Action Plan for the High Alleghenies Conservation Focus Area

August 29, 2022

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List of Acronyms Used

ACEP- Agricultural Conservation Easement Program
AFF- American Forest Foundation
AMJV- Appalachian Mountain Joint Venture
ATFS- American Tree Farm System
BMPs- Best Management Practices
B-Rank- Biodiversity Rank
CASRI- Central Appalachian Spruce Restoration Initiative
CFA- Conservation Focus Area
CCV- Cave Conservancy of the Virginias
CCVI- Climate Change Vulnerability Index
CERW- Cerulean Winged Warbler
CREP- Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CSP- Conservation Stewardship Program
EQIP- Environmental Quality Improvement Program
FOB- Friends of Blackwater
FOC- Friends of the Cheat
FSA- Farm Service Agency
FSC- Forest Stewardship Council
G Rank- Global Rank
GWWA- Golden-winged Warbler
HUC- Hydrologic Unit Code
NRCS- Natural Resources Conservation Service
NWTF- National Wild Turkey Foundation
NSS- National Speleologial Society
OHCF- Outdoor Heritage Conservation Fund
OSMRE- Office of Surface Mining, Reclamation and Enforcement
RGS- Roughed Grouse Society
SGCN- Species of Greatest Conservation Need
SFI- Sustainable Forestry Initiative
S Rank- State Rank
SWAP- State Wildlife Action Plan
TCF- The Conservation Fund
TNC- The Nature Conservancy
TU- Trout Unlimited
USDA- United States Department of Agriculture
USDOI- United States Department of Interior
USFWS- United States Fish and Wildlife Service
WMA- Wildlife Management Area
WVACS- West Virginia Association for Cave Studies
WVCA- West Virginia Conservation Agency
WVCC- West Virginia Cave Conservancy
WVDA- West Virginia Department of Agriculture
WVDHHR- West Virginia Department of Health and Human Resources
WVDNR- West Virginia Division of Natural Resources
WVDEP- West Virginia Department of Environmental Protection
WVDOF- West Virginia Division of Forestry
WVDOH- West Virginia Division of Highways
WVLT- West Virginia Land Trust
WVU- West Virginia University

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the first revision to the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species, and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups, cave interest groups and other non-profit conservation organizations working in the area to develop the Action Plan for the High Alleghenies CFA. The plan addresses the eight essential elements required in the SWAP. It provides an overview of the landscape and major habitat types within this CFA, including forest and woodland habitats, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. It also identifies 347 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the plan lists the priority species, stresses, and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. An implementation plan for each major habitat type lists partners and programs available to assist with each of the actions as well as metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA, and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience, and outlines next steps in plan implementation.

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

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

Introduction to the State Wildlife Action Plan & Conservation Focus Areas

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

Species of Greatest Conservation Need, Habitats and Stresses

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

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

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

Conservation Actions

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

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

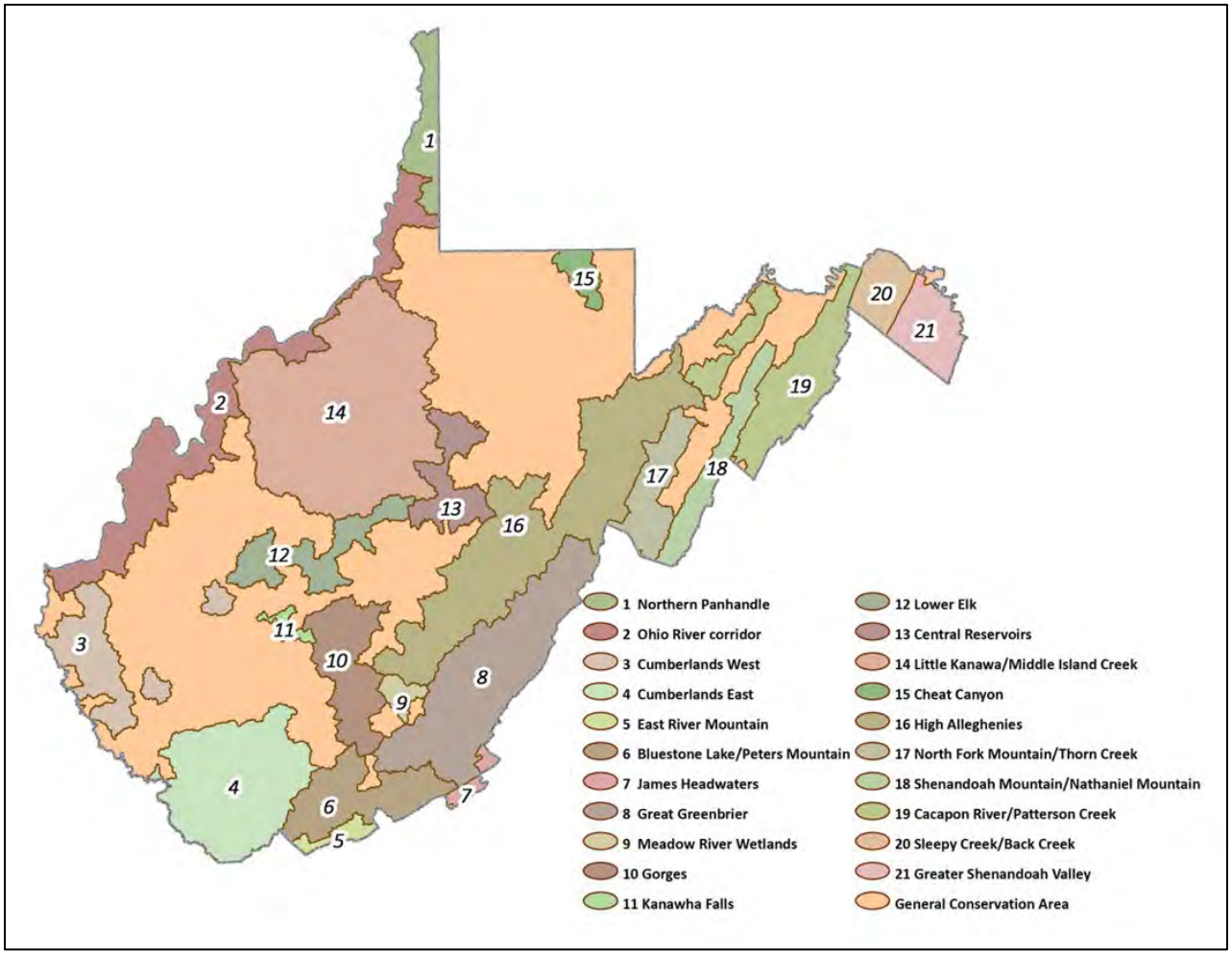
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve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

Conservation Focus Areas and Action Plans

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

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

Map 1. Conservation Focus Areas in West Virginia.



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

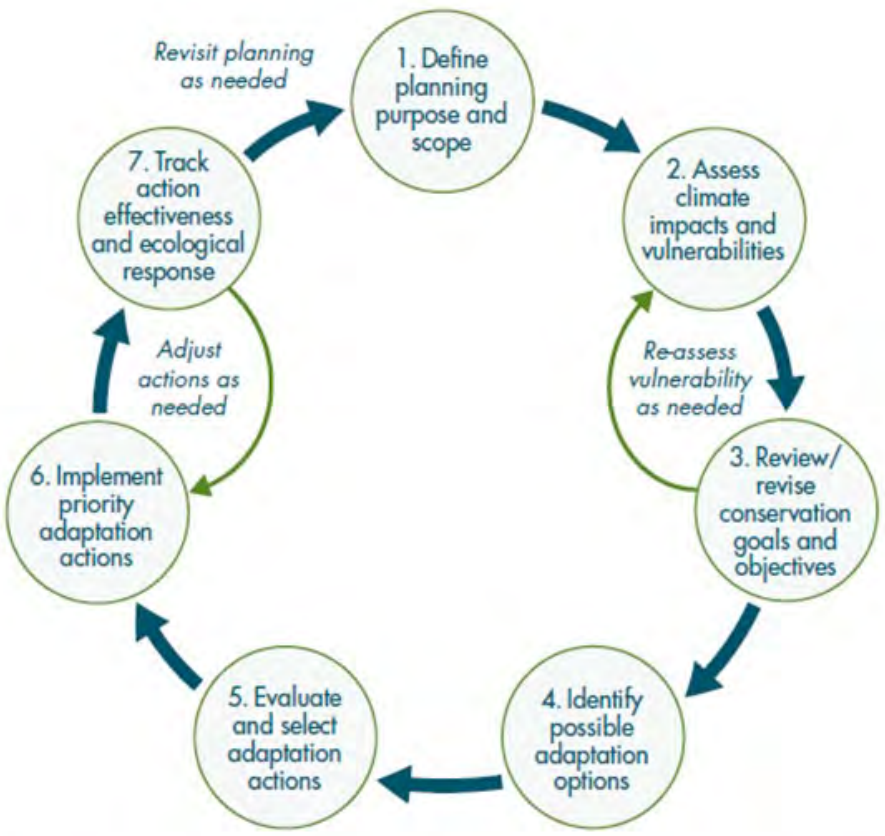
habitat fragmentation in others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change, and ecological connectivity within and between landscapes. Rather than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



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

Organization of this Action Plan

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

How to use this plan

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

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

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

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

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

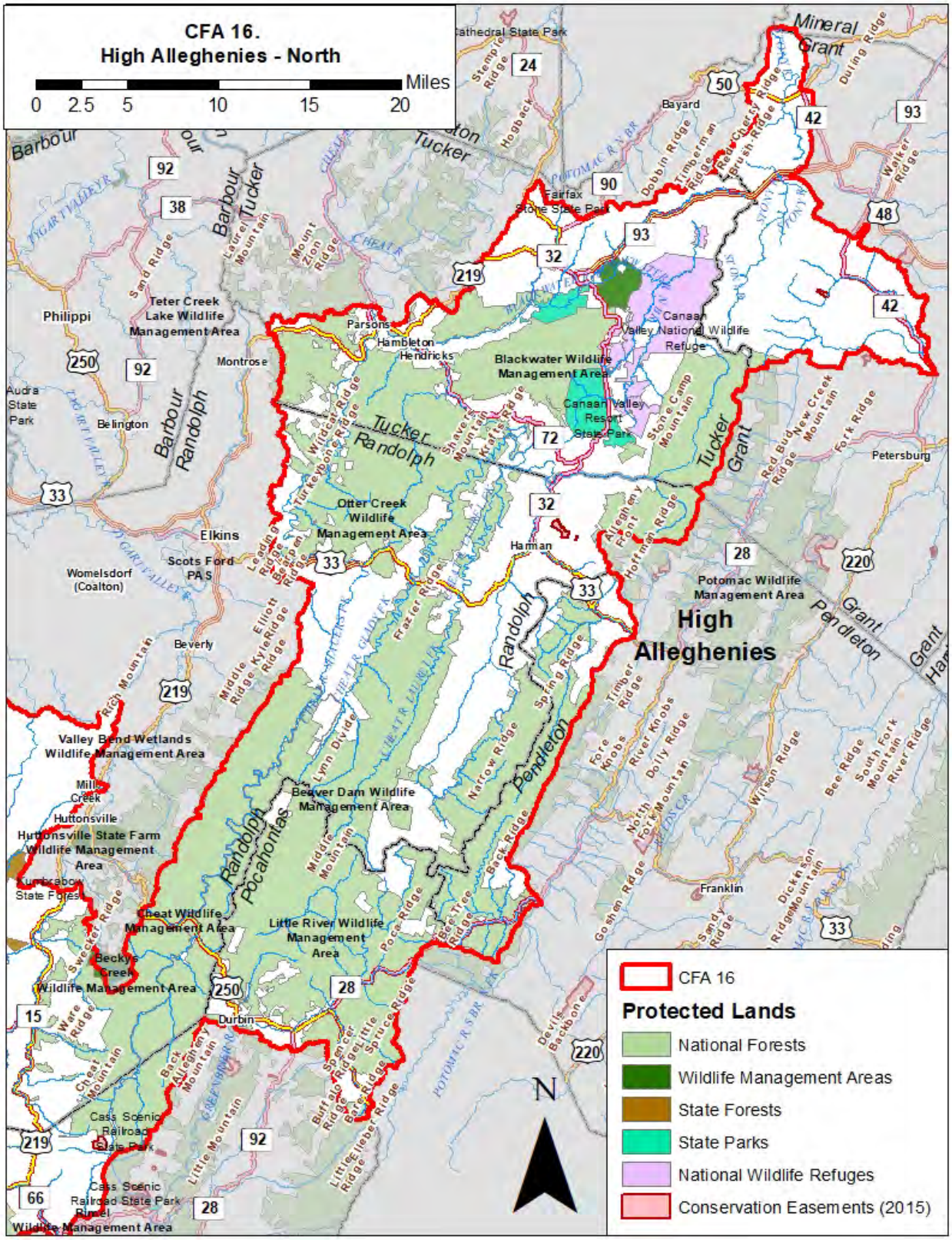
The High Allegheny Conservation Focus Area

Overview

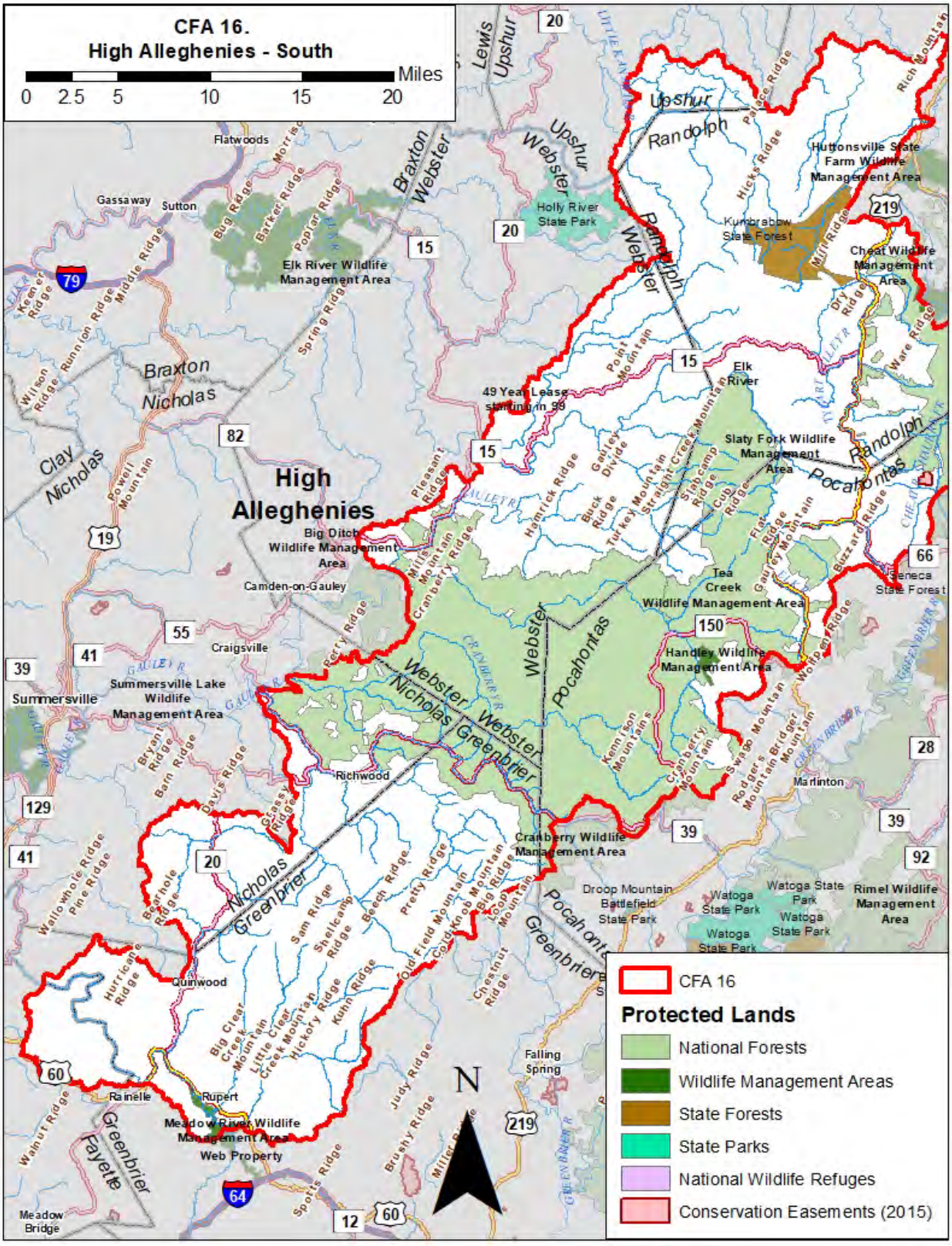
The High Alleghenies Conservation Focus Area (CFA) spans the highest mountains of West Virginia, from the Huckleberry Plains atop the Allegheny Front, Canaan Valley, and Blackwater Canyon region in the north, south across Spruce Mountain and the headwaters of the Cheat and Greenbrier rivers, and southwest across the Gauley and Yew mountains and headwaters of the Gauley River. High mountain corridors such as the Allegheny Front and Shavers Mountain form critical north-south migratory pathways for birds and other wildlife species. Mountaintops in the CFA are generally broad, resulting in substantial areas of high elevation, and are often separated by similarly broad valleys at medium elevations (1,800–2,500 feet). The CFA has substantial variations in elevational relief, underlying geology, and landforms.

The region includes the wettest, snowiest, and coldest parts of West Virginia. It is predominantly forested with federal land ownership predominating, primarily comprised by the Monongahela National Forest. Most private forestland is in small to medium-sized non-industrial private holdings. Many large industrial forestlands have changed hands in the last 10 to 15 years, and the largest tracts are currently concentrated in the vicinity of Canaan Valley, Kumbrabow State Forest, and the Gauley River headwaters. Valleys are typically sparsely settled with small farms managed as pasture. Maps providing overviews of the northern and southern portions of the CFA are on the following pages.

Map 2. Overview – North



Map 3. Overview – South



Habitats

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

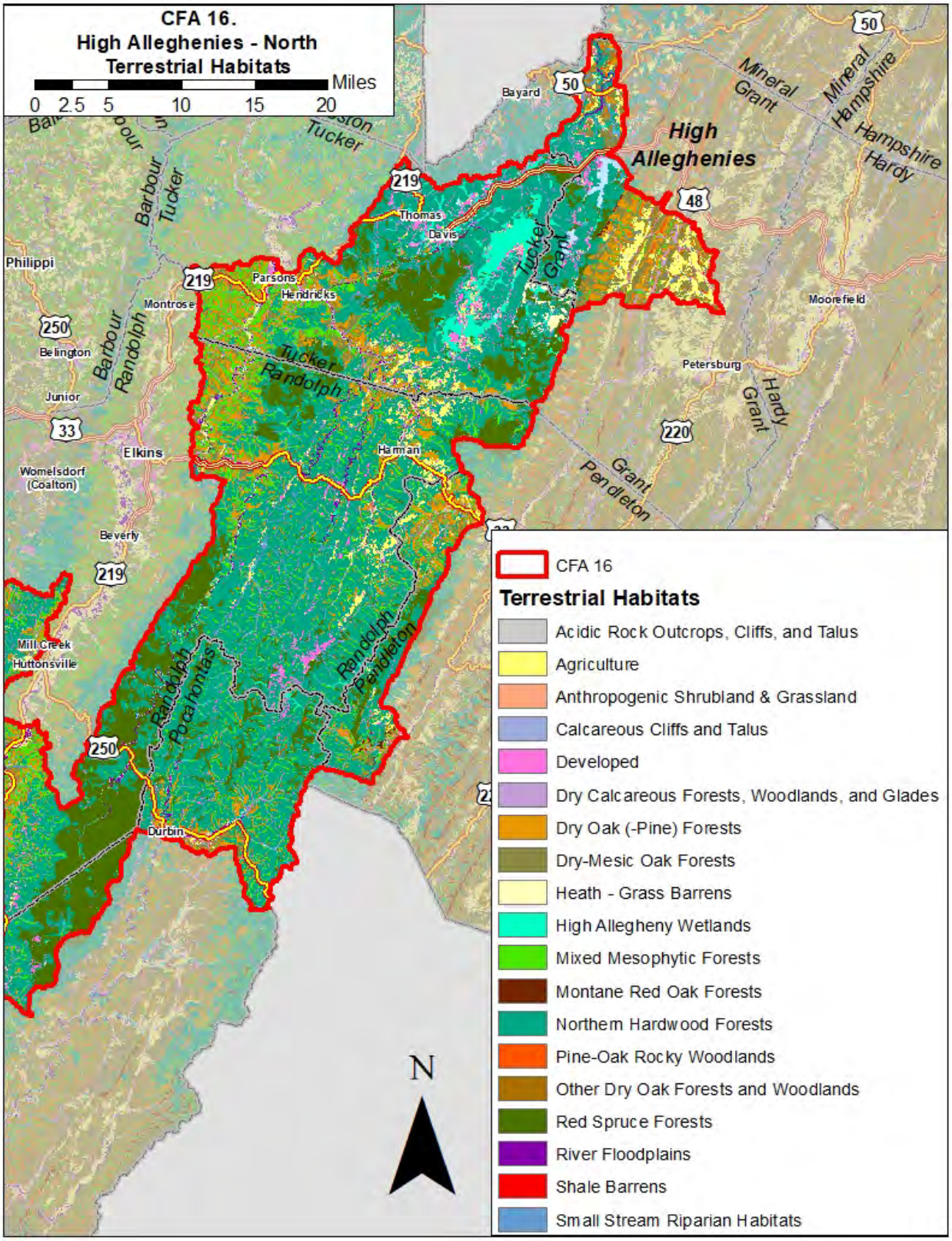
Terrestrial Habitats

Nineteen of the habitat types described in the SWAP are present in this CFA, including over 90% of the state's red spruce forests. Heath-grass barrens represent a tiny portion of the terrestrial habitat present in this CFA (less than 1%) yet represent over 95% of the state's total heath-grass barren habitat. High Allegheny wetlands also compose a small percentage of the total habitat type in the CFA at just over 1%, yet represents over 80% of the state's total high Allegheny wetland habitat. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

