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Left Fork/Scrabble Creek	<ul style="list-style-type: none"> • Biological
Lick Branch	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria
Lick Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Line Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Madam Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Marr Branch	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria • Iron
Meadow Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Meadow River	<ul style="list-style-type: none"> • Fecal/Bacteria
Mill Creek	<ul style="list-style-type: none"> • Fecal/Bacteria

Stream Name	Cause
New River (Lower)	<ul style="list-style-type: none"> • Fecal/Bacteria
Osborne Creek	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria • Iron
Otter Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron
Owens Branch	<ul style="list-style-type: none"> • Fecal/Bacteria
Peters Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron (trout)
Piney Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron (trout)
Rich Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron (trout)
Right Fork/Line Creek	<ul style="list-style-type: none"> • Iron
Rocklick Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Scrabble Creek	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria
Short Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Squealing Fork	<ul style="list-style-type: none"> • Biological
Summersville Lake	<ul style="list-style-type: none"> • Methylmercury
Tug Creek	<ul style="list-style-type: none"> • Fecal/Bacteria
Twentymile Creek	<ul style="list-style-type: none"> • Fecal/Bacteria • Iron
UNT/Line Creek RM 1.31	<ul style="list-style-type: none"> • Aluminum • pH
UNT/Marr Branch RM 1.00	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria • Iron
UNT/Mill Creek RM 1.71	<ul style="list-style-type: none"> • Fecal/Bacteria
UNT/Osborne Creek RM 0.62	<ul style="list-style-type: none"> • Fecal/Bacteria
UNT/Sal Willis Branch RM 0.73	<ul style="list-style-type: none"> • Biological
UNT/Wolf Creek RM 9.08	<ul style="list-style-type: none"> • Aluminum • Iron • pH
Wilson Branch	<ul style="list-style-type: none"> • Biological
Wolf Creek	<ul style="list-style-type: none"> • Biological • Fecal/Bacteria • Iron

Appendix 5. Partners and Assistance Provided

Below is a list of partners and assistance provided to landowners for conservation actions in the CFA.

Partner	Role/Assistance Provided
<p>Appalachian Mountains Joint Venture (AMJV)</p> <p>https://amjv.org/</p>	<ul style="list-style-type: none"> 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.
<p>American Forest Foundation (AFF)</p> <p>https://www.forestfoundation.org/</p> <p>https://www.familyforestcarbon.org/</p>	<ul style="list-style-type: none"> The American Forest Foundation's mission is to deliver meaningful conservation impact through the empowerment of family forest landowners. 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. 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)
<p>Cave Conservancy of the Virginias (CCV)</p> <p>https://caveconservancyofvirginia.org/</p>	<ul style="list-style-type: none"> Promoting conservation, management, knowledge and acquisition of caves and karst resources in Virginia and West Virginia Contributes to educational, research and environmental protection projects Funds a variety of cave and karst education, outreach, research, cleanup and acquisition projects. Provides research scholarships and stipends for graduate and undergraduate students Supports <i>Project Underground</i> environmental education program to promote a better understand of caves and karst lands.

Partner	Role/Assistance Provided
Consulting Foresters https://wvforestry.com/forestry-consultants/	<ul style="list-style-type: none"> • Developing Forest Stewardship Plans • Promoting Forestry BMPs • Designing forest management practices to achieve landowner goals and ecological objectives • Assisting landowners with developing forest carbon projects aimed at achieving verifiable carbon sequestration through improved forest management practices
County Farmland Protection Boards http://wvfp.org/	<ul style="list-style-type: none"> • 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 • Assist in sustaining the farming community • Provide sources of agricultural products within the state for citizens of the state • Control the urban expansion which is consuming the agricultural land, topsoil and woodland of the state • Curb the spread of urban blight and deterioration • Protect agricultural land and woodland as open-space land • Enhance tourism • Protect worthwhile community values, institutions & landscapes which are inseparably associated with traditional farming
County Planning Commissions	<ul style="list-style-type: none"> • Planning to manage floodplains and guide new development
Forest Certification Programs: <ul style="list-style-type: none"> • American Tree Farm System (ATFS) https://www.treefarmssystem.org/ • Sustainable Forestry Initiative (SFI) https://www.forests.org/ https://www.wvfa.org/sfi/ • Forest Stewardship Council (FSC) https://fsc.org/en 	<ul style="list-style-type: none"> • Resources, assistance and certification for sustainable forest management on public and private lands