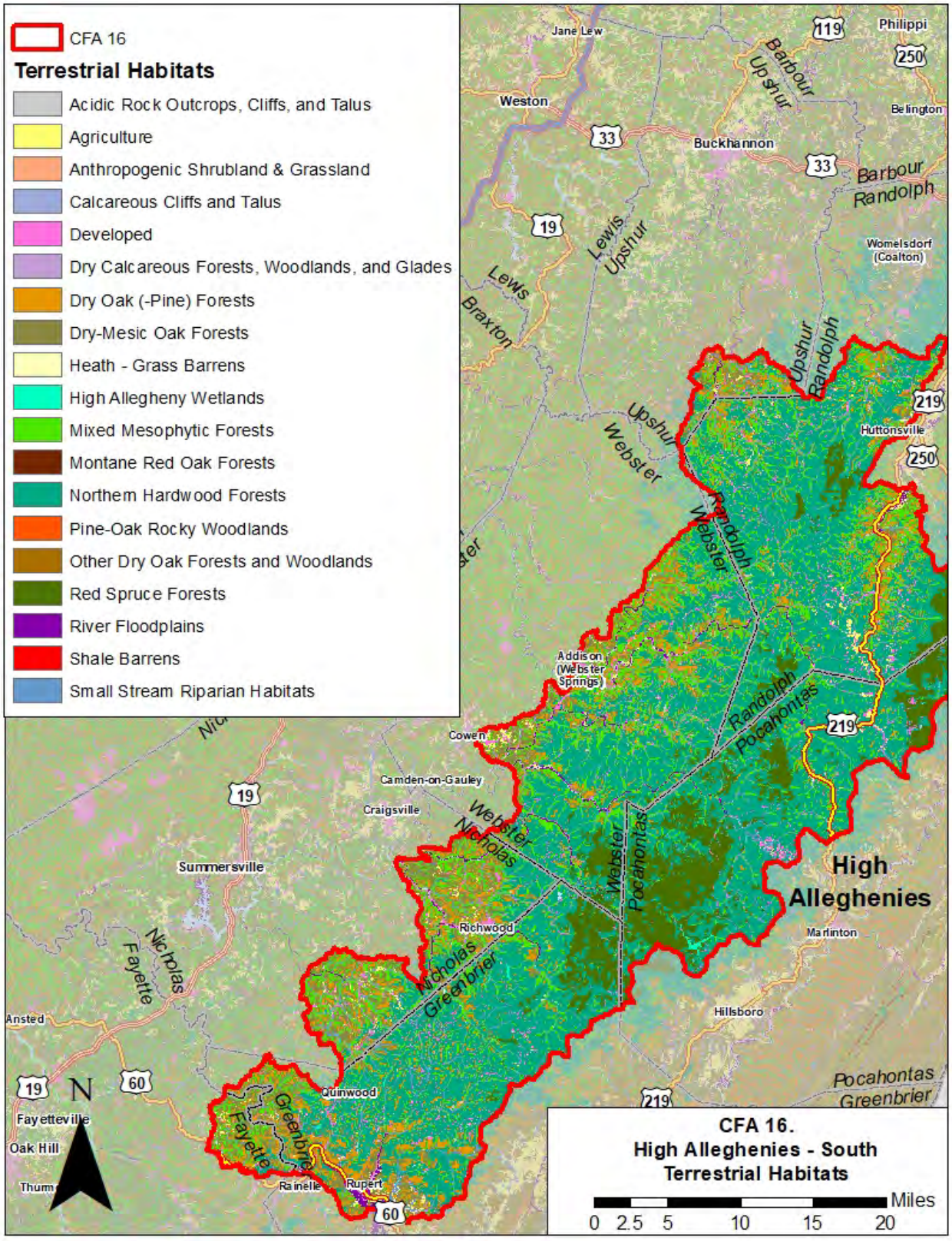
Table 1. Terrestrial Habitat Summary

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

Map 4. Terrestrial Habitats – North



Map 5. Terrestrial Habitats – South



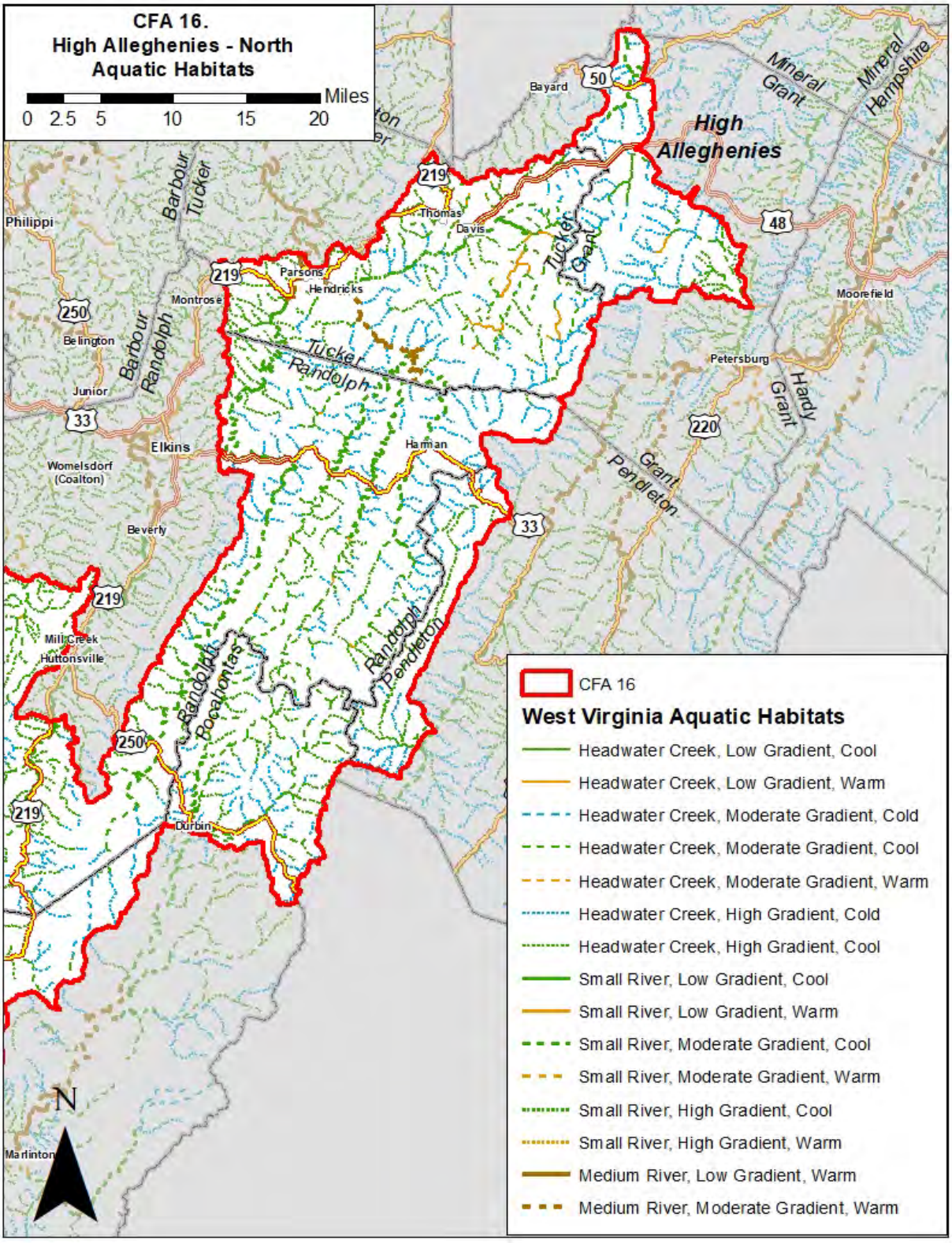
Aquatic Habitats

Fifteen of the aquatic habitat types described in the SWAP are present within the High Alleghenies CFA, including all of the state's cool, high gradient small river habitat, as well as over half of the state's cool, low gradient headwater, and cold, moderate gradient headwater habitats. Almost half of the total aquatic habitat found within the CFA is composed of cool, high gradient headwater streams.

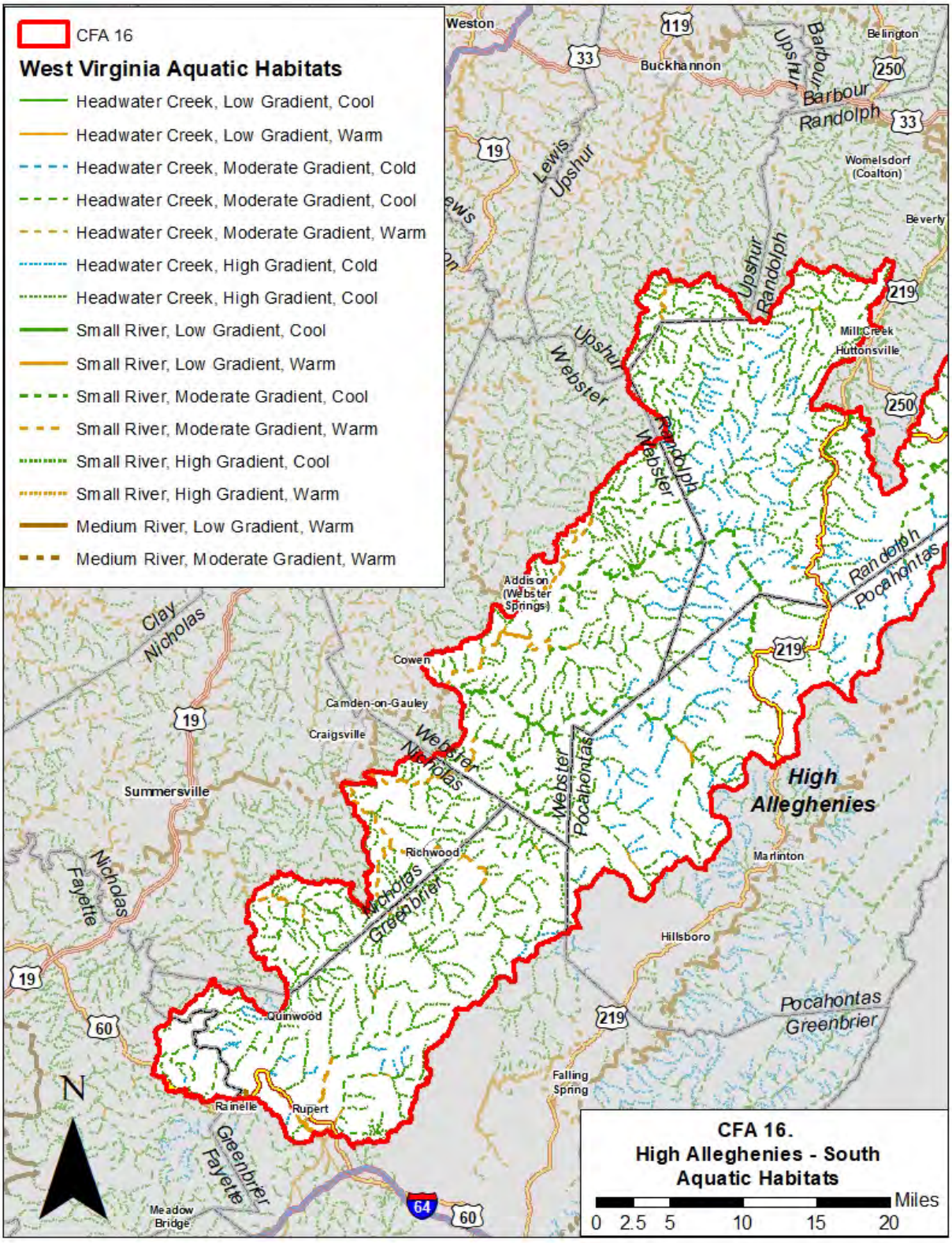
Table 2. Aquatic Habitat Summary

Habitat Type	Miles in CFA	% of CFA Miles	% of WV Total for Type
Headwater Creek,Low Gradient,Cool	10	0.39%	73.98%
Headwater Creek,Low Gradient, Warm	54	2.03%	9.69%
Headwater Creek,Moderate Gradient,Cold	32	1.19%	60.20%
Headwater Creek,Moderate Gradient,Cool	478	17.95%	21.79%
Headwater Creek,Moderate Gradient,Warm	1	0.04%	0.03%
Headwater Creek,High Gradient,Cold	648	24.33%	22.10%
Headwater Creek,High Gradient,Cool	1,073	40.29%	17.14%
Small River,Low Gradient,Cool	17	0.64%	45.09%
Small River,Low Gradient, Warm	12	0.46%	2.68%
Small River,Moderate Gradient,Cool	228	8.54%	48.83%
Small River,Moderate Gradient,Warm	64	2.38%	11.70%
Small River,High Gradient,Cool	9	0.32%	100.00%
Small River,High Gradient,Warm	0	0.01%	1.92%
Medium River, Low Gradient,Warm	7	0.27%	1.54%
Medium River,Moderate Gradient,Warm	31	1.16%	8.89%
Totals	2,664	100.00%	

Map 6. Aquatic Habitat – North



Map 7. Aquatic Habitat – South



Species of Greatest Conservation Need

Table 3 lists the number of Priority 1 and 2 SGCN in each taxa group listed in the SWAP for the High Alleghenies CFA.

Table 3. SGCN Summary by Taxa

Taxa	# SGCN
Amphibians	11
Birds	54
Butterflies and Moths	26
Cave Invertebrates	30
Crayfish	4
Dragonflies and Damselflies	36
Fish	15
Mammals	23
Mussels	4
Other Invertebrates	5
Plants	193
Reptiles	13
Snails	26
Tiger Beetles	2
Totals	**442**

This CFA supports nearly all of West Virginia's Red Spruce Forests, most Heath-Grass Barrens, the majority of High Allegheny Wetlands, a significant amount of cool-water stream habitats, and caves with endemic cave species and significant bat populations. Canaan Valley supports the largest wetland complex in West Virginia and the unglaciated Appalachian Mountains. Cheat Mountain supports the most extensive Red Spruce forests remaining south of the Adirondack Mountains in New York. Shavers Fork is the highest river of its size in the East. The High Alleghenies CFA also includes some of the largest intact forest blocks, between the Adirondack Mountains and Great Smoky mountains, representing several major forest types. Cranberry Wilderness and surrounding areas constitute the largest intact forest block in the Mid-Atlantic States and Central Appalachian Mountains. These forest blocks are critical for forest interior nesting birds, maintaining embedded patch habitats, regional connectivity, and functional, resilient forest communities. Some high elevation and cave species are endemic or nearly so to the High Alleghenies CFA including:

- Cheat Mountain Salamander
- West Virginia Northern Flying Squirrel

- Gandy Creek Cave Springtail

The High Alleghenies CFA also supports all or most of the West Virginia distribution for many taxa endemic to the Central/Southern Appalachians, such as:

- Southern Rock Vole
- Southern Water-shrew
- Spruce Knob Three-tooth Snail
- Shriver's Frilly Orchid
- Blue Ridge St. John's-wort

Many northern species also have all or most of their West Virginia distribution here including:

- Snowshoe Hare
- Northern Goshawk
- Harris' Checkerspot
- White Monkshood

Caves in the CFA support 30 Species of Greatest Conservation Need (SGCN) cave invertebrates. One cave houses one of the largest known maternity colonies of Virginia Big-eared Bat in its range nationwide. Several caves serve as hibernacula for Virginia Big-eared Bats, Indiana Bats and other SGCN bats.

With 54 SGCN birds, the importance of this CFA cannot be overstated. The area is of large significance to most bird SGCNs across all habitat groupings and is important for the continued breeding presence in West Virginia for many, especially northern species reaching their southern extents and species of forest interiors.

Seven of the 10 New River endemic fishes occur in the CFA, including the largest remaining global occurrences of the globally rare and federally endangered Candy Darter (*Etheostoma osburni*). Forested streams such as the East Fork and West Fork of the Greenbrier are increasingly recognized as strongholds for the Eastern Hellbender in West Virginia.

The amazing diversity and extent of high-quality habitats here also support 26 SGCN butterflies and moths, 36 SGCN dragonflies and damselflies, 23 SGCN mammals, 26 SGCN snails, and 193 SGCN plants

This Plan lists the priority SGCNs in each major habitat type.

Distinctive Stresses

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

Upland forests and wetlands have been significantly affected by historical industrial logging and related fires, which substantially altered wetlands and upland deciduous forest structure and composition and greatly reduced the area and quality of Red Spruce forests.

Aquatic habitats have been impacted by:

1. Historic tanneries operations and past mining activities which degraded water quality.
2. Acid precipitation which has degraded many medium to high elevation streams, caused spruce die- offs, and reduced deciduous forest growth and productivity.

Imminent threats to upland terrestrial and aquatic habitats include:

1. Energy development, transmission corridors, and resort and vacation home development which fragment high elevation habitats.
2. Climate change is expected to impact high elevation species and habitats.

In addition to this list of general stresses, this Plan lists more-specific local stresses affecting priority SGCNs in each major habitat type.

Conservation Actions

To address these stresses, the 2015 SWAP recommended three main areas of action within the CFA.

Land Protection

- Cooperative efforts with public landowners to acquire and/or maintain large, intact forest blocks, thus protecting many other special habitats.
- Partner with public land managers to avoid habitat loss and fragmentation by renewable energy and other development.

Habitat Restoration

- Continue and expand Red Spruce/high elevation forest restoration.
- Continue stream treatments to offset acidification.
- Assist with the management of industrial timberlands to provide opportunities that benefit early-successional forest species.

Climate Friendly Conservation

- 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.

This Plan also lists more specific conservation actions to address the stresses affecting priority SGCNs 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:

- Monongahela National Forest (MNF)
- WV Division of Forestry (WVDOF)
- US Fish and Wildlife Service (USFWS)
- Central Appalachian Spruce Restoration Initiative (CASRI)
- Potomac Highlands Cooperative Weed and Pest Management Area (PHCWPMA)
- The Nature Conservancy (TNC)
- Appalachian Mountain Joint Venture (AMJV)
- National Wild Turkey Federation (NWTF)
- Corporate landowners

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

Protected Lands

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

- Monongahela National Forest
- Canaan Valley National Wildlife Refuge
- Canaan Valley State Park
- Blackwater Falls State Park
- Cass Scenic Railroad State Park
- Little Canaan WMA
- Huttonsville WMA
- Becky's Creek WMA
- Handley WMA
- Kumbrabow State Forest.

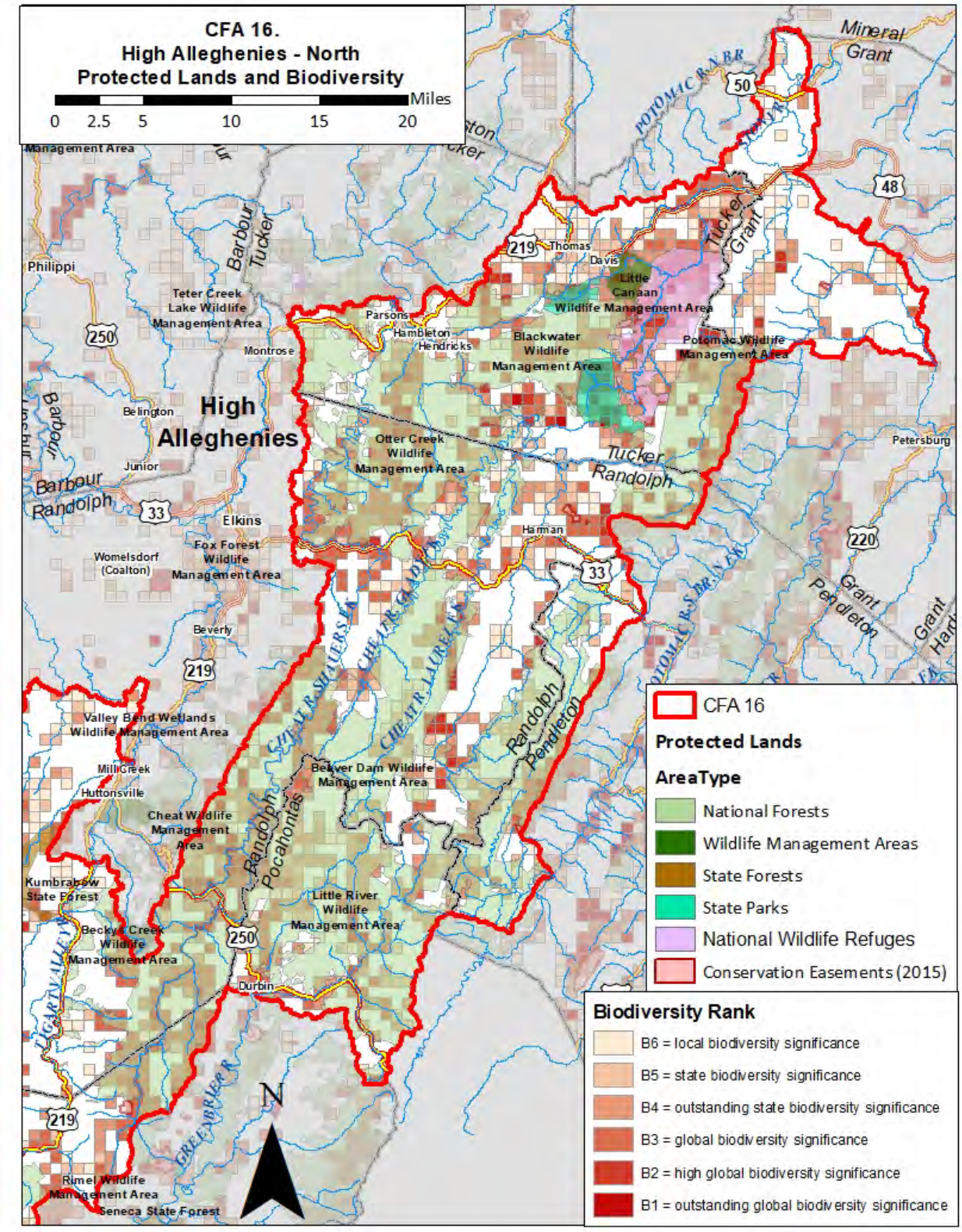
These public lands provide important wildlife habitat and are managed for conservation or other compatible goals. Appendix 3 lists habitat types occurring on these public lands within this CFA. WVDNR will work with public land managers to identify opportunities to plan and implement conservation actions that address stresses in these habitats and support priority SGCNs. 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.

In addition, The Nature Conservancy and the Grant County Farmland Protection Board hold conservation easements that may protect important wildlife habitats and provide additional wildlife conservation opportunities within the CFA.

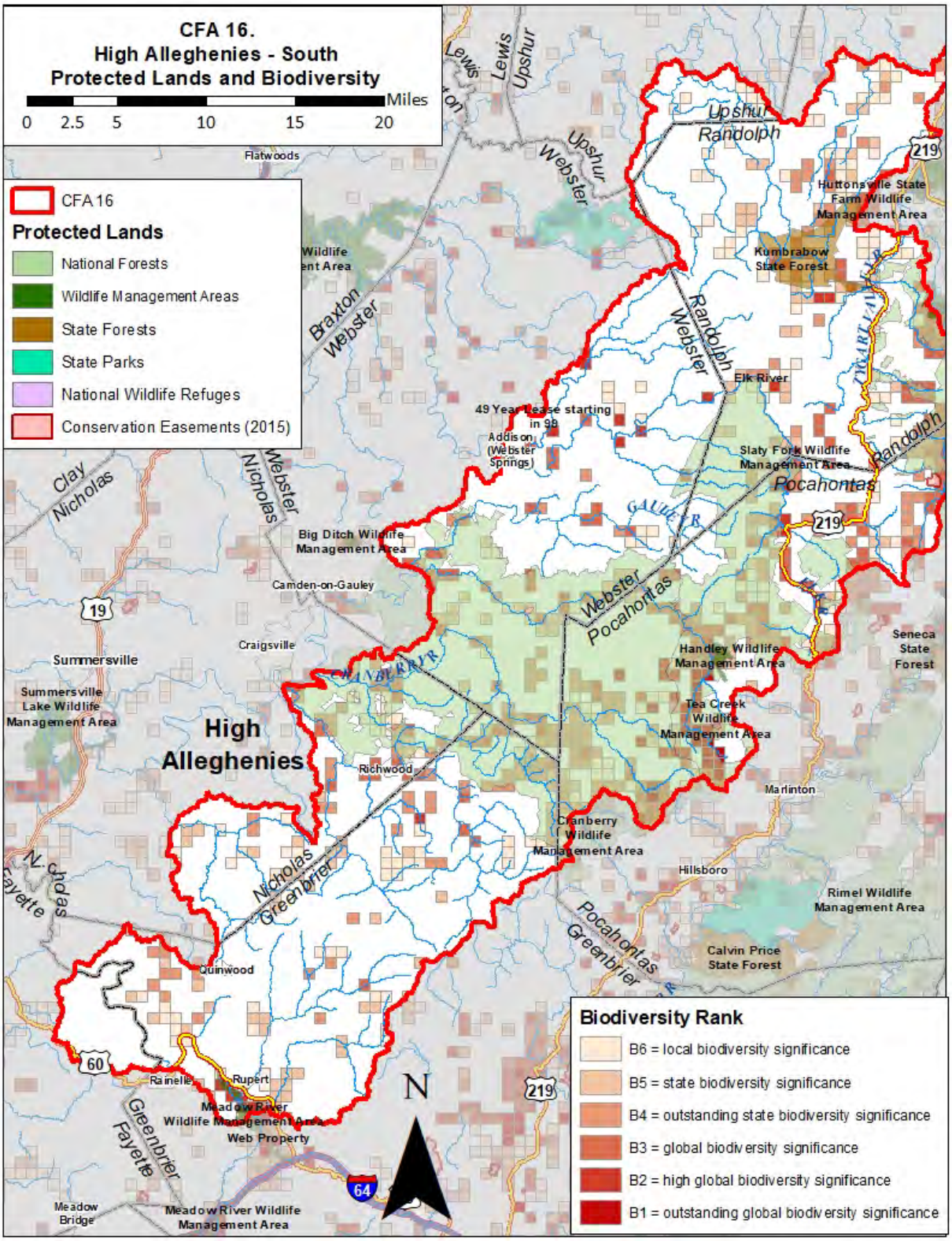
Maps 8 and 9 show the location of public lands and conservation easements in the CFA as of 2015,

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). It also shows known occurrences of SGCNs and rare plant communities within a 1-square kilometer grid, 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 lands 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 8. Protected Lands and Biodiversity – North



Map 9. Protected Lands and Biodiversity – South



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 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

Table 4 lists SGCNs that were selected as priorities within the CFA based on the above criteria. Also listed are at risk species by the United States Fish and Wildlife Service.

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 High Alleghenies CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank
Amphibian	Aneides aeneus	Green Salamander	S3	G3G4
Amphibian	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3G4
Amphibian	Plethodon nettingi	Cheat Mountain Salamander	S2	G2G3
Bird	Accipiter gentilis	Northern Goshawk	S1B, S1N	G5
Bird	Ammodramus henslowii	Henslow's Sparrow	S1B	G4
Bird	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5
Bird	Aquila chrysaetos	Golden Eagle	S3N	G5
Bird	Asio otus	Long-eared Owl	S1B, S1N	G5
Bird	Bonasa umbellus	Ruffed Grouse	S3B, S3N	G5
Bird	Botaurus lentiginosus	American Bittern	S1B, S1N	G4
Bird	Buteo platypterus	Broad-winged Hawk	S3B	G5
Bird	Cardellina canadensis	Canada Warbler	S3B	G5
Bird	Chaetura pelagica	Chimney Swift	S3B	G5
Bird	Chordeiles minor	Common Nighthawk	S2B	G5
Bird	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5
Bird	Contopus cooperi	Olive-sided Flycatcher	S1B	G4
Bird	Dolichonyx oryzivorus	Bobolink	S3B	G5
Bird	Falco sparverius	American Kestrel	S3B	G5
Bird	Hylocichla mustelina	Wood Thrush	S3B	G5
Bird	Parkesia motacilla	Louisiana Waterthrush	S3B	G5
Bird	Scolopax minor	American Woodcock	S3B	G5
Bird	Seiurus noveboracensis	Northern Waterthrush	S2B	G5
Bird	Setophaga cerulea	Cerulean Warbler	S2B	G4
Bird	Spizella pusilla	Field Sparrow	S3B, S3N	G5
Bird	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5
Bird	Tyto alba	Barn Owl	S2B, S2N	G5
Bird	Vermivora chrysoptera	Golden-winged Warbler	S1B	G4
Cave Invertebrate	Apochthonius paucispinosus	Dry Fork Valley Cave Pseudoscorpion	S1	G1
Cave Invertebrate	Arrhopalites pavo	A Cave Springtail	S1S2	G1G2
Cave Invertebrate	Caecidotea cannula	An Isopod	S1	G2G3
Cave Invertebrate	Caecidotea simonini	An Isopod	S1	G1G2
Cave Invertebrate	Pseudosinella certa	Gandy Creek Cave Springtail	S1	G1
Cave Invertebrate	Pseudosinella sp. 8	A Springtail	S2	G2
Cave Invertebrate	Stygobromus culveri	Culver's Cave Amphipod	S1	G1G2

Taxa	Scientific Name	Common Name	S Rank	G Rank
Cave Invertebrate	Stygobromus emarginatus	Greenbrier Cave Amphipod	S3	G3G4
Cave Invertebrate	Stygobromus franzi	Franz's Cave Amphipod	S1	G3G4
Cave Invertebrate	Stygobromus nanus	Pocahontas Cave Amphipod	S1	G1G2
Cave Invertebrate	Stygobromus parvus	Minute Cave Amphipod	S1	G2G3
Fish	Ameiurus melas	Black Bullhead	S1	G5
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5
Fish	Anguilla rostrata	American Eel	S2	G4
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4
Fish	Cottus kanawhae	Kanawha Sculpin	S2	G4
Fish	Etheostoma osburni	Candy Darter	S1	G3
Fish	Exoglossum laurae	Tonguetied Minnow	S2	G4
Fish	Luxilus cornutus	Common Shiner	S1S2	G5
Fish	Margariscus margarita	Pearl Dace	S2S3	G5
Fish	Notropis scabriceps	New River Shiner	S2	G4
Fish	Percina gymnocephala	Appalachia Darter	S2	G4
Fish	Percina peltata	Shield Darter	S1	G5
Fish	Phenacobius teretulus	Kanawha Minnow	S1	G3G4
Fish	Salvelinus fontinalis	Brook Trout	S5	G5
Fish	Thoburnia rhothoeca	Torrent Sucker	S3	G4
Gastropoda	Discus catskillensis	Angular Disk	S2	G5
Gastropoda	Glyphyalinia picea	Rust Glyph	S2	G3
Gastropoda	Mesodon aff. Andrewsae	Balsam Globe	S1	GNR
Gastropoda	Stenotrema simile	Bear Creek Slitmouth	S2	G2
Gastropoda	Striatura exigua	Ribbed Striate	S2	G5
Gastropoda	Triodopsis picea	Spruce Knob Threetooth	S3	G3
Gastropoda	Zonitoides elliotti	Green Dome	S2	G4
Lepidoptera	Euphydryas phaeton	Baltimore Checkerspot	S3S4	G4
Lepidoptera	Euphyes bimacula	Two-spotted Skipper	S1	G4
Lepidoptera	Pieris virginiensis	West Virginia White	S3	G3?
Lepidoptera	Polygonia faunus symthi	Smyth's Green Comma	S1	G5T3
Mammal	Corynorhinus townsendii virginianus	Virginia Big-eared Bat	S2	G4T2
Mammal	Glaucomys sabrinus fuscus	WV Northern Flying Squirrel	S2	G5T2
Mammal	Lasionycteris noctivagans	Silver-haired Bat	S2	G5
Mammal	Lasiurus borealis	Eastern Red Bat	S4	G5
Mammal	Lasiurus cinereus	Hoary Bat	S3	G5
Mammal	Lepus americanus	Snowshoe Hare		G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Mammal	Microtus chrotorrhinus carolinensis	Southern Rock Vole	S2	G4T3
Mammal	Myotis lucifugus	Little Brown Myotis	S2*	G3
Mammal	Myotis septentrionalis	Northern Myotis	S2*	G2G3
Mammals	Myotis sodalis	Indiana Bat	S1	G2
Mammal	Neotoma magister	Allegheny Woodrat	S3	G3G4
Mammal	Sorex dispar	Long-tailed Shrew	S2S3	G4
Mammal	Sorex palustris punctulatus	Southern Water Shrew	S1	G5T3
Mammal	Sylvilagus obscurus	Appalachian Cottontail	S2	G4
Mammal	Synaptomys cooperi	Southern Bog Lemming	S3	G5
Mussel	Alasmidonta marginata	Elktoe	S1	G4
Mussel	Lasmigona subviridis	Green Floater	S2	G3
Odonata	Argia bipunctulata	Seepage Dancer	S1	G4
Odonata	Gomphus adelphus	Mustached Clubtail	S1	G4
Odonata	Gomphus quadricolor	Rapids Clubtail	S3	G3G4
Odonata	Lanthus parvulus	Northern Pygmy Clubtail	S3	G4
Odonata	Leucorrhinia glacialis	Crimson-ringed Whiteface	S1	G5
Odonata	Ophiogomphus mainensis fastigiatus	Maine Snaketail	S3	G4TU
Odonata	Rhionaeschna mutata	Spatterdock Darner	S1	G4
Odonata	Somatochlora elongata	Ski-tipped Emerald	S3	G5
Odonata	Somatochlora forcipata	Forcipate Emerald	S3	G5
Other Invertebrate	Allocapnia frumi	Monongahela Snowfly	S2	G2
Other Invertebrate	Hansonoperla appalachia	Appalachian Stonefly	S2	G3
Other Invertebrate	Megaleuctra flinti	Shenandoah Needlefly	S1	G2
Other Invertebrate	Sweltsa pocahontas	A Stonefly	S2	G2
Plant	Abies balsamea	Balsam Fir	S1	G5
Plant	Aconitum reclinatum	White Monkshood	S3	G3
Plant	Agrostis mertensii	Northern Bentgrass	S1	G5
Plant	Amelanchier bartramiana	Oblong-fruit Serviceberry	S2	G5
Plant	Andromeda polifolia var. glaucophylla	Bog-rosemary	S1	G5T5
Plant	Anemone canadensis	Roundleaf Thimbleweed	S1	G5
Plant	Botrychium lanceolatum var. angustisegmentum	Lanceolate Grapefern	S1	G5T4

Taxa	Scientific Name	Common Name	S Rank	G Rank
Plant	Calopogon tuberosus var. tuberosus	Tuberous Grass-pink	S1	G5T5
Plant	Carex arctata	Drooping Woodland Sedge	S1	G5?
Plant	Carex atherodes	Awned Sedge	S1	G5
Plant	Carex bushii	Bush's Sedge	S2S3	G4
Plant	Carex deflexa	Northern Sedge	S1	G5
Plant	Carex haydenii	Cloud Sedge	S1	G5
Plant	Carex lacustris	Lake Sedge	S2	G5
Plant	Carex lasiocarpa var. americana	Woolly-fruit Sedge	S1	G5T5
Plant	Carex manhartii	Manhart's Sedge	S1	G3G4
Plant	Carex meadii	Mead's Sedge	S1	G4G5
Plant	Carex novae-angliae	New England Sedge	S1	G5
Plant	Carex pauciflora	Few-flower Sedge	S1	G5
Plant	Carex roanensis	Roan Mountain Sedge	S2	G3
Plant	Carex tetanica	Rigid Sedge	S1	G4G5
Plant	Carex trichocarpa	Hairy-fruit Sedge	S1	G4
Plant	Carex tuckermanii	Tuckerman's Sedge	S1	G4
Plant	Carex vesicaria	Inflated Sedge	S2	G5
Plant	Clematis occidentalis var. occidentalis	Purple Virgin's Bower	S2	G5T5
Plant	Coeloglossum viride var. virescens	Long-bracted Green Orchid, Satyr Orchid	S1	G5T5
Plant	Corallorhiza bentleyi	Bentley's Coralroot	S1	G1G2
Plant	Corallorhiza maculata var. occidentalis	Western Spotted Coralroot	S1	G5T3T5
Plant	Corallorhiza trifida	Early Coralroot	S1	G5
Plant	Cryptogramma stelleri	Fragile Rockbrake	S1	G5
Plant	Cuscuta rostrata	Beaked Dodder	S2	G4
Plant	Cypripedium reginae	Showy Lady's-slipper	S1	G4
Plant	Eleocharis elliptica	Elliptic Spikerush	S1	G5
Plant	Equisetum sylvaticum	Woodland Horsetail	S1	G5
Plant	Euphorbia purpurea	Glade Spurge	S2	G3
Plant	Fraxinus nigra	Black Ash	S2	G5
Plant	Gentianopsis crinita	Greater Fringed Gentian	S1	G5
Plant	Geum aleppicum	Yellow Avens	S1	G5
Plant	Geum rivale	Purple Avens	S1	G5
Plant	Glyceria grandis var. grandis	American Mannagrass	S2	G5T5
Plant	Goodyera repens	Dwarf Rattlesnake-plantain	S1S2	G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Plant	Gymnocarpium appalachianum	Appalachian Oak Fern	S2	G3
Plant	Gymnocarpium dryopteris	Northern Oak Fern	S1	G5
Plant	Hasteola suaveolens	False Indian-plantain	S3	G4
Plant	Hypericum mitchellianum	Blue Ridge St. John's-wort	S1	G3
Plant	Ilex collina	Hill Holly	S2	G3
Plant	Isotria medeoloides	Small Whorled Pogonia	S1	G2
Plant	Juncus filiformis	Thread Rush	S2	G5
Plant	Juncus trifidus	Highland Rush	S1	G5
Plant	Linnaea borealis ssp. americana	Twinflower	S1	G5T5
Plant	Listera cordata var. cordata	Heartleaf Twayblade	S2	G5T5
Plant	Listera smallii	Kidneyleaf Twayblade	S2	G4
Plant	Lonicera canadensis	Fly Honeysuckle	S2	G5
Plant	Luzula bulbosa	Bulbous Woodrush	S1	G5
Plant	Lycopodiella alopecuroides	Foxtail Clubmoss	S1	G5
Plant	Lycopodiella inundata	Northern Bog Clubmoss	S2	G5
Plant	Lycopodium lagopus	One-cone Groundpine	S1	G5
Plant	Marshallia grandiflora	Monongahela Barbara's-buttons	S2	G2
Plant	Menyanthes trifoliata	Buckbean	S1	G5
Plant	Ophioglossum pusillum	Northern Adder's-tongue	S1	G5
Plant	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus	S2	G4
Plant	Piptatherum canadense	Canada Mountain Ricegrass	S1	G5
Plant	Platanthera psycodes	Lesser Purple Fringed Orchid	S1	G5
Plant	Platanthera shriveri	Shriver's Frilly Orchid	S1	G1?
Plant	Poa saltuensis	Old-pasture Bluegrass	S1	G5
Plant	Polemonium vanbruntiae	Bog Jacob's-ladder	S2	G3G4
Plant	Polygala cruciata var. aquilonia	Cross-leaved Milkwort	S1	G5T4
Plant	Populus balsamifera ssp. balsamifera	Balsam Poplar	S1	G5T5
Plant	Potamogeton tennesseensis	Tennessee Pondweed	S2	G2
Plant	Prenanthes crepidinea	Corymbed Rattlesnake-root	S1	G4
Plant	Rhamnus alnifolia	Alderleaf Buckthorn	S1S2	G5
Plant	Rhynchospora fusca	Brown Beaksedge	S1	G4G5
Plant	Ribes lacustre	Bristly Black Currant	S2	G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Plant	Rubus pubescens var. pubescens	Dwarf Red Bramble	S1	G5T5
Plant	Sagittaria calycina var. calycina	Long-lobe Arrowhead	S2	G5T5?
Plant	Saxifraga michauxii	Cliff Saxifrage	S1	G4G5
Plant	Saxifraga pensylvanica	Eastern Swamp Saxifrage	S2	G5
Plant	Schizachne purpurascens	False Melicgrass	S1	G5
Plant	Sericocarpus linifolius	Narrowleaf Whitetop Aster	S1	G5
Plant	Sibbaldiopsis tridentata	Mountain-cinquefoil	S2	G5
Plant	Spiraea virginiana	Virginia Spiraea	S1	G2
Plant	Stachys aspera	Gritty Hedge-nettle	S1	G4?
Plant	Stellaria borealis ssp. borealis	Northern Stitchwort	S1	G5T5
Plant	Symphyotrichum novi-belgii	New Belgium American-aster	S2S3	G5
Plant	Taxus canadensis	Canada Yew	S2S3	G5
Plant	Thelypteris simulata	Bog Fern	S1	G4G5
Plant	Torreyochloa pallida var. fernaldii	Mannagrass	S2	G5T4Q
Plant	Torreyochloa pallida var. pallida	Pale False Mannagrass	S1	G5T5?
Plant	Triantha glutinosa	Sticky Bog-asphodel	S1	G3G5
Plant	Trichomanes boschianum	Appalachian Bristle Fern	S1	G4
Plant	Trifolium stoloniferum	Running Buffalo Clover	S3	G3
Plant	Trillium nivale	Snowy Trillium	S2	G4
Plant	Triphora trianthophora	Threebirds	S2	G3G4
Plant	Viburnum opulus var. americanum	Highbush Cranberry	S1	G5T5
Plant	Vittaria appalachiana	Appalachian Shoestring Fern	S1	G4
Plant	Zigadenus leimanthoides	Pine Barren Deathcamas	S2	G4Q
Reptile	Opheodrys vernalis	Smooth Greensnake	S5	G5
Reptile	Plestiodon anthracinus anthracinus	Northern Coal Skink	S2	G5T5
Reptile	Virginia valeriae pulchra	Mountain Earthsnake	S2	G5T3T4

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

Covering almost half of the CFA, Northern Hardwood Forests represent the largest proportion of forest habitat types. Mixed Mesophytic Forests and Red Spruce Forests are the next most abundant forest types found within the CFA, covering just over 12% and 11% of the total area respectively. Although Red Spruce Forests occupy a small portion of the CFA's total area, these forests represent over 90% of overall Red Spruce occurrence in the state. Map 10 illustrates the vast landscape once dominated by red spruce forests in West Virginia, and the current red spruce cover within the state (Byers et al., 2013). Extensive logging in the late 1800s and early 1900s reduced the area covered by red spruce forests in West Virginia from over 500,000 acres to around 30,000 acres remaining today (CASRI, 2021).
Red Spruce Forests can most commonly be found around the Kennison Mountain, Back Allegheny Mountain, Shavers Mountain, and Canaan Mountain regions within this CFA. Dry Mesic Oak Forests, Dry Oak-Pine Forests, and some Montane Red Oak Forests have a smaller footprint in the CFA. Over-browsing by deer reduces regeneration of oak and other palatable understory species.