Partner	Role/Assistance Provided
<p>Master Naturalists Program</p> <p>http://mnofwv.org/</p>	<ul style="list-style-type: none"> • Training interested people in the fundamentals of natural history, nature interpretation and teaching. • Instilling an appreciation of the importance of responsible environmental stewardship. • 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
<p>National Speleological Society (NSS)</p> <p>https://caves.org/</p>	<ul style="list-style-type: none"> • Promotes safe and responsible caving practices, effective cave and karst management, speleology, and conservation. • Members work together in NSS grottos (i.e. chapters), regions, surveys, and sections to develop ideas and pursue projects in the areas of speleology, as well as cave conservation, management, preservation, restoration, exploration, surveying, rescue, equipment, techniques, and education.
<p>National Wild Turkey Federation (NWTf)</p> <p>https://www.nwtf.org/</p>	<ul style="list-style-type: none"> • Provides information to landowners on hunting and habitat management for wild turkey and other wildlife • Partners with state and federal agencies on hunting access and habitat management for wild turkey and other wildlife species
<p>New River Alliance of Climbers</p> <p>https://www.newriverclimbing.net/about-us.html</p>	<ul style="list-style-type: none"> • Preserves and promotes access to climbing areas and conserves climbing resources in the New River Gorge and surrounding areas
<p>New River Conservancy</p> <p>https://www.newriverconservancy.org/</p>	<ul style="list-style-type: none"> • Dedicated to protecting the waters, woodlands and wildlife of the New River Watershed. Priorities include water quality, protecting and restoring the land and keeping the river clean.
<p>Outdoor Heritage Conservation Fund (OHCF)</p> <p>https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/</p>	<ul style="list-style-type: none"> • 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.

Partner	Role/Assistance Provided
<p>Ruffed Grouse Society/American Woodcock Society (RGS)</p> <p>https://ruffedgrousesociety.org/#</p>	<ul style="list-style-type: none"> • Creates healthy forest habitat for the benefit of ruffed grouse, American woodcock and other forest wildlife • Works with landowners and government agencies to develop critical habitat using scientific management practices • RGS works with the forest product industry, including landowners, foresters, loggers, and forest product manufacturers, to scale up capacity building, investment and conservation benefits from working forests to the landscape scale. <p>https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/</p>
<p>Summit Bechtel Reserve</p> <p>https://www.summitbsa.org/</p>	<ul style="list-style-type: none"> • Situated in the wilds of West Virginia, The Summit Bechtel Reserve is a training, Scouting, and adventure center for the millions of youth and adults involved in the Boy Scouts of America and anyone who loves the outdoors. The Summit Bechtel Reserve is also home to the National Scout Jamboree and the Paul R. Christen National High Adventure Base.
<p>The Conservation Fund (TCF)</p> <p>https://www.conservationfund.org/where-we-work/west-virginia</p>	<ul style="list-style-type: none"> • 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.
<p>The Nature Conservancy (TNC)</p> <p>https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/</p>	<ul style="list-style-type: none"> • Assist public land managers with land protection, management and restoration to maintain landscape resilience and connectivity • Assist private landowners with land protection and improved management, including conservation easements and forest carbon projects • Manages a network of nature preserves and conservation easements for conservation and recreation

Partner	Role/Assistance Provided
<p>Trout Unlimited (TU)</p> <ul style="list-style-type: none"> • http://www.wvtu.org/ • http://www.tu.org/ 	<ul style="list-style-type: none"> • 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 • 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
<p>US Army Corps of Engineers (USACE): Great Lakes and Ohio River Division</p> <p>https://www.lrd.usace.army.mil/</p> <ul style="list-style-type: none"> • Environmental Stewardship https://www.lrd.usace.army.mil/Missions/Environmental/ • Flood Risk Management: https://www.lrd.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/ 	<ul style="list-style-type: none"> • 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. • 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 • Flood risk management includes operation of dams, reservoirs and levees along the Ohio River and its tributaries

Partner	Role/Assistance Provided
<p>USDA Farm Service Agency (FSA)</p> <p>https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index</p> <ul style="list-style-type: none"> • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP) • State Acres for Wildlife Enhancement (SAFE) • Farmable Wetlands Program (FWP) • Grasslands Reserve Program (GRP) 	<ul style="list-style-type: none"> • 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. • 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 • 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. • The Farmable Wetlands Program (FWP) provides farmers and ranchers annual rental payments in return for restoration wetlands and wetland buffers zones. • The Grassland Reserve Program (GRP) provides farmers a rental payment to voluntarily prevent grazing and pasture land from being converted into cropland or urban development.