Maps 11-14 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. 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 a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change.

Large, intact forest patches cover the vast majority of this CFA and host most of the CFA's SGCN occurrences, including many forest interior breeding birds such as Broad-winged Hawk, Cerulean Warbler (CERW) and Wood Thrush. Early-successional forest habitats support Black-billed Cuckoos and Golden-winged Warblers (GWWA). Around the edges of the CFA, Pine-Oak Rocky Woodlands and Dry Oak-Pine Forests support several rare plant species, such as the Canada Mountain Ricegrass and Mountain-cinquefoil. Red Spruce forests in the high mountains support Northern Flying Squirrel, Snowshoe Hare, Cheat Mountain Salamander, and native Brook Trout in streams.

Priority Species

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

Table 5. Priority Species in Forest and Woodland Habitats.

Taxa	Scientific Name	Common Name
Amphibian	Aneides aeneus	Green Salamander
Amphibian	Plethodon nettingi	Cheat Mountain Salamander
Bird	Accipiter gentilis	Northern Goshawk
Bird	Aquila chrysaetos	Golden Eagle
Bird	Asio otus	Long-eared Owl
Bird	Bonasa umbellus	Ruffed Grouse
Bird	Buteo platypterus	Broad-winged Hawk

Taxa	Scientific Name	Common Name
Bird	Cardellina canadensis	Canada Warbler
Bird	Coccyzus erythropthalmus	Black-billed Cuckoo
Bird	Hylocichla mustelina	Wood Thrush
Bird	Setophaga cerulea	Cerulean Warbler
Bird	Vermivora chrysoptera	Golden-winged Warbler
Gastropoda	Discus catskillensis	Angular Disk
Gastropoda	Glyphyalinia picea	Rust Glyph
Gastropoda	Mesodon aff. Andrewsae	Balsam Globe
Gastropoda	Stenotrema simile	Bear Creek Slitmouth
Gastropoda	Striatura exigua	Ribbed Striate
Gastropoda	Triodopsis picea	Spruce Knob Threetooth
Gastropoda	Zonitoides elliotti	Green Dome
Lepidoptera	Pieris virginiensis	West Virginia White
Lepidoptera	Polygonia faunus symthi	Smyth's Green Comma
Mammal	Corynorhinus townsendii virginianus	Virginia Big-eared Bat
Mammal	Glaucomys sabrinus fuscus	WV Northern Flying Squirrel
Mammal	Lasionycteris noctivagans	Silver-haired Bat
Mammal	Lasiurus borealis	Eastern Red Bat
Mammal	Lasiurus cinereus	Hoary Bat
Mammal	Lepus americanus	Snowshoe Hare
Mammal	Microtus chrotorrhinus carolinensis	Southern Rock Vole
Mammal	Myotis septentrionalis	Northern Myotis
Mammal	Myotis sodalis	Indiana Bat
Mammal	Neotoma magister	Allegheny Woodrat
Mammal	Sorex dispar	Long-tailed Shrew
Mammal	Sorex palustris punctulatus	Southern Water Shrew
Mammal	Sylvilagus obscurus	Appalachian Cottontail
Plant	Aconitum reclinatum	White Monkshood
Plant	Botrychium lanceolatum var. angustisegmentum	Lanceolate Grapefern
Plant	Carex manhartii	Manhart's Sedge
Plant	Carex roanensis	Roan Mountain Sedge
Plant	Clematis occidentalis var. occidentalis	Purple Virgin's Bower
Plant	Coeloglossum viride var. virescens	Long-bracted Green Orchid, Satyr Orchid
Plant	Corallorhiza bentleyi	Bentley's Coralroot
Plant	Cuscuta rostrata	Beaked Dodder
Plant	Goodyera repens	Dwarf Rattlesnake-plantain
Plant	Gymnocarpium appalachianum	Appalachian Oak Fern
Plant	Gymnocarpium dryopteris	Northern Oak Fern
Plant	Isotria medeoloides	Small Whorled Pogonia
Plant	Lycopodium lagopus	One-cone Groundpine

Taxa	Scientific Name	Common Name
Plant	Piptatherum canadense	Canada Mountain Ricegrass
Plant	Platanthera shriveri	Shriver's Frilly Orchid
Plant	Poa saltuensis	Old-pasture Bluegrass
Plant	Ribes lacustre	Bristly Black Currant
Plant	Schizachne purpurascens	False Melicgrass
Plant	Sibbaldiopsis tridentata	Mountain-cinquefoil
Plant	Taxus canadensis	Canada Yew
Plant	Trifolium stoloniferum	Running Buffalo Clover
Plant	Trillium nivale	Snowy Trillium
Plant	Triphora trianthophora	Threebirds
Reptile	Crotalus horridus	Timber Rattlesnake
Reptile	Plestiodon anthracinus anthracinus	Northern Coal Skink
Reptile	Virginia valeriae pulchra	Mountain Earthsnake

Rare Plant Communities

The following rare plant communities are found in Forest and Woodland habitats in this CFA. Note that all of the state's Rough Sedge Seep is located here, along with over 80% of the state's Red Spruce Hemlock beech Forest, Red Spruce Yellow Birch Forest, Red Spruce Great Laurel Forest, and Typical Northern Hardwoods Forest. These communities are vulnerable to disturbance by logging and grazing activities, and consequently the spread of nonnative invasive plants. Disturbance should be avoided, and nonnative invasive plant infestations should be treated.

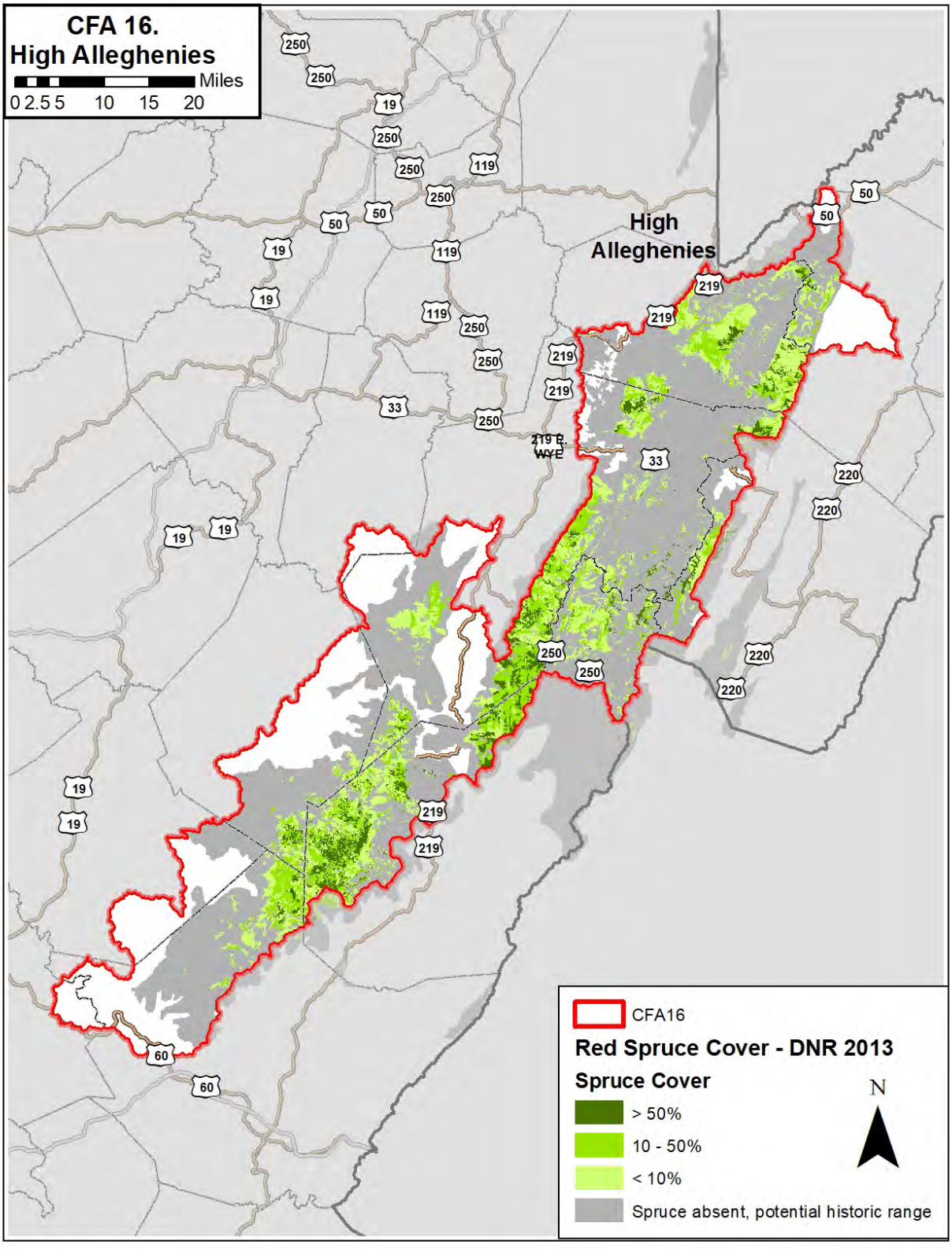
Table 6. Rare Plant Communities in Forest and Woodland Habitats.

Habitat	Common Name	G Rank	S Rank	Relative Abundance
Dry-Mesic Oak Forests and Northern Hardwood Forests	Allegheny Montane Red Oak Forest	G4?	S2S3	35.29%
Northern Hardwood Forests	Allegheny Mountains Hemlock - Hardwood Forest	G4?	S3	72.22%
Mixed Mesophytic Forests	Black Walnut / Wingstem Ruderal Forest	GNA	SNA	20.00%
Dry Oak (-Pine) Forests	Chestnut Oak - Red Oak / Great Laurel Forest	G4	S3	18.75%
Montane Red Oak Forests	Eastern Ridges Montane Red Oak Forest	G3G4	S3	5.13%

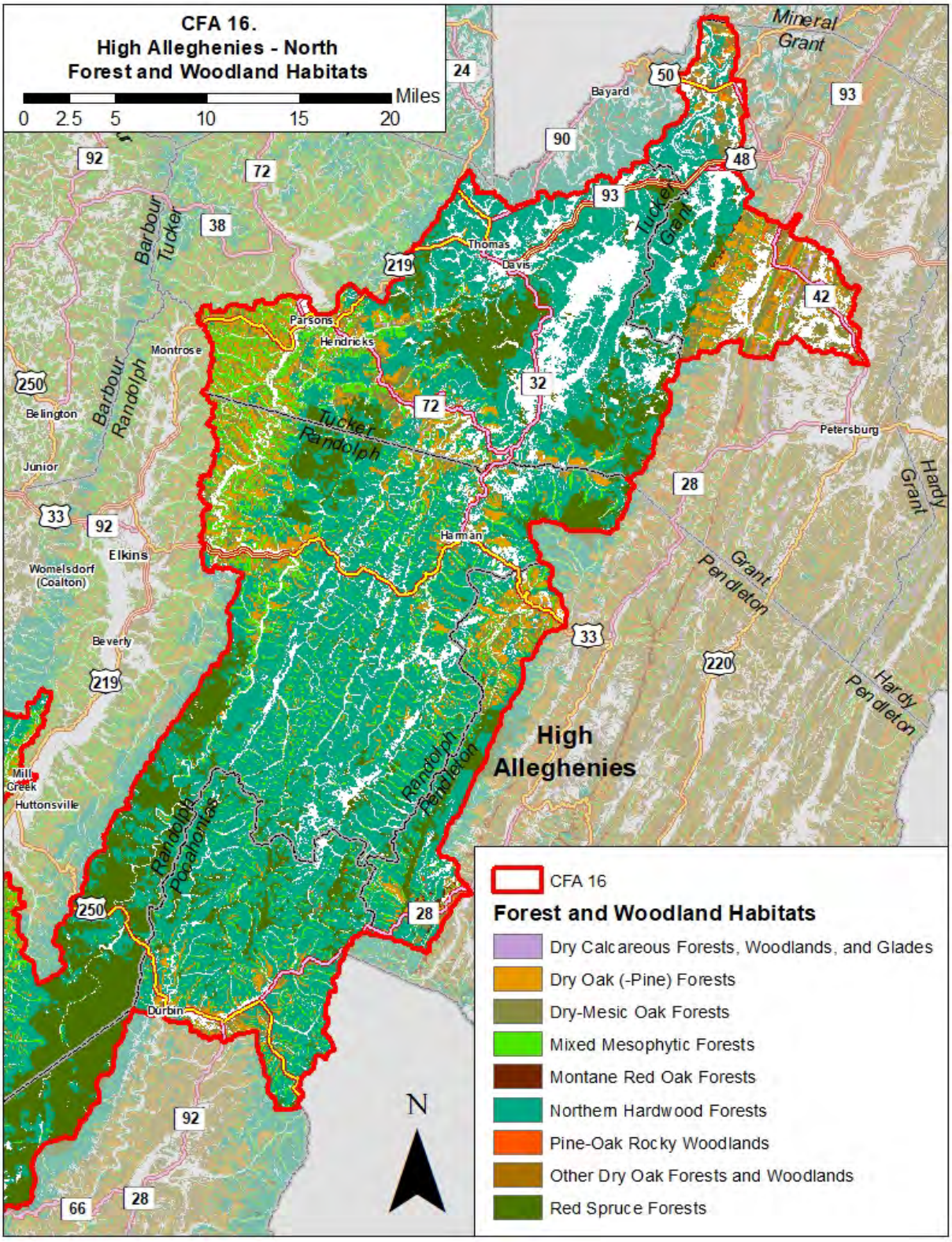
Habitat	Common Name	G Rank	S Rank	Relative Abundance
Northern Hardwood Forests & Red Spruce Forests	Golden Saxifrage Seep	G3G5	S3	71.43%
Mixed Mesophytic Forests	Hemlock - Hardwood / Great Laurel Acidic Cove Forest	G5	S4	2.56%
Mixed Mesophytic Forests & Northern Hardwood Forests	Mixed Hardwoods Ruderal Forest	GNA	SNA	50.00%
Red Spruce Forests	Red Spruce – Hemlock – Beech Forest	G3	S3	84.21%
Red Spruce Forests	Red Spruce – Yellow Birch Forest	G2	S2	81.67%
Red Spruce Forests	Red Spruce / Great Laurel Forest	G2G3	S2	89.29%
Red Spruce Forests	Red Spruce / Heath Rocky Woodland	G2	S1	59.09%
Red Spruce Forests	Red Spruce / Southern Mountain Cranberry Forest	G2	S1	63.16%
Mixed Mesophytic Forests	Rich Hemlock - Hardwood Forest	G4	S2	4.35%
Northern Hardwood Forests & Red Spruce Forests	Rough Sedge Seep	G3	S2	100.00%
Northern Hardwood Forests	Southern Appalachian Northern Hardwoods Forest	G3	S1	62.50%
Northern Hardwood Forests	Typical Northern Hardwoods Forest	G4	S4	87.50%
Dry Oak (-Pine) Forests	Western Allegheny Plateau Oak / Heath Forest	G4?	S4	13.33%
Mixed Mesophytic Forests	Yellow Birch - (Hemlock, Tuliptree) Cold Cove Forest, Upside Down Northern Hardwoods Forest	G3	S2	11.54%

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

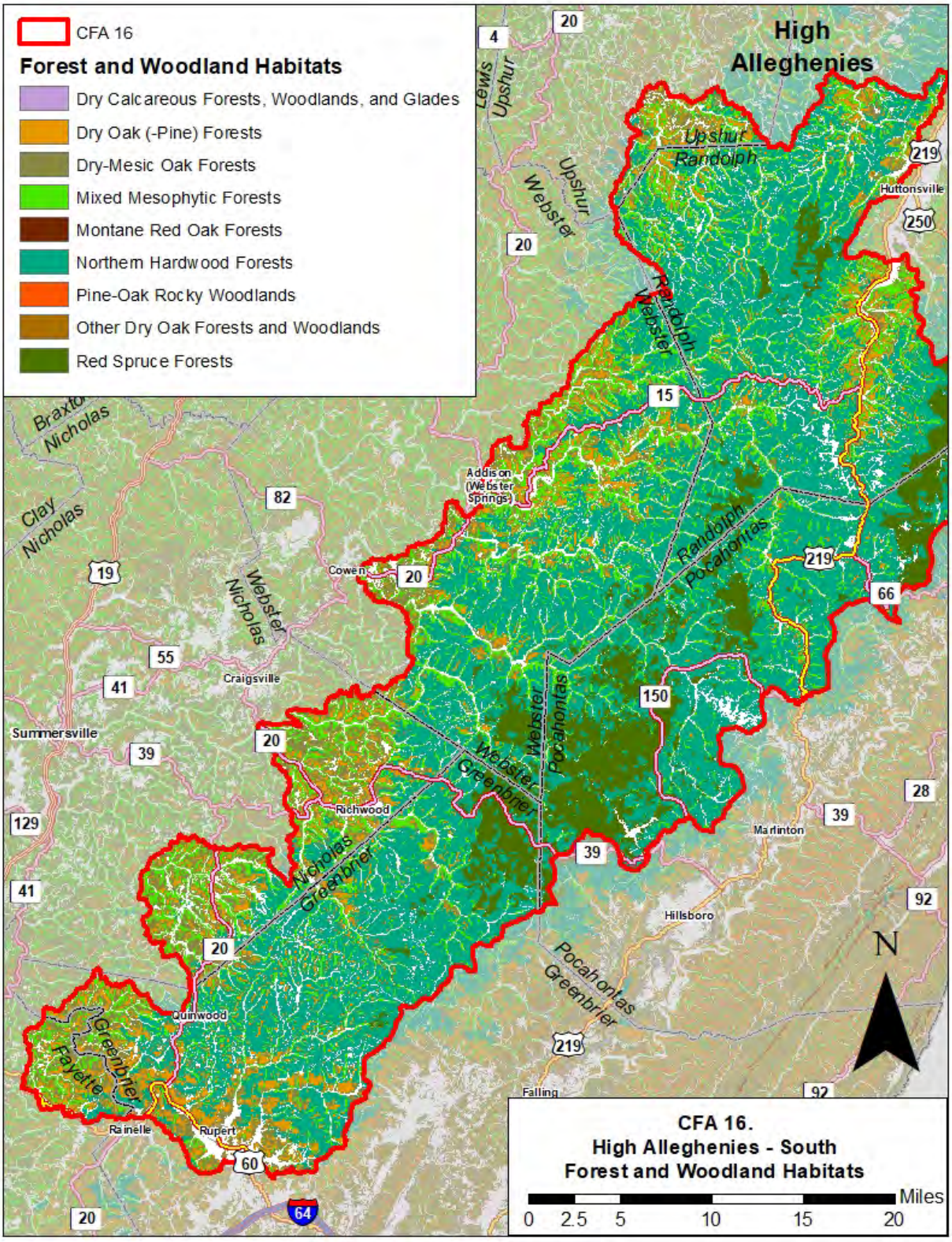
Map 10. Red Spruce Cover



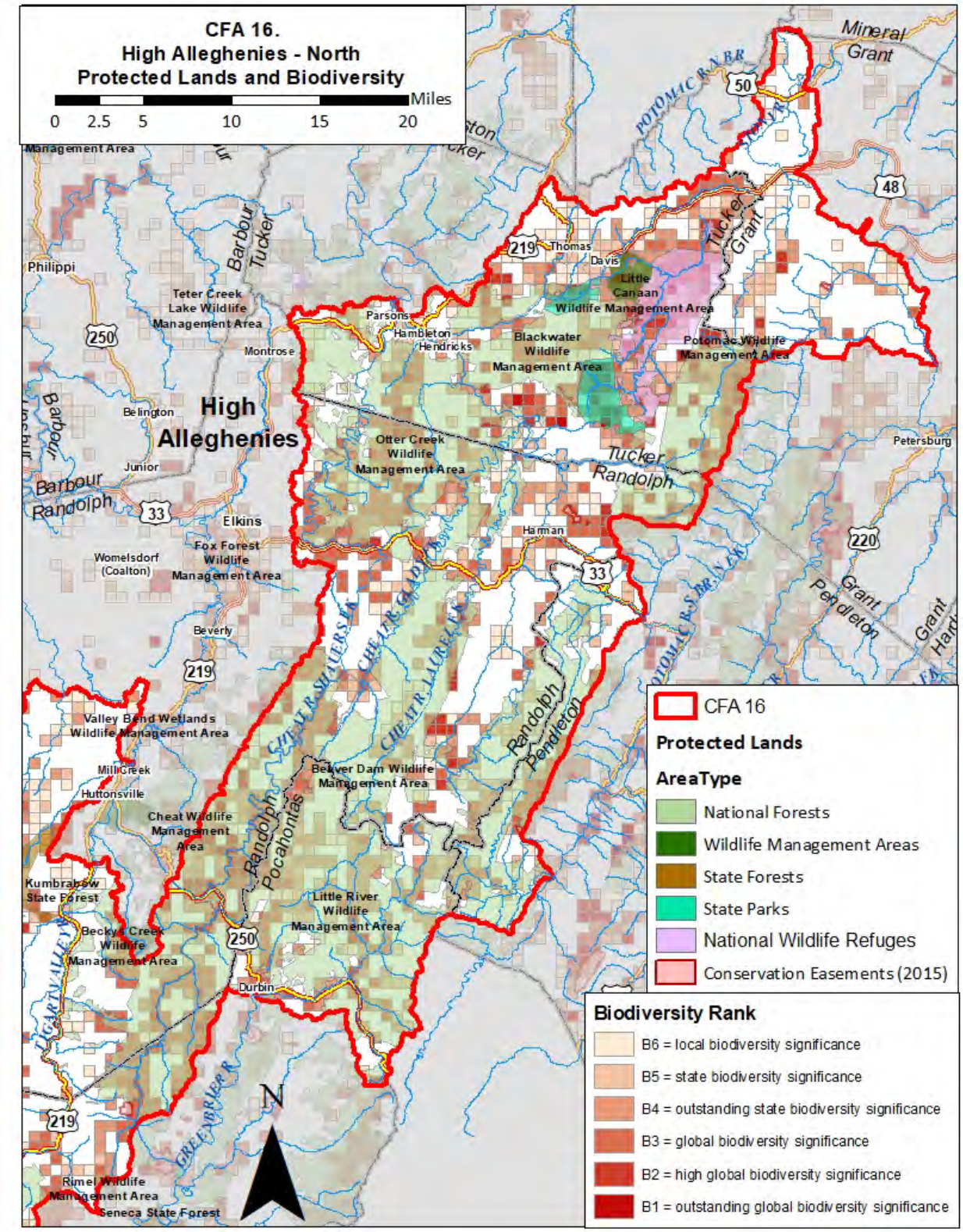
Map 11. Forest and Woodland Habitats – North



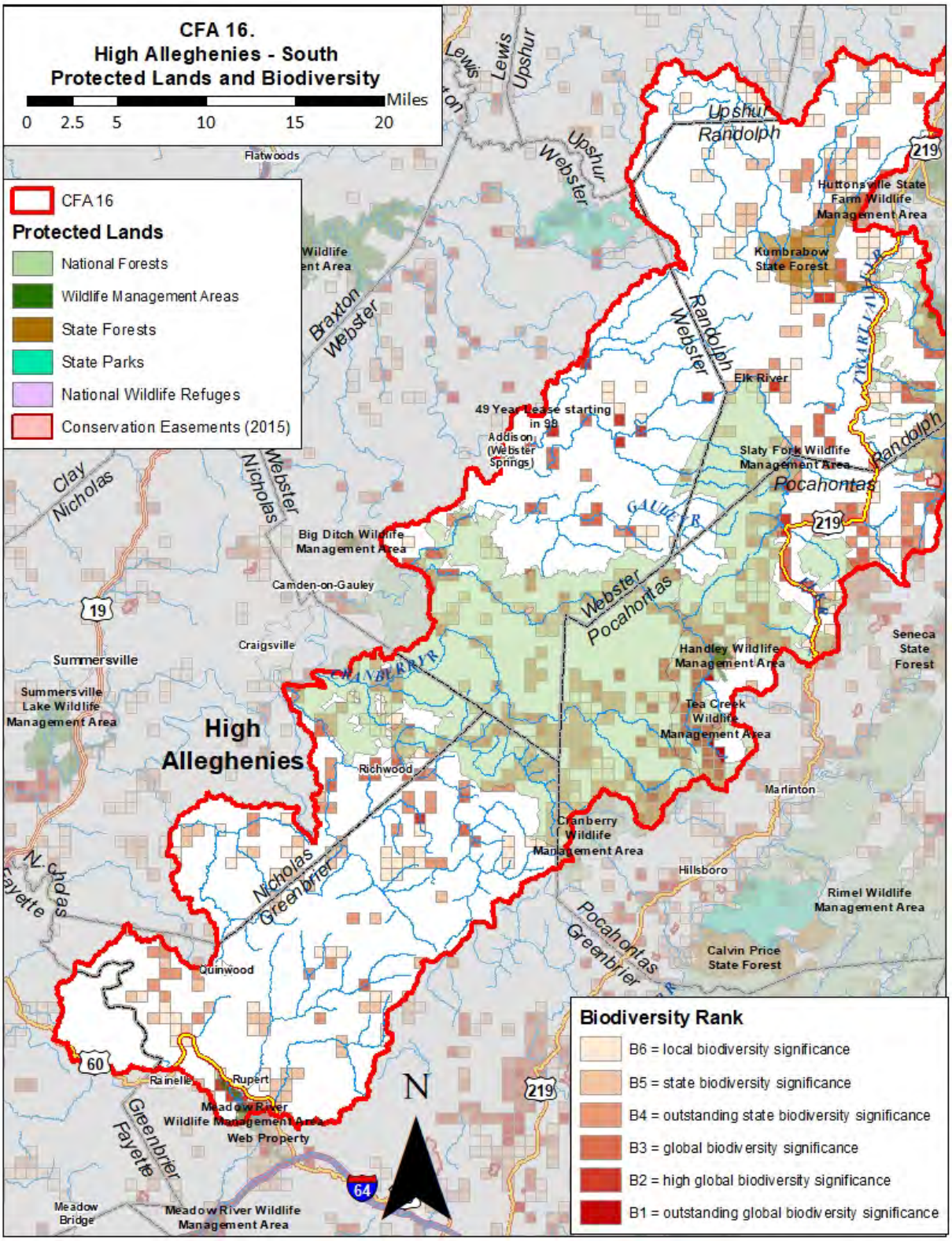
Map 12. Forest and Woodland Habitats – South



Map 13. Intact Forest Patches and Biodiversity – North



Map 14. Intact Forest Patches and Biodiversity – South



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**
Deforestation, forest fragmentation, poor forest structure and climate change (microhabitats)	Maintain contiguous forest cover, structural complexity and habitat diversity
Deforestation, climate change, and disturbance of hydrological features and rare habitats	Maintain forest cover and hydrology, especially around seeps, streams, bogs, cliffs, talus, and other rare habitat features
Development, deforestation, poor habitat quality & water quality degradation around caves	Promote contiguous, diverse forest habitat and natural hydrology around caves.
Early-successional habitat: Poor forest structure, forest maturation, fire suppression	Promote structural complexity, including gaps with healthy native grasses & forbs through forest management and controlled burns
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity including old growth, small openings, snags and decaying logs
Deer browse impacting forest structure	Manage deer populations where abundant
Deforestation & forest fragmentation on ridgetops, lack of mast trees for Allegheny Woodrat	Keep ridgetops forested and promote mast producing trees.
Logging, burning, canopy and ground disturbance, altered light regime and introduction of invasive weeds around rare plants	Avoid & minimize logging impacts and disturbance; monitor and treat invasive weeds to prevent their spread
Ground disturbance in Cheat Mountain Salamander Habitat (extremely sensitive)	Minimize, manage and mitigate impacts of trails, roads, logging, agriculture and development activities in Cheat Mountain Salamander habitat
Loss of basking/ gestation/ denning habitat for timber rattlesnake	Use forest management to create canopy gaps; reduce canopy over known gestation and basking sites; develop basking structures; avoid impact to dens
Invasive weeds due to deforestation, forest fragmentation, climate change	Maintain forest cover and control invasive weeds, especially around rare habitat features
Forest fragmentation and habitat loss from energy and other development	Develop guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests
Forest fragmentation and habitat loss from historic mining activity	Restoration and reforestation with native species using Forest Reclamation Approach

Habitat Stress	Conservation Action
Forest pests and pathogens including Hemlock Woolly Adelgid, Emerald Ash Borer	Monitoring and treatment of target tree species in select priority areas
Loss of red spruce forests, forest succession without red spruce and yellow birch, climate change, acid deposition	Red spruce plantings & release, preservation of red spruce/yellow birch habitat, preservation of rocky substrates at high elevations
Climate change (microhabitat impacts), acid rain and forest disturbance (gastropods)	Maintain contiguous forest cover and connectivity
Climate change; gypsy moth spraying & acid deposition/food shortage; forest defoliation	Maintain or create riparian buffers; reduce & monitor impacts of gypsy moth spraying (for Southern Water Shrew).

In addition to the habitat-linked stresses listed above, direct stresses to priority species include mining, logging, and ROW clearance impacting the Canada Warbler during nesting season, collision mortality associated with wind energy farms and bright lights for Black-billed Cuckoos, harassment, collection deliberate killing of Timber Rattlesnakes and predation and competition from the Southern Flying Squirrel impacting native WV Northern Flying Squirrels.

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 late-successional, interior forest habitats are needed for priority SGCN.

Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et al., 2015) describes many potential impacts of climate change on forests in the region. Likely impacts include increased temperatures (especially during the summer and fall), a decrease in winter snowpack, longer growing seasons, increased precipitation during spring and even greater decreases in precipitation during summer and fall, more frequent heavy precipitation events, and increasing frequency and severity of storms. These impacts will likely lead to changing soil moisture patterns, increased risk of wildfire, increased damage from pests and pathogens, and increased extent and abundance of invasive plants. Habitat for northern species is likely to decline, although species such as red spruce 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 more susceptible to climate change than those with greater diversity. Forest species in fragmented landscapes will have less opportunity to migrate across the landscape in response to changing conditions, and ecological communities tied to specific hydrological conditions or geologic features may also be unable to migrate. Urban areas and impervious cover can exacerbate the effects of increasing temperatures and heavier precipitation. However, ecosystems within areas of high landscape complexity, including a diversity of topography and microhabitats, may be more able to persist and adapt in response to climate change.

The 2015 assessment also described likely impacts to specific forest types. The large areas of Northern Hardwood Forests and Red Spruce Forests may be particularly affected by climate change. Increased heat and moisture stress in summer and fall may interact with acid deposition as well as increases in insect pests and pathogens, storm disturbance and wildfires to stress these forests, reducing species diversity and coverage. Cool valley bottoms in areas of complex topography may provide some refuge and buffer the effects of climate change.

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

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

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

Dry Calcareous Forests, Woodlands and Glades- adapted to heat, drought, and wildfire, but may be impacted by increased fire intensity, correlated with increases in invasive plant species. Management of invasive plants will be critical for the long-term resilience of the ecosystem. Dependence on unique soils may impede the ecosystem's ability to shift across the landscape.

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 a 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
• 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	• Restore or maintain fire in fire-adapted ecosystems • Manage deer populations to promote regeneration • Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Promote diversity of native species and age classes through planting and silviculture • 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
Forest Habitat, Reserve Area and Corridor Protection: • Conservation Easements • Land Acquisition • Natural Area designation	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • WVDOF Forest Legacy • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Manage forests at landscape scale for diversity of native species and age classes, and structural and spatial complexity appropriate for the forest type	• AMJV • Consulting Foresters • NWTF and RGS • USDA NRCS • WVDOF • WVU Extension • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Develop and Implement Plans to Manage Forest Habitats • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs	• AMJV • AFF • AFTS, FSC, SFI • Consulting Foresters • Planning Commissions • Public Land Managers • USDA NRCS • WVDOF • Forest Carbon Programs	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Manage deer population where abundant	• WVDNR • Private Landowners and Hunt Clubs • Public Land Managers	• Change in deer population • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Forest management to avoid disturbance of rare plants	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat protected • Before and after comparison: abundance, diversity, and distribution of priority species
Restore native forest vegetation on adjacent degraded lands through planting and silviculture	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Monitor and control invasive weeds, promptly revegetate disturbed sites	• WVDOF • WVCA • USDA NRCS • Public Land Managers	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Monitor and treat pests and pathogens targeting specific trees and plant communities in priority sites, including ash and hemlock	• Public Land Managers • WVDA, WVDOF, WVDNR	• Acres of habitat maintained for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Red spruce plantings & release	• Public Land Managers • TNC • WV Highlands Conservancy • CASRI	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Restore legacy mine lands and other degraded areas using Forest Reclamation Approach	• USDOI OSMRE • Public Land Managers • Green Forests Work • CASRI	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Create or maintain early-successional habitat (ESH) to benefit wildlife species through forest management on appropriate sites. GWWA guidelines for large forest patches with > 70% forest cover: · Maintain ESH on 15-20% of forest at any one time, as part of shifting mosaic • ESH should include irregular clumps of shrubs and/or saplings, grasses and forbs, and widely spaced overstory trees (10-30% canopy cover or 20-40 ft2 residual basal area)	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • NWTF and RGS • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites. CERW guidelines for large forest patches with > 70% forest cover: • Provide heterogenous stand structure and species diversity with 40-90 ft2 residual basal area of well-spaced, large diameter trees (favor white oak, hickory, sugar maple) with canopy gaps and well-developed understory vegetation. Mesic north- and east-facing slopes optimal.	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Minimize ground disturbance from trails, roads, agriculture and logging in Cheat Mountain Salamander habitat	• Public Land Managers • Consulting Foresters • WVDNR	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Provide guidance on timber rattlesnake den avoidance	• WVU Extension • Public land managers	• Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species
Reduce aerial application of pesticides	• USDA NRCS • WVDA	• Change in pesticide use • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Minimize, manage and mitigate for impacts of recreational activities, trails and other infrastructure on sensitive species and habitats	• FOB • Public Land Managers • WVDNR • WVSTA	• Acres of habitat avoided, managed or restored for priority species • Before and after comparison: abundance and diversity 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, forest carbon sequestration opportunities, hunting, wildlife viewing, tourism, and recreational opportunities.

Barrens, Rock Outcrops, Cliffs and Talus Habitats

Acidic Rock Outcrops, Cliffs and Talus, Calcareous Cliffs and Talus, and Shale and Heath-grass Barrens cover small areas within the CFA and are threatened by nonnative invasive plants, woody encroachment, quarrying, and other development. Acidic Rock Outcrops, Cliffs and Talus, and Calcareous Cliffs and Talus are the most common rocky habitat types present and can be found scattered throughout the High Alleghenies CFA primarily along the course of the numerous rivers and streams present within the area, while Heath-grass and Shale barrens are less common and can only be found in the northern corner of the CFA near the Potomac Wildlife Management area. The following table lists priority species along with their primary habitat. Some species also occur outside of their primary habitat. Maps 14-15 illustrate the location of these rare habitat types and their correlation with biodiversity occurrences.

Priority Species

Table 10 lists priority species in the CFA associated with Barrens, Rock Outcrops, Cliffs and Talus Habitats.

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

Taxa	Scientific Name	Common Name	Primary Habitat
Amphibian	Aneides aeneus	Green Salamander	Acidic Rock Outcrops, Cliffs and Talus
Lepidoptera	Colias interior (high elev)	Pink-edged Sulphur	Heath-Grass Barrens
Lepidoptera	Glaucopsyche l. lygdamus	Silvery Blue	Shale Barrens
Mammal	Myotis leibii	Eastern Small-footed Bat	Acidic Rock Outcrops/ Calcareous Cliffs and Talus
Mammal	Neotoma magister	Allegheny Woodrat	Acidic Rock Outcrops/ Calcareous Cliffs and Talus
Mammal	Spilogale putorius	Eastern Spotted Skunk	Acidic Rock Outcrops, Cliffs, and Talus
Plant	Ageratina a. aromatica	Small White Snakeroot	Calcareous Cliffs and Talus
Plant	Carex arctata	Drooping Woodland Sedge	Heath-Grass Barrens
Plant	Carex novae-angliae	New England Sedge	Acidic Rock Outcrops, Cliffs, and Talus
Plant	Cryptogramma stelleri	Fragile Rockbrake	Calcareous Cliffs and Talus
Plant	Heuchera alba	White Alumroot	Acidic Rock Outcrops, Cliffs, and Talus and Heath-Grass Barrens
Plant	Juncus trifidus	Highland Rush	Acidic Rock Outcrops, Cliffs, and Talus
Plant	Oenothera argillicola	Shalebarren Evening-primrose	Shale Barrens

Taxa	Scientific Name	Common Name	Primary Habitat
Plant	Saxifraga michauxii	Cliff Saxifrage	Acidic Rock Outcrops, Cliffs, and Talus
Plant	Taenidia montana	Mountain-pimpernel	Shale Barrens
Plant	Trichomanes boschianum	Appalachian Bristle Fern	Acidic Rock Outcrops, Cliffs, and Talus
Plant	Vittaria appalachiana	Appalachian Shoestring Fern	Acidic Rock Outcrops, Cliffs, and Talus
Reptile	Crotalus horridus	Timber Rattlesnake	Heath-Grass Barrens and Shale Barrens
Reptile	Plestiodon anthracinus anthracinus	Northern Coal Skink	Shale Barrens

Rare Plant Communities

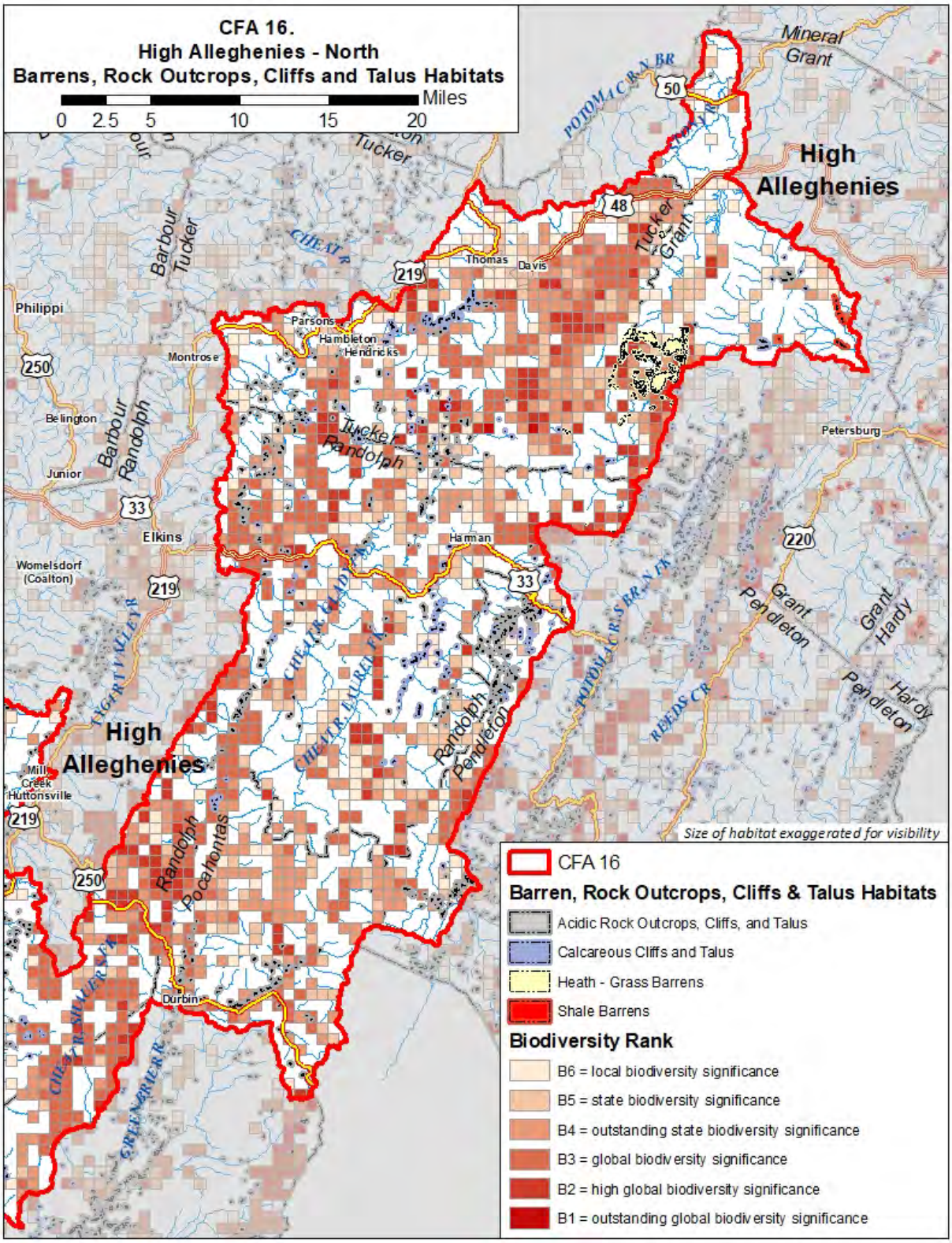
These habitats are home to several rare plant communities, with over 95% of the states blueberry heath barrens found in this CFA. Additionally, more than half of the state's high elevation sandstone boulderfield and mountain laurel – black huckleberry heath barren can also be found within this CFA.