Partner	Role/Assistance Provided
<p>USDA Natural Resources Conservation Service (NRCS):</p> <p>https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/</p> <p>Environmental Quality Incentive Program (EQIP)</p> <ul style="list-style-type: none"> • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP) 	<ul style="list-style-type: none"> • 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 • 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 • The RCPP-EQIP Cerulean Warbler Initiative is designed to enhance Cerulean Warbler habitat and increase their populations • The RCPP-EQIP WV Aquatic Passage-Working Farms project is a partnership between NRCS, TU and USFWS designed to improve fish and aquatic wildlife habitat, reduce infrastructure risk and increase flood resiliency. CSP provides payments to farm and forest landowners for actively managing, maintaining and expanding conservation activities to enhance natural resources and improve their business operations. Priority resource concerns for funding include terrestrial habitat for wildlife and invertebrates. • 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. • 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.

Partner	Role/Assistance Provided
<p>US DOI National Park Service (USNPS)</p> <ul style="list-style-type: none"> • New River Gorge National Park and Preserve https://www.nps.gov/neri/index.htm • Gauley River National Recreation Area https://www.nps.gov/gari/index.htm • Eastern Rivers and Mountains Inventory & Monitoring Network https://www.nps.gov/im/ermn/index.htm 	<ul style="list-style-type: none"> • The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. • The Eastern Rivers and Mountains Inventory & Monitoring Network is one of 32 National Park Service Inventory & Monitoring Networks across the country established to conduct baseline resource inventories and implement sustained natural resource monitoring.
<p>US DOI Office of Surface Mining Reclamation and Enforcement (OSMRE) https://www.osmre.gov/index.shtm</p> <p>Appalachian Regional Reforestation Initiative (ARRI) https://arri.osmre.gov/About/AboutARRI.shtm</p>	<ul style="list-style-type: none"> • OSMRE is the primary regulator of coal mining under the Surface Mining Control and Reclamation Act (SMCRA) of 1977 until a State or Indian Tribe develops its own regulations to meet SMCRA and OSMRE requirements. • OSMRE partners with States to regulate mining on Federal lands and to support States' regulatory programs with grants and technical assistance • Abandoned Mine Land (AML) Reclamation Program addresses the hazards and environmental degradation posed by mines abandoned before the SMCRA • The Appalachian Regional Reforestation Initiative (ARRI) is a coalition of groups, including citizens, the coal industry and government dedicated to restoring forests on coal mined lands in the Eastern United States

Partner	Role/Assistance Provided
<p>US DOI Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program https://www.fws.gov/northeast/ecologicalservices/partners.html</p>	<ul style="list-style-type: none"> • 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) • 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 • Works in coordination with the USDA Natural Resources Conservation Service farm bill programs, Trout Unlimited and other partners
<p>WV Association for Cave Studies (WVACS) https://www.wvacs.org/</p>	<ul style="list-style-type: none"> • Contributes to cave surveys and research • Hosts cave scientists and graduate students pursuing cave research at field stations in Greenbrier County
<p>WV Cave Conservancy https://wvcc.net/</p>	<ul style="list-style-type: none"> • Manages caves to protect sensitive cave resources and environments • Educates and provides expertise to landowners, developers, local governments and the public on the value of cave and karst resources • Organizes cave and karst conservation projects including sinkhole cleanups and livestock barrier fences. • Preserves access to significant caves through ownership and management agreements • Sponsor research and survey projects on WVCC caves

Partner	Role/Assistance Provided
<p>WV Conservation Agency (WVCA) and Conservation Districts</p> <p>http://www.wvca.us</p> <ul style="list-style-type: none"> • Ag Enhancement Program (AgEP) • Non-Point Source Program • Stream Partners Program 	<ul style="list-style-type: none"> • 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. • 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. • 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.