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

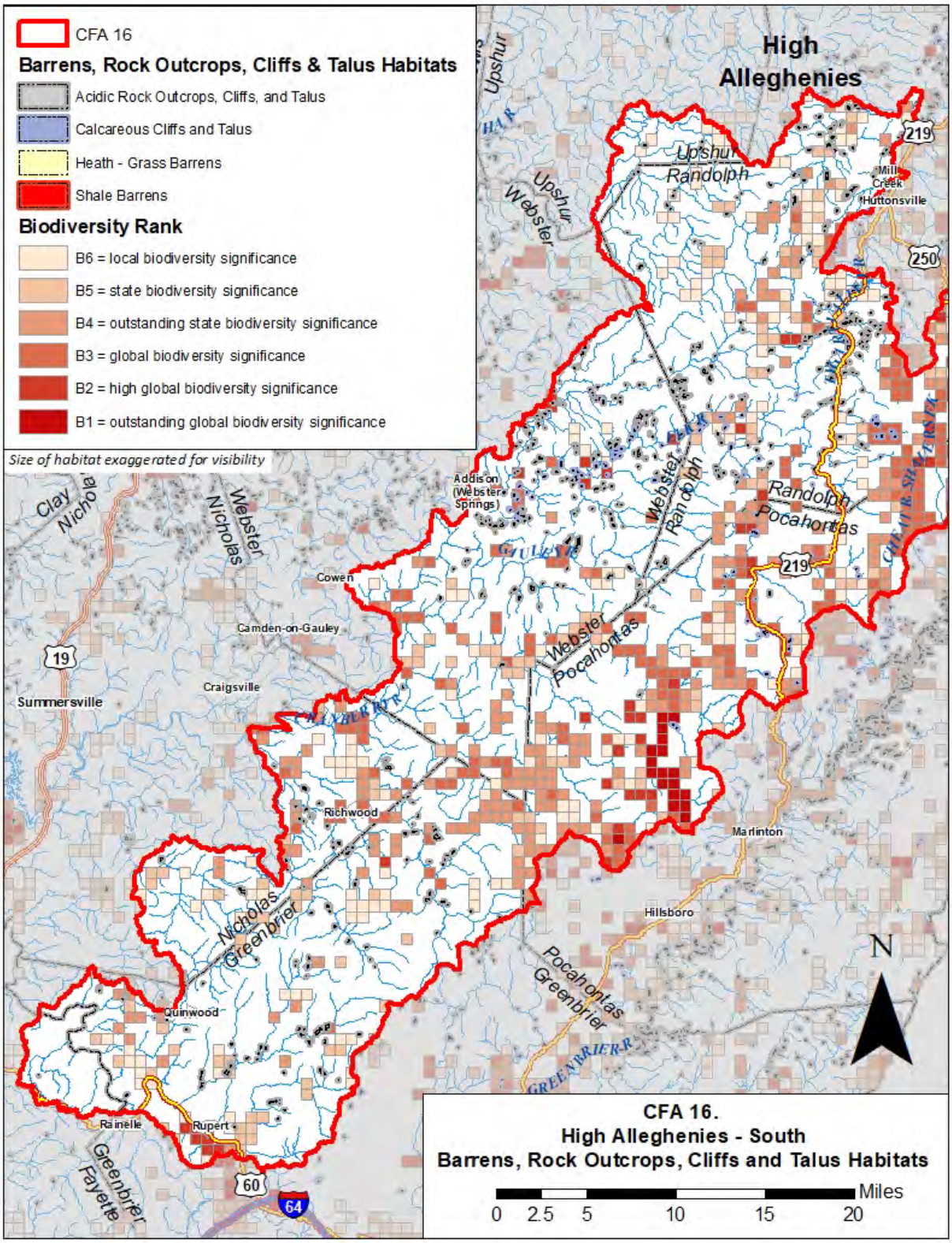
Habitat	Common Name	Relative Abundance	G Rank	S Rank
Acidic Rock Outcrops, Cliffs, and Talus	Basswood Boulderfield Forest	6.25%	G3	S1S2
Acidic Rock Outcrops, Cliffs, and Talus	Common Rocktripe Acidic Rock Outcrop	33.33%	G4?	S3
Acidic Rock Outcrops, Cliffs, and Talus	High Elevation Sandstone Boulderfield	60.87%	G2?	S2
Acidic Rock Outcrops, Cliffs, and Talus	High-Elevation Boulderfield Forest	27.27%	G2	S2
Acidic Rock Outcrops, Cliffs, and Talus	Sweet Birch - Chestnut Oak Rocky Woodland	6.25%	G4	S3
Heath - Grass Barrens	Blueberry Heath Barren	95.45%	G3G4	S2
Heath - Grass Barrens	Mountain Laurel - Black Huckleberry Heath Barren	57.14%	G2	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 15. Barrens, Rock Outcrops, Cliff and Talus Habitat – North



Map 16. Barrens, Rock Outcrops, Cliff and Talus Habitat – South



Habitat Stresses and Conservation Actions

Table 12 lists stresses to priority species in these sensitive habitats and conservation actions to alleviate those stress.

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

Habitat Stress	**Conservation Action**
Disturbance from development	Conservation easement or purchase
Agriculture, forest fragmentation, lack of mast trees for Allegheny Woodrat	Keep ridgetops forested and promote mast producing trees.
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 and avoid dens
Fire suppression, climate change	Controlled burns and forest practices that maintain appropriate cover and winter browse for Appalachian Cottontail.

In addition to the habitat-linked stresses listed on Table 12, direct stresses to priority species include the collection of Green Salamanders, and the spreading of disease among them. It should be noted that there is also a lack of knowledge about the status of the Appalachian Bristle Fern, the Appalachian Shoestring Fern, the New England Sedge, and the Drooping Woodland Sedge within this CFA, and the stresses affecting them.

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 and storms, and from invasion by nonnative invasive plants. Maintaining intact forest ecosystems around these rare habitats and controlling invasive species may help maintain resilience to a changing climate.

Table 13. Climate Stresses and Resilience Actions in Barrens, Rock Outcrop, Cliffs and Talus Habitats

Climate Stresses	Habitat Resilience Actions
• Increased risk of drought and wildfire • Increased frequency and severity of storms • Increased competition from nonnative invasive species	• 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 shale barrens, heath-grass barrens, acid rock outcrops, and calcareous cliffs and talus.

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

Action	Partners	Effectiveness Measures
Protection of rare habitats and forested buffers: • Conservation Easements • Land Acquisition • Natural Area designation	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • WVDOF Forest Legacy • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Protection of rare habitats and forested buffers: • Cost-Share Programs	• USDA NRCS	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Protection of rare habitats and forested buffers: • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning for development around cliffs, steep slopes, and fragile soils
Re-vegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species	• WVDOF • WVCA and Conservation Districts • USDA NRCS • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species

Action	Partners	Effectiveness Measures
Prescribed burning by public agencies to restore fire adapted plant communities	• Public Land Managers • WVDNR	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Minimize, manage and mitigate for impacts of recreation on sensitive sites	• Public Land Managers • WVDNR • WVSTA	• 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	• WVU Extension • Public Land Managers	• Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species
Work with quarries and developers to minimize impact on fragile habitat	• Public Land Managers • Quarries and developers • WVDNR	• Acres of habitat protected for priority species • Before and after comparison: abundance, diversity, and distribution of priority species

Human Benefits

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

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from cool, low-gradient headwater streams to warm, moderate gradient, medium sized rivers such as the upper section of the Cheat River or the Dry Fork River in the northern portion of the High Alleghenies CFA. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are tightly connected with their adjacent floodplains, wetlands and riparian habitats. Many plant and animal species rely on aquatic habitats such as streams, rivers, and wetlands, as well as their adjacent terrestrial habitats, especially riparian areas and forests. The loss of natural floodplain habitats and riparian corridors often impacts water quality and adjacent aquatic habitat. Improving wildlife habitat in streams and rivers often requires conservation actions to improve adjacent floodplain and riparian habitats. Therefore aquatic, floodplain, wetland and riparian habitats will be addressed together.

Priority Species

Tables 15, 16 and 17 list priority aquatic, wetland, floodplain and riparian species that occur in the CFA. This CFA contains more than half of the state's occurrences of several species of fish, including Brook Trout, Appalachia Darter, Kanawha Minnow, and Candy darter, as well as almost half of the state's Eastern Hellbenders and at least 60% of all occurrences of three Dragonfly and Damselfly species: Maine Snaketail, Mustached Clubtail, and Northern Pygmy Clubtail. Additionally, this CFA contains all known occurrences within the state of the Forcipate Emerald dragonfly as well as the Shenandoah Needlefly. Most of the state's High Allegheny Wetland habitats are in this CFA and host many priority species. Many priority SGCN also depend upon the riparian and floodplain habitats found within this CFA. The Balsam Globe for example, is a gastropod endemic to the southern Appalachian Mountain range which partly relies on the river floodplain habitats found in this CFA, all of the state's known occurrences of the Balsam Globe can be found within this CFA.

Table 15. Priority Aquatic Species

Taxa	Scientific Name	Common Name
Amphibian	Cryptobranchus alleganiensis	Eastern Hellbender
Fish	Ameiurus melas	Black Bullhead
Fish	Ameiurus nebulosus	Brown Bullhead
Fish	Anguilla rostrata	American Eel
Fish	Clinostomus elongatus	Redside Dace
Fish	Cottus kanawhae	Kanawha Sculpin
Fish	Etheostoma osburni	Candy Darter
Fish	Exoglossum laurae	Tonguetied Minnow
Fish	Luxilus cornutus	Common Shiner
Fish	Margariscus margarita	Pearl Dace
Fish	Notropis scabriceps	New River Shiner
Fish	Percina gymnocephala	Appalachia Darter
Fish	Percina peltata	Shield Darter

Taxa	Scientific Name	Common Name
Fish	Phenacobius teretulus	Kanawha Minnow
Fish	Salvelinus fontinalis	Brook Trout
Fish	Thoburnia rhothoeca	Torrent Sucker
Mussel	Alasmidonta marginata	Elktoe
Mussel	Lasmigona subviridis	Green Floater
Odonata	Gomphus adelphus	Mustached Clubtail
Odonata	Gomphus quadricolor	Rapids Clubtail
Odonata	Lanthus parvulus	Northern Pygmy Clubtail
Odonata	Ophiogomphus mainensis fastigiatus	Maine Snaketail
Odonata	Somatochlora elongata	Ski-tipped Emerald
Odonata	Somatochlora forcipata	Forcipate Emerald
Other Invertebrate	Allocapnia frumi	Monongahela Snowfly
Other Invertebrate	Hansonoperla appalachia	Appalachian Stonefly
Other Invertebrate	Megaleuctra flinti	Shenandoah Needlefly
Other Invertebrate	Sweltsa pocahontas	A Stonefly

Table 16. Priority Species in High Allegheny Wetlands

Taxa	Scientific Name	Common Name
Bird	Botaurus lentiginosus	American Bittern
Bird	Circus cyaneus	Northern Harrier
Bird	Contopus cooperi	Olive-sided Flycatcher
Bird	Seiurus noveboracensis	Northern Waterthrush
Lepidoptera	Euphydryas phaeton	Baltimore Checkerspot
Lepidoptera	Euphyes bimacula	Two-spotted Skipper
Mammal	Synaptomys cooperi	Southern Bog Lemming
Odonata	Argia bipunctulata	Seepage Dancer
Odonata	Leucorrhinia glacialis	Crimson-ringed Whiteface
Odonata	Somatochlora elongata	Ski-tipped Emerald
Odonata	Somatochlora forcipata	Forcipate Emerald
Plant	Abies balsamea	Balsam Fir
Plant	Aconitum reclinatum	White Monkshood
Plant	Agrostis mertensii	Northern Bentgrass
Plant	Amelanchier bartramiana	Oblong-fruit Serviceberry
Plant	Andromeda polifolia var. glaucophylla	Bog-rosemary
Plant	Calopogon tuberosus var. tuberosus	Tuberous Grass-pink
Plant	Carex atherodes	Awned Sedge
Plant	Carex bushii	Bush's Sedge
Plant	Carex deflexa	Northern Sedge
Plant	Carex haydenii	Cloud Sedge

Taxa	Scientific Name	Common Name
Plant	Carex lacustris	Lake Sedge
Plant	Carex lasiocarpa var. americana	Woolly-fruit Sedge
Plant	Carex meadii	Mead's Sedge
Plant	Carex pauciflora	Few-flower Sedge
Plant	Carex trichocarpa	Hairy-fruit Sedge
Plant	Carex vesicaria	Inflated Sedge
Plant	Coeloglossum viride var. virescens	Long-bracted Green Orchid, Satyr Orchid
Plant	Corallorhiza maculata var. occidentalis	Western Spotted Coralroot
Plant	Corallorhiza trifida	Early Coralroot
Plant	Cuscuta rostrata	Beaked Dodder
Plant	Cypripedium reginae	Showy Lady's-slipper
Plant	Eleocharis elliptica	Elliptic Spikerush
Plant	Equisetum sylvaticum	Woodland Horsetail
Plant	Euphorbia purpurea	Glade Spurge
Plant	Fraxinus nigra	Black Ash
Plant	Gentianopsis crinita	Greater Fringed Gentian
Plant	Geum aleppicum	Yellow Avens
Plant	Geum rivale	Purple Avens
Plant	Glyceria grandis var. grandis	American Mannagrass
Plant	Goodyera repens	Dwarf Rattlesnake-plantain
Plant	Gymnocarpium dryopteris	Northern Oak Fern
Plant	Hasteola suaveolens	False Indian-plantain
Plant	Hypericum mitchellianum	Blue Ridge St. John's-wort
Plant	Ilex collina	Hill Holly
Plant	Juncus filiformis	Thread Rush
Plant	Linnaea borealis ssp. americana	Twinflower
Plant	Listera cordata var. cordata	Heartleaf Twayblade
Plant	Listera smallii	Kidneyleaf Twayblade
Plant	Lonicera canadensis	Fly Honeysuckle
Plant	Luzula bulbosa	Bulbous Woodrush
Plant	Lycopodiella alopecuroides	Foxtail Clubmoss
Plant	Lycopodiella inundata	Northern Bog Clubmoss
Plant	Menyanthes trifoliata	Buckbean
Plant	Ophioglossum pusillum	Northern Adder's-tongue
Plant	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus
Plant	Platanthera psycodes	Lesser Purple Fringed Orchid
Plant	Platanthera shriveri	Shriver's Frilly Orchid
Plant	Polemonium vanbruntiae	Bog Jacob's-ladder
Plant	Populus balsamifera ssp. balsamifera	Balsam Poplar

Taxa	Scientific Name	Common Name
Plant	Potamogeton tennesseensis	Tennessee Pondweed
Plant	Rhamnus alnifolia	Alderleaf Buckthorn
Plant	Ribes lacustre	Bristly Black Currant
Plant	Rubus pubescens var. pubescens	Dwarf Red Bramble
Plant	Sagittaria calycina var. calycina	Long-lobe Arrowhead
Plant	Saxifraga pensylvanica	Eastern Swamp Saxifrage
Plant	Stachys aspera	Gritty Hedge-nettle
Plant	Stellaria borealis ssp. borealis	Northern Stitchwort
Plant	Symphyotrichum novi-belgii	New Belgium American-aster
Plant	Taxus canadensis	Canada Yew
Plant	Thelypteris simulata	Bog Fern
Plant	Torreyochloa pallida var. fernaldii	Mannagrass
Plant	Torreyochloa pallida var. pallida	Pale False Mannagrass
Plant	Triantha glutinosa	Sticky Bog-asphodel
Plant	Viburnum opulus var. americanum	Highbush Cranberry
Plant	Zigadenus leimanthoides	Pine Barren Deathcamas

Table 17. Priority Riparian and Floodplain Species

Taxa	Scientific Name	Common Name
Bird	Parkesia motacilla	Louisiana Waterthrush
Bird	Rallus limicola	Virginia Rail
Gastropoda	Mesodon aff. Andrewsae	Balsam Globe
Lepidoptera	Pieris virginiensis	West Virginia White
Mammal	Lasiurus borealis	Eastern Red Bat
Mammal	Lasiurus cinereus	Hoary Bat
Mammal	Myotis lucifugus	Little Brown Myotis
Mammal	Myotis septentrionalis	Northern Myotis
Mammal	Sorex palustris punctulatus	Southern Water Shrew
Mammal	Synaptomys cooperi	Southern Bog Lemming
Plant	Agrostis mertensii	Northern Bentgrass
Plant	Anemone canadensis	Roundleaf Thimbleweed
Plant	Carex haydenii	Cloud Sedge
Plant	Carex lasiocarpa var. americana	Woolly-fruit Sedge
Plant	Carex meadii	Mead's Sedge
Plant	Carex novae-angliae	New England Sedge
Plant	Carex tetanica	Rigid Sedge
Plant	Carex trichocarpa	Hairy-fruit Sedge
Plant	Carex tuckermanii	Tuckerman's Sedge

Taxa	Scientific Name	Common Name
Plant	Carex vesicaria	Inflated Sedge
Plant	Eleocharis elliptica	Elliptic Spikerush
Plant	Fraxinus nigra	Black Ash
Plant	Geum aleppicum	Yellow Avens
Plant	Geum rivale	Purple Avens
Plant	Glyceria grandis var. grandis	American Mannagrass
Plant	Hasteola suaveolens	False Indian-plantain
Plant	Hypericum mitchellianum	Blue Ridge St. John's-wort
Plant	Ilex collina	Hill Holly
Plant	Listera smallii	Kidneyleaf Twayblade
Plant	Lonicera canadensis	Fly Honeysuckle
Plant	Lycopodiella inundata	Northern Bog Clubmoss
Plant	Marshallia grandiflora	Monongahela Barbara's-buttons
Plant	Ophioglossum pusillum	Northern Adder's-tongue
Plant	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus
Plant	Platanthera psycodes	Lesser Purple Fringed Orchid
Plant	Platanthera shriveri	Shriver's Frilly Orchid
Plant	Poa saltuensis	Old-pasture Bluegrass
Plant	Polygala cruciata var. aquilonia	Cross-leaved Milkwort
Plant	Potamogeton tennesseensis	Tennessee Pondweed

Rare Plant Communities

The following rare plant communities may be found in aquatic, floodplain, and riparian habitats in this CFA. Note that of the 85 plant communities present, 12 of them can only be found within this CFA, while thirty-six of the plant communities represent 50% or more of the state's occurrences.

Table 18. Rare Plant Communities in Aquatic, Floodplain and Riparian Habitats.

Habitat	Common Name	Relative Abundance	G Rank	S Rank
High Allegheny Wetlands	American Bur-Reed Marsh	29.27%	G3?	S2
High Allegheny Wetlands	Balsam Fir - Black Ash Swamp	100.00%	G1	S1
High Allegheny Wetlands	Balsam Fir - Oatgrass Swamp	100.00%	G2	S2
High Allegheny Wetlands	Balsam Fir - Winterberry Swamp	100.00%	G2	S1
High Allegheny Wetlands	Beaked Sedge Fen	87.50%	G4G5	S1

Habitat	Common Name	Relative Abundance	G Rank	S Rank
High Allegheny Wetlands	Blueberry - Bracken Fern Shrub Swamp	86.21%	GNR	S3
High Allegheny Wetlands	Bog-Rosemary Peatland	100.00%	G1	S1
High Allegheny Wetlands	Bushy St. Johnswort Shrub Swamp	74.51%	GNR	S3
High Allegheny Wetlands	Chokeberry - Wild Raisin Peatland	73.53%	GNR	S3
High Allegheny Wetlands	Cottongrass Fen	94.81%	G3	S1
High Allegheny Wetlands	Cranberry - Beakrush Peatland	70.59%	G2	S1
High Allegheny Wetlands	Golden Saxifrage Seep	71.43%	G3G5	S3
High Allegheny Wetlands	Goldenrod Wet Meadow	84.13%	GNR	S3
High Allegheny Wetlands	Hemlock - Great Laurel - Peatmoss Swamp	35.29%	G4?	S1
High Allegheny Wetlands	Lake Sedge Fen	100.00%	G4G5	S1
High Allegheny Wetlands	Meadowsweet Shrub Swamp	100.00%	GNR	S3
High Allegheny Wetlands	Nodding Sedge - Prickly Bog Sedge Seep	86.67%	G2	S1
High Allegheny Wetlands	Pitch Pine / Heath Peat Woodland	70.00%	G1G2	S1
High Allegheny Wetlands	Quaking Aspen Swamp	100.00%	GNR	S3
High Allegheny Wetlands	Red Maple - Black Gum / Peatmoss Swamp	23.33%	GNR	S2
High Allegheny Wetlands	Red Spruce - Hemlock / Great Laurel Swamp	94.44%	G2?	S2
High Allegheny Wetlands	Red Spruce - Southern Mountain Cranberry Swamp	100.00%	G2	S2
High Allegheny Wetlands	Red Spruce - Yellow Birch - Mannagrass Swamp	86.84%	G3	S1

Habitat	Common Name	Relative Abundance	G Rank	S Rank
High Allegheny Wetlands	Red Spruce / Heath Peat Woodland	94.74%	G2G3	S1
High Allegheny Wetlands	Red Spruce / Three-seeded Sedge Peat Woodland	85.71%	G2	S2
High Allegheny Wetlands	Rice Cutgrass Marsh	19.61%	GNR	S3
High Allegheny Wetlands	Silky Willow Shrub Swamp	84.62%	GNR	S2S3
High Allegheny Wetlands	Silvery Sedge Fen	100.00%	GNR	S2
High Allegheny Wetlands	Softstem Bulrush Marsh	100.00%	GNR	S2
High Allegheny Wetlands	Speckled Alder Shrub Swamp	73.02%	G5	S3
High Allegheny Wetlands	Star Sedge Fen	100.00%	G2?	S1
High Allegheny Wetlands	Steeplebush Shrub Swamp	100.00%	GNR	S2
High Allegheny Wetlands	Threeway Sedge Fen	64.29%	GNR	S1
High Allegheny Wetlands	Tussock Sedge Wet Meadow	6.90%	G4G5	S3
High Allegheny Wetlands	Woolgrass Wet Meadow	82.22%	GNR	S3
River Floodplains	American Bur-Reed Marsh	29.27%	G3?	S2
River Floodplains	Barbara's-buttons Ice-Scour Prairie	100.00%	G1	S1
River Floodplains	Beech - Sugar Maple Floodplain Forest	80.00%	G2G3	S1
River Floodplains	Bitternut Hickory Floodplain Forest	23.08%	G2G3	S1
River Floodplains	Black Walnut / Wingstem Ruderal Forest	20.00%	GNA	SNA
River Floodplains	Bushy St. Johnswort Shrub Swamp	74.51%	GNR	S3
River Floodplains	Buttonbush Shrub Swamp	6.25%	G4	S3
River Floodplains	Common Rush Ruderal Marsh	14.29%	G5	SNA

Habitat	Common Name	Relative Abundance	G Rank	S Rank
River Floodplains	Cottonwood Floodplain Forest	50.00%	G3G5	S1
River Floodplains	Goldenrod Wet Meadow	84.13%	GNR	S3
River Floodplains	Hairy-fruit Sedge Floodplain Prairie	85.71%	G4?	S1
River Floodplains	Hazel Alder Swamp	18.00%	G4	S3
River Floodplains	Hemlock Floodplain Forest	27.59%	GNR	S2
River Floodplains	Indian Hemp Cobble/Boulder Bar Herbaceous Vegetation	71.43%	GNR	S2S3
River Floodplains	Meadow River Oak Swamp	12.50%	GNR	S1
River Floodplains	Nodding Sedge - Prickly Bog Sedge Seep	86.67%	G2	S1
River Floodplains	Ohio River Silver Maple Floodplain Forest	13.56%	G4?	S2
River Floodplains	Red Maple - Black Gum / Peatmoss Swamp	23.33%	GNR	S2
River Floodplains	Red Spruce - Hemlock / Great Laurel Swamp	94.44%	G2?	S2
River Floodplains	Red Spruce - Yellow Birch - Mannagrass Swamp	86.84%	G3	S1
River Floodplains	Rice Cutgrass Marsh	19.61%	GNR	S3
River Floodplains	Switchgrass - Big Bluestem Riverscour Prairie	28.57%	G2G3	S2
River Floodplains	Sycamore - Buckeye Floodplain Forest	16.13%	GNR	S2
River Floodplains	Tall Herb Rivershore	19.05%	GNR	S2
River Floodplains	Threeway Sedge Fen	64.29%	GNR	S1
River Floodplains	Tussock Sedge Wet Meadow	6.90%	G4G5	S3

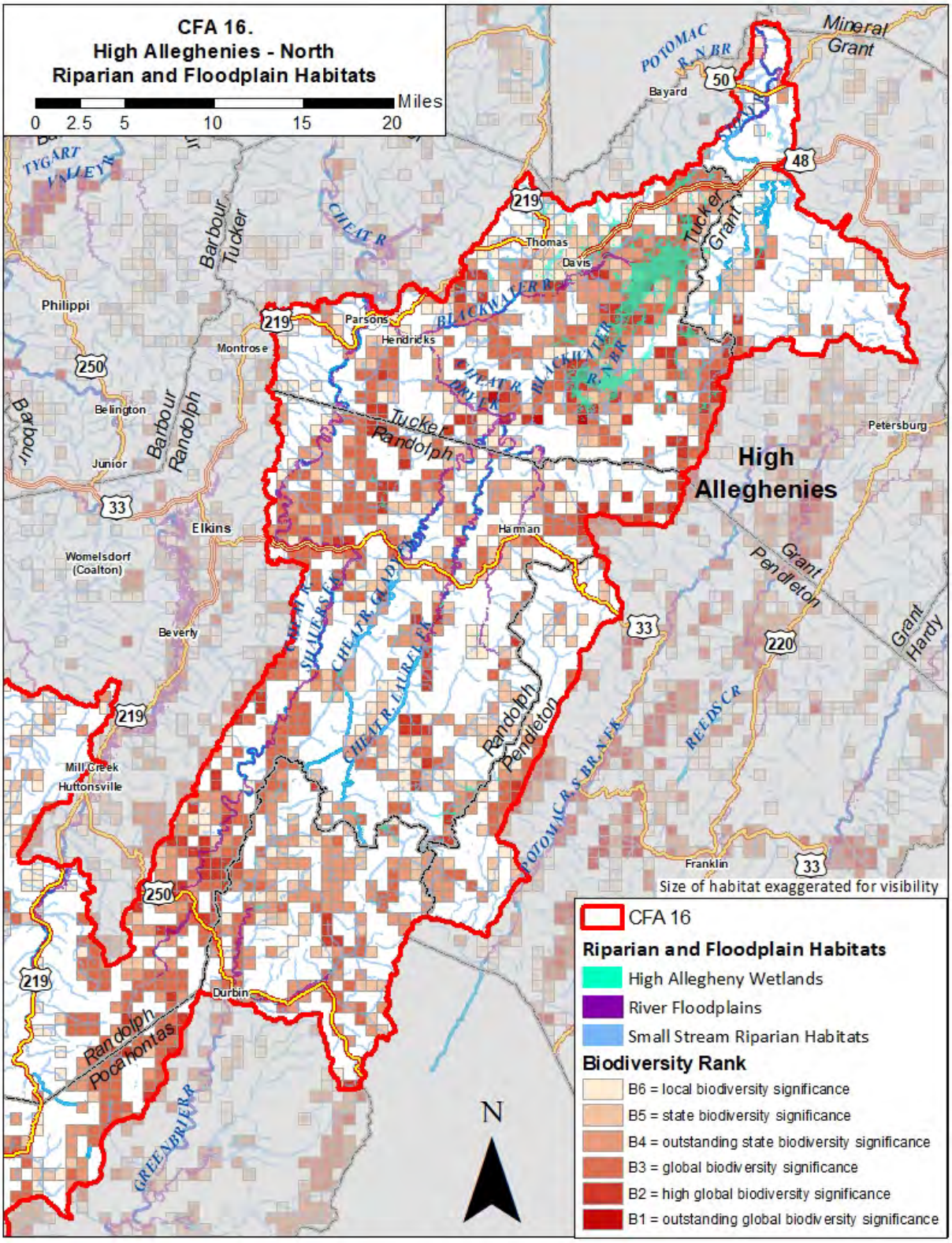
Habitat	Common Name	Relative Abundance	G Rank	S Rank
River Floodplains	Twisted Sedge Rivershore	41.67%	G3G4	S3
River Floodplains	Woolgrass Wet Meadow	82.22%	GNR	S3
Small Stream Riparian	American Bur-Reed Marsh	29.27%	G3?	S2
Small Stream Riparian	Bushy St. Johnswort Shrub Swamp	74.51%	GNR	S3
Small Stream Riparian	Buttonbush Shrub Swamp	6.25%	G4	S3
Small Stream Riparian	Golden Saxifrage Seep	71.43%	G3G5	S3
Small Stream Riparian	Goldenrod Wet Meadow	84.13%	GNR	S3
Small Stream Riparian	Hazel Alder Swamp	18.00%	G4	S3
Small Stream Riparian	Hemlock - Great Laurel - Peatmoss Swamp	35.29%	G4?	S1
Small Stream Riparian	Hemlock Floodplain Forest	27.59%	GNR	S2
Small Stream Riparian	Meadow River Oak Swamp	12.50%	GNR	S1
Small Stream Riparian	Ohio River Silver Maple Floodplain Forest	13.56%	G4?	S2
Small Stream Riparian	Red Maple - Black Gum / Peatmoss Swamp	23.33%	GNR	S2
Small Stream Riparian	Red Spruce - Yellow Birch - Mannagrass Swamp	86.84%	G3	S1
Small Stream Riparian	Rice Cutgrass Marsh	19.61%	GNR	S3
Small Stream Riparian	Silky Willow Shrub Swamp	84.62%	GNR	S2S3
Small Stream Riparian	Softstem Bulrush Marsh	100.00%	GNR	S2
Small Stream Riparian	Steeplebush Shrub Swamp	100.00%	GNR	S2

Habitat	Common Name	Relative Abundance	G Rank	S Rank
Small Stream Riparian	Sycamore - Buckeye Floodplain Forest	16.13%	GNR	S2
Small Stream Riparian	Tall Herb Rivershore	19.05%	GNR	S2
Small Stream Riparian	Threeway Sedge Fen	64.29%	GNR	S1
Small Stream Riparian Habitats	Tussock Sedge Wet Meadow	6.90%	G4G5	S3
Small Stream Riparian	Twisted Sedge Rivershore	41.67%	G3G4	S3
Small Stream Riparian	Woolgrass Wet Meadow	82.22%	GNR	S3

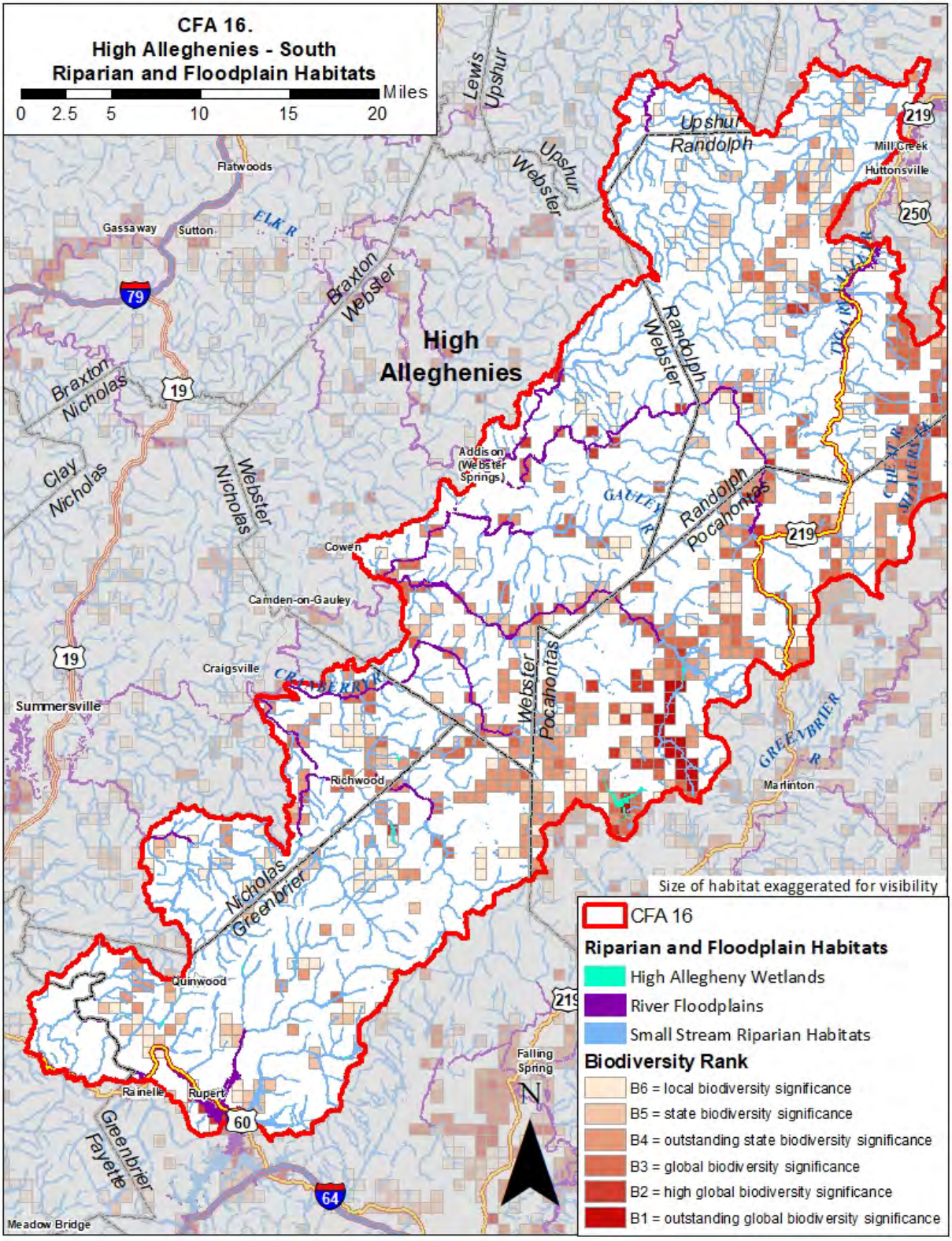
S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

Maps 17-18 illustrate the High Allegheny Wetland, riparian and floodplain habitats, and maps 19-20 illustrate mussel streams (mapped by WVDNR in 2018), exemplary wetlands (as assembled by WVDNR in 2015) along with biodiversity occurrences. Canaan Valley holds the largest matrix of High Allegheny Wetlands in the state, large exemplary wetlands along the Meadow River and in the headwaters of the South Fork of the Cranberry River, and smaller wetlands scattered throughout the CFA. There are intact river floodplain habitats along the Blackwater, Dry Fork, Glady Fork, Laurel Fork and Shavers Fork of the Cheat River in the northern half of the CFA, and along the Elk, Gauley, Williams, Cranberry, Cherry and Meadow Rivers in the southern half of the CFA, and small stream riparian habitats along their tributaries. Portions of the Blackwater, Glady Fork and Greenbrier River, the Left Fork and Right Fork of the Buckhannon River, Sugar Creek, the Elk, Gauley, and Williams Rivers, Turkey Creek, Cherry River and Little Clear Creek are designated state mussel streams. 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 biodiversity rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain, and riparian habitats.

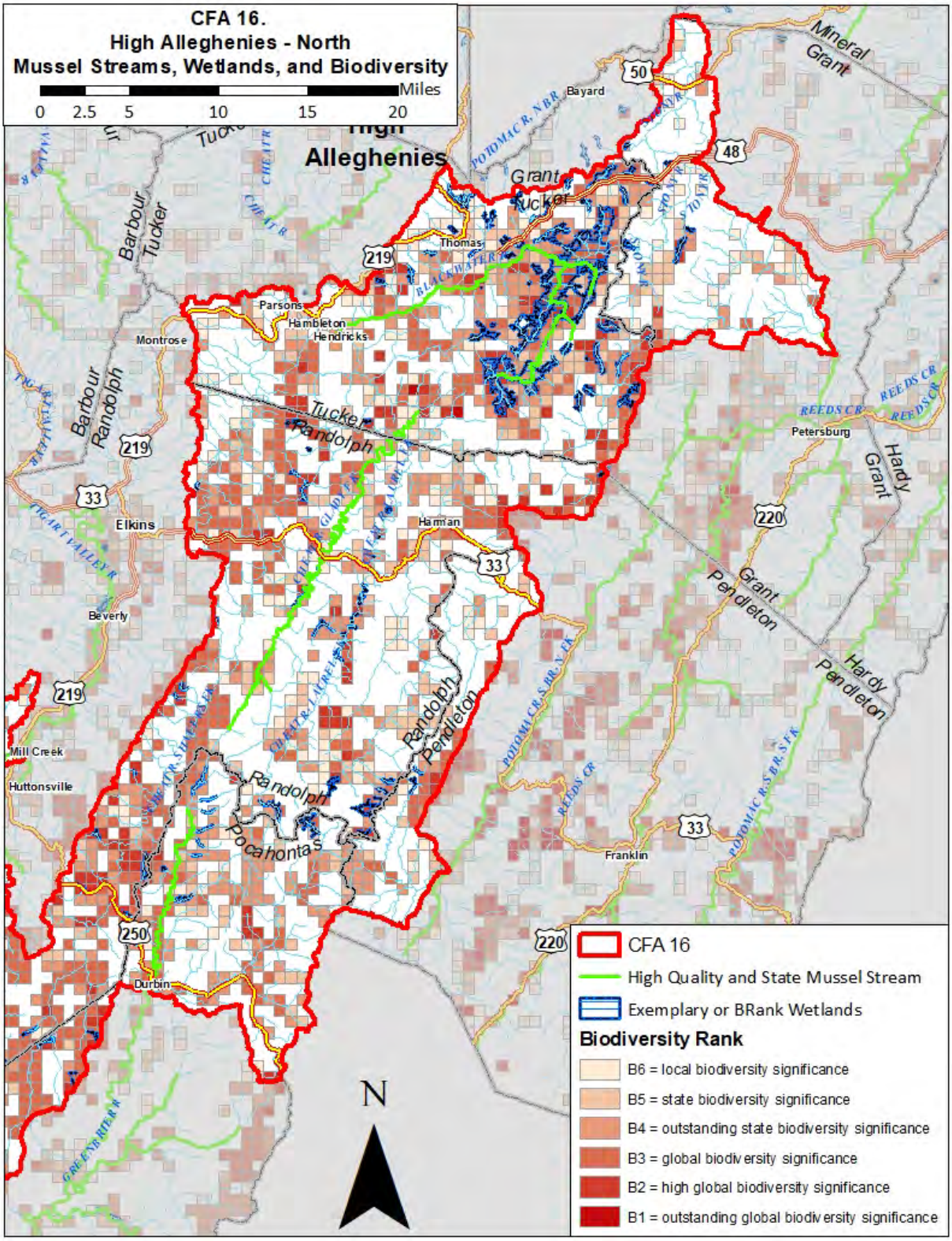
Map 17. Riparian and Floodplain Habitats – North



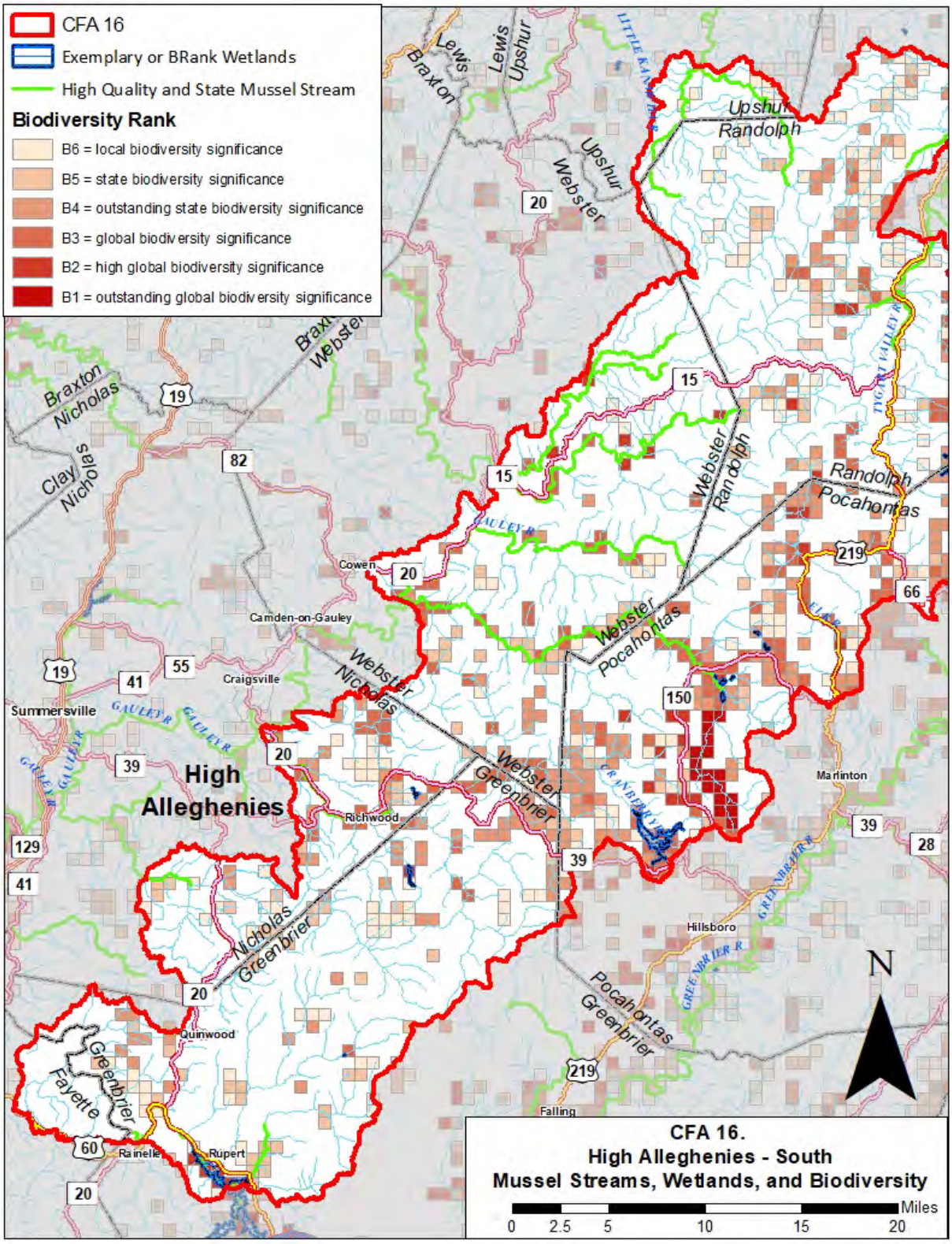
Map 18. Riparian and Floodplain Habitats – South