Partner	Role/Assistance Provided
<p>WV Department of Environmental Protection (WVDEP)</p> <ul style="list-style-type: none"> • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonpointsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonpointsource/WBP/Pages/WBP.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx • Division of Mining and Reclamation (DMR) https://dep.wv.gov/dmr/Pages/default.aspx • Rehabilitation Environmental Action Plan (REAP) https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx • WVDEP Youth Environmental Program (YEP) https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx 	<ul style="list-style-type: none"> • Supports partners and citizen-based watershed organizations in restoring impaired watersheds • Provides assistance in proper installation and maintenance of Best Management Practices • 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 • Practices include wastewater treatment, agricultural BMPs, rain gardens for stormwater runoff, streambank restoration and community outreach • Save our Streams provides training for volunteers to monitor local wadable streams and rivers • DMR's mission is to assure compliance with the West Virginia Surface Mining and Reclamation Act and other applicable state laws and rules by means of effective and high quality reclamation of mining sites, an efficient permitting program and constructive communications between the public and regulated industry. • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects

Partner	Role/Assistance Provided
<p>WV Department of Health and Human Resources (WVDHHR)</p> <ul style="list-style-type: none"> On-Site Sewage Program <p>https://www.wvdhhr.org/phs/sewage/index.asp</p>	<ul style="list-style-type: none"> 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.
<p>WV Division of Forestry (WVDOF)</p> <p>http://www.wvforestry.com/</p>	<ul style="list-style-type: none"> Oversees the Managed Timberland Program to provide tax incentives for landowners who manage their forest land sustainably according to a management plan Oversee timber sales and Best Management Practices Provides training workshops for loggers on safety and Best Management Practices Maintains list of consulting foresters who can help landowners with Forest Stewardship Plans to enhance wildlife habitat Protection of large private forest tracts through Forest Legacy Program
<p>WV Division of Natural Resources (WVDNR)</p> <p>http://www.wvdnr.gov/wildlife/wdpintro.shtm</p>	<ul style="list-style-type: none"> Identification of SGCN and rare communities Education, outreach and teaching resources Field guides, Landscaping and Management guidelines Fish and game management Habitat restoration assistance Natural Areas Program
<p>WV Land Trust (WVLT)</p> <p>https://www.wvlandtrust.org/</p>	<ul style="list-style-type: none"> 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.

Partner	Role/Assistance Provided
<p>West Virginia University Extension Service (WVU Extension):</p> <ul style="list-style-type: none"> • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife 	<ul style="list-style-type: none"> • Landowner technical assistance and information on financial assistance for forest and wildlife management • Training workshops and conferences on forestry Best Management Practices and safety practices

Appendix 5. Resources

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

New River Watershed- Watershed Based Plans for Indian Creek, Piney Creek, Pipestem Creek and Wolf Creek. Available at: https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx
Long Range Plan for the Elk and Southern Conservation Districts. Summarize natural resources conditions and ranks 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
2011 Final Foundation Plan and General Management Plan for the New River Gorge National River. The Foundation Plan describes the park's origin and enabling legislation, special designations, purpose, significance, interpretive themes, analyses of important resources and values, and legislative and administrative mandates affecting park management. The General Management Plan summarizes the foundational information and describes the plan background and purpose, and preferred alternative for park management, including management zones, desired conditions, natural and cultural resource management, scenic resources, visitor experience, facilities and access, hunting and fishing, partnerships and communities, land protection and costs, the record of decision and background information. Available at: https://parkplanning.nps.gov/document.cfm?parkID=259&projectID=11040&documentID=61182
Living on Karst- A Reference Guide for Landowners in Limestone Regions http://www.livingonkarst.org/living_on_karst.htm
Guidelines for Cave and Karst Protection- IUCN https://www.iucn.org/content/guidelines-cave-and-karst-protection-0
A Guide to Responsible Caving, by the National Speleological Society https://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf
National Wild Turkey Foundation- Landowner's Toolbox https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Resp_Caving_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
Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners. http://gwwa.org/resources/GWWA-APPLRegionalGuide_130808_lo-res.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 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
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/

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