Map 19. Streams, Wetlands, and Biodiversity – North



Map 20. Streams, Wetlands, and Biodiversity – South



Habitat Stresses and Conservation Actions

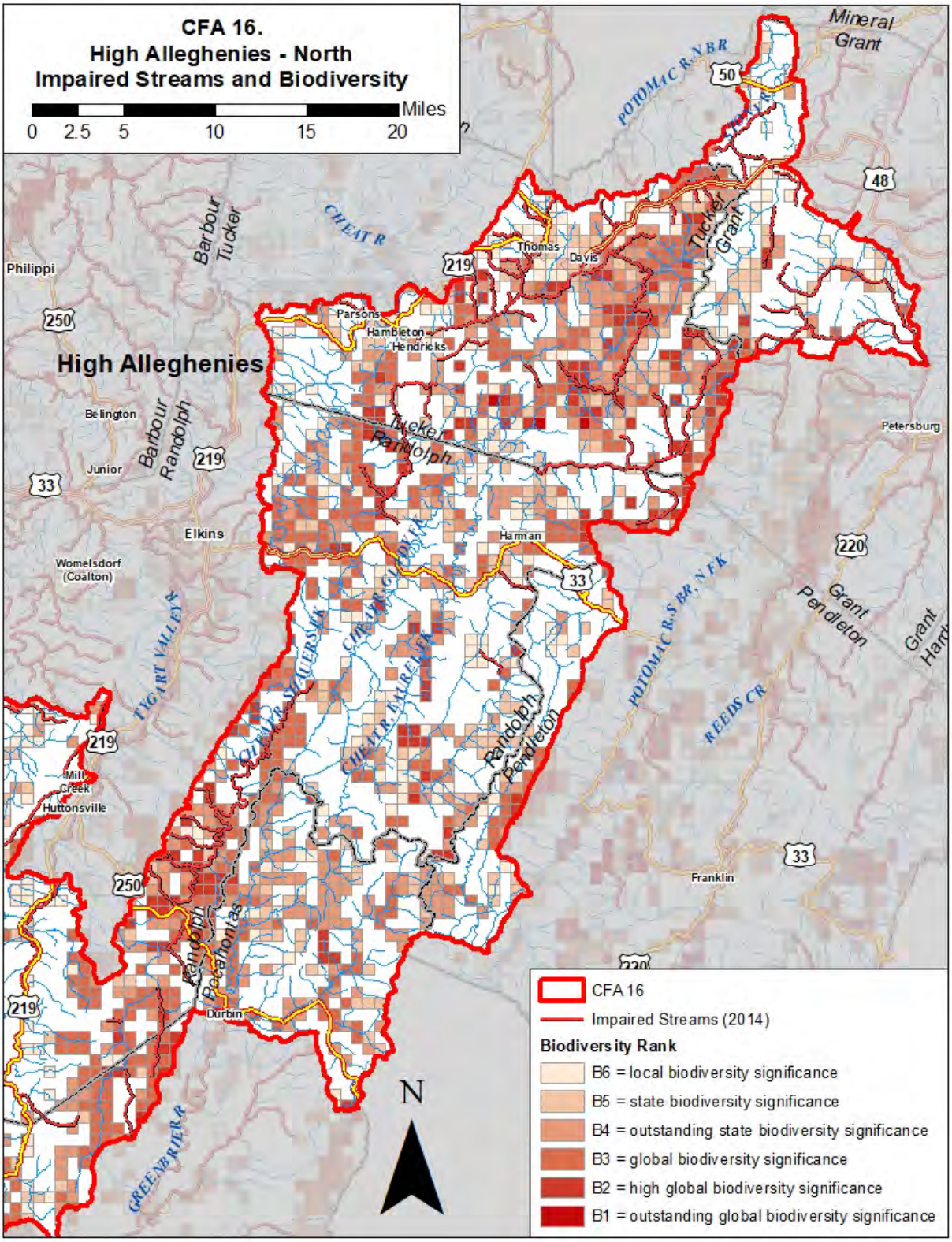
Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly, and plant species. Streams impacted by water quality impairments, as illustrated in Maps 21-22 based on data compiled by WVDEP in 2014, are additional sources of habitat stress. Direct stresses to priority species include cattle trampling mussels and hybridization of Appalachia Darters, Common Shiners, Brown Bullhead, and Candy Darters. American Eels suffer from overharvesting. Eastern Hellbenders suffer from illegal collection and deaths caused by anglers.

Table 19. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat

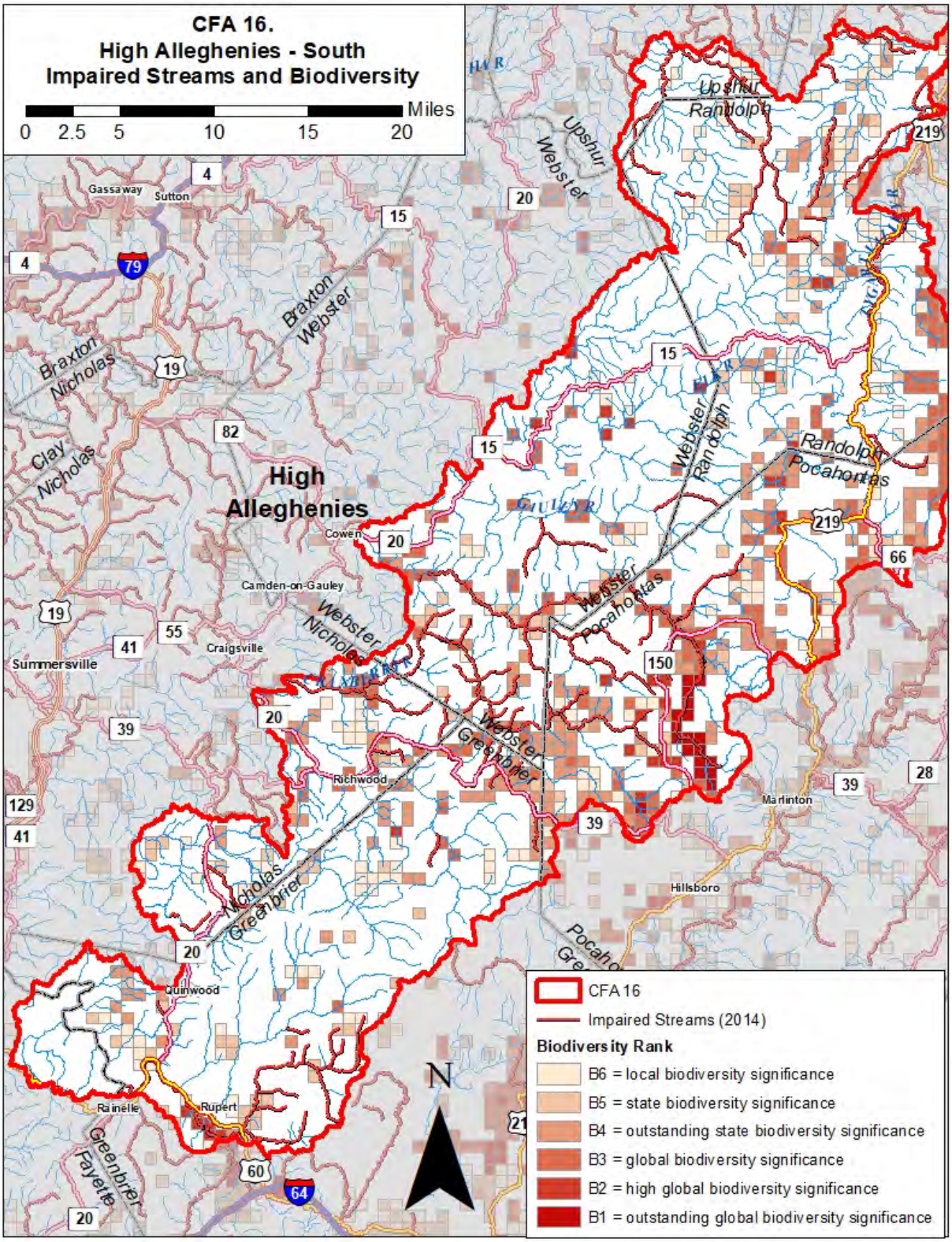
Habitat Stress	**Conservation Action**
Altered hydrology, runoff, sediment, & contamination from roads, deforestation, agriculture, development	Landowner outreach; plant, fence, maintain forested riparian corridors; decommission and reclaim unused roads and restore natural drainage patterns
Habitat disturbance, climate change, invasive weeds	Landowner outreach; plant, fence, maintain forested riparian corridors; minimize disturbance; control invasive weeds
Habitat disturbance, trampling rare plants	Landowner outreach; plant, fence, maintain forested riparian corridors; minimize disturbance
Water quality degradation (acid mine drainage, organic and chemical pollutants, sedimentation, dredging)	Pollution control, improved sewage treatment, stormwater management and sediment load reductions, mine drainage treatment
Aquatic passage barriers	Modify or remove barriers for aquatic organism passage and high flows
Floodplain ecosystem and hydrology impacts	Reconnect floodplain hydrology, restore stream channels and floodplains, protect and restore floodplain ecosystems
Degradation of wetlands, wet meadows, and forested swamps; climate change	Protect and maintain and restore wetland integrity and resilience
Mussels: Habitat impacts from stream restoration	Consider habitat needs in restoration plans; survey and salvage before restoration activities
Northern harrier: Natural succession of wetlands and other open areas in Canaan Valley	Maintain sufficient habitat to support a breeding population
Southern bog lemming: Climate change (hydrology); forest maturation	Retain mossy boulders, promote wet meadows, manage timber to create pockets of lower forest/ground cover.
Southern water shrew: Climate change; gypsy moth spraying & acid deposition/food shortage; forest defoliation	Maintain or create riparian buffers; reduce & monitor impacts of gypsy moth spraying.
American bittern: Breeding occurrence now possibly limited to Canaan Valley wetlands	Implement 2017 CVNWR habitat management plan; survey private lands in the valley and nearby wetlands

Olive sided flycatcher: Habitat limited to Cranberry Glades	Maintain current habitat, identify locations of historical occurrence where management could improve habitat; survey suitable habitats

Map 21. Impaired Streams and Biodiversity – North



Map 22. Impaired Streams and Biodiversity – South



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 20 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 a 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 20. Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat

Climate Stresses	Habitat Resilience Actions
• 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	• 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 and wetlands, 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 21. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition • Natural Area designation	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Cost-Share Programs	• USDA FSA	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection: • Land Use Planning	• County Planning Commissions	• Acres of habitat protected through land use planning, floodplain, and stormwater regulations

Action	Partners	Effectiveness Measures
In-stream and riparian habitat restoration, streambank stabilization and floodplain re-connection	• USDA FSA & NRCS • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDEP and WVCA • Public Land Managers	• 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	• USDA FSA & NRCS • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOF • WVDEP and WVCA • Public Land Managers	• 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
Improved wastewater and stormwater treatment	• WVDEP • WVDHHR • County governments	• # systems installed or improved • Change in fecal and other water quality measurements • Before and after comparison: abundance and diversity of priority species
Clean, redesign or remove dams, culverts and stream crossings for higher peak flow, habitat connectivity and aquatic organism passage	• FOC • Public Land Managers • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDEP, WVDOH, WVDNR	• # barriers re-designed or removed • # miles stream opened • Before and after comparison: abundance and diversity of priority species
Improve water quality in streams and wetlands	• WVDEP and WVCA • USDA FSA & NRCS	• Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Improve pH in headwater streams	• WVDEP • WVDNR	• Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Decommission and reclaim unused roads, restore natural drainage patterns	• Public Land Managers • WVDOH • Trout Unlimited	• Change in water quality and hydrology • Before and after comparison: abundance and diversity of priority species and habitat

Action	Partners	Effectiveness Measures
Monitor and treat pests and pathogens targeting specific trees and plant communities in priority sites	• Public Land Managers • WVDA, WVDNR	• Acres of habitat maintained for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Treat and underplant remaining riparian hemlock stands along headwater streams	• Trout Unlimited • USFWS Partners for Fish and Wildlife • U.S. Forest Service • WVDA, WVDNR	• Acres or linear feet of riparian area treated • Treatment and planting success rate
Treat cattail and other invasive plants in wetlands and riparian areas	• FOB • USDA FSA & NRCS • Public Land Managers • USFWS Partners for Fish and Wildlife	• Acres of wetland treated • Treatment success rate • Before and after comparison: abundance and diversity of priority species
Minimize, manage and mitigate for impacts of recreational activities, trails and other infrastructure on sensitive species and habitats	• FOB • Public Land Managers • WVDNR • WVSTA	• Acres of habitat avoided, managed or restored for priority species • Before and after comparison: abundance and diversity of priority species
Reduce flood impacts see also: • Remove or re-design barriers • Planting and fencing stream buffer zones • Restoration of in-stream and riparian habitat	• County Planning Departments	

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.

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 (troglobites) include blindness (or complete loss of eyes) and reduced pigmentation.

Maps 23-24 illustrate several bands of karst geology (based on maps from the WV Geologic and Economic Survey in 1998) around Canaan Valley, along the Dry Fork, Glady Fork, lower Shavers Fork, Big Spring Run, Laurel Run, and Gandy Creek, as well as along several other ridges and valleys spanning the northern half of the CFA. These maps also illustrate the correlation of karst areas and biodiversity occurrences, especially in the Canaan Valley. Maps 25-26 illustrate multiple biologically significant caves that host rare bat or endemic cave species, or exceptional biological diversity, with 3-mile buffers offset randomly. They also illustrate numerous karst features with 3-kilometer random offset buffers, and karst feature density. The biologically significant caves and karst features are generally found along the karst bands in the previous maps. This data was provided by the West Virginia Speleological Survey, with offset buffers developed by WVDNR. Buffers around karst features and biologically significant caves cover most of the northern half of the CFA. These areas require careful management to minimize disturbance to priority species.

Priority Species

Caves in this CFA host the following priority species, all of which are rare and dependent on specific cave habitats for their survival. Of special significance, this CFA hosts all of the state's Dry Fork Valley Cave Pseudoscorpion, Gandy Creek Cave Springtail, and Culver's Cave Amphipod, as well as 46% of the state's Minute Cave Amphipod and 37% of the state's Virginia Big-eared Bat.

Table 22. Priority Species in Subterranean Habitats

Taxa	Scientific Name	Common Name
Cave Invertebrate	Apochthonius paucispinosus	Dry Fork Valley Cave Pseudoscorpion
Cave Invertebrate	Arrhopalites pavo	A Cave Springtail
Cave Invertebrate	Caecidotea cannula	An Isopod
Cave Invertebrate	Caecidotea simonini	An Isopod
Cave Invertebrate	Pseudosinella certa	Gandy Creek Cave Springtail
Cave Invertebrate	Pseudosinella sp. 8	A Springtail
Cave Invertebrate	Stygobromus culveri	Culver's Cave Amphipod
Cave Invertebrate	Stygobromus emarginatus	Greenbrier Cave Amphipod
Cave Invertebrate	Stygobromus franzi	Franz's Cave Amphipod

Taxa	Scientific Name	Common Name
Cave Invertebrate	Stygobromus nanus	Pocahontas Cave Amphipod
Cave Invertebrate	Stygobromus parvus	Minute Cave Amphipod
Mammal	Corynorhinus townsendii virginianus	Virginia Big-eared Bat
Mammal	Myotis lucifugus	Little Brown Myotis
Mammal	Myotis sodalis	Indiana Bat
Mammal	Neotoma magister	Allegheny Woodrat

Habitat Stresses and Conservation Actions

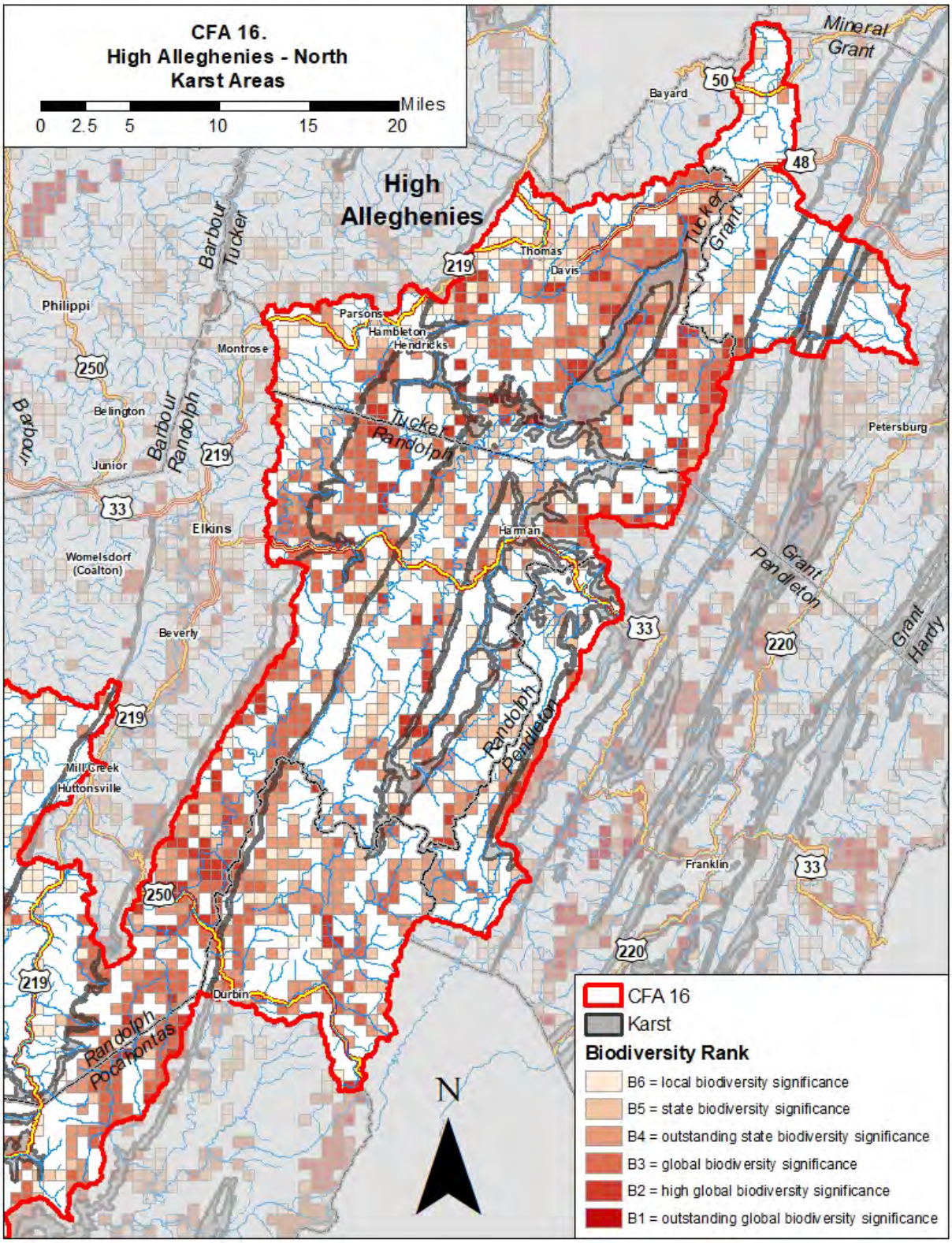
Caves and subterranean habitats, particularly in porous karst geology, are closely tied to and impacted by changes to water quality and land use in adjacent areas. The following table lists stresses affecting wildlife in caves and subterranean habitats, and conservation actions landowners and partners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

Table 23. Habitat Stresses and Conservation Actions in Subterranean Habitats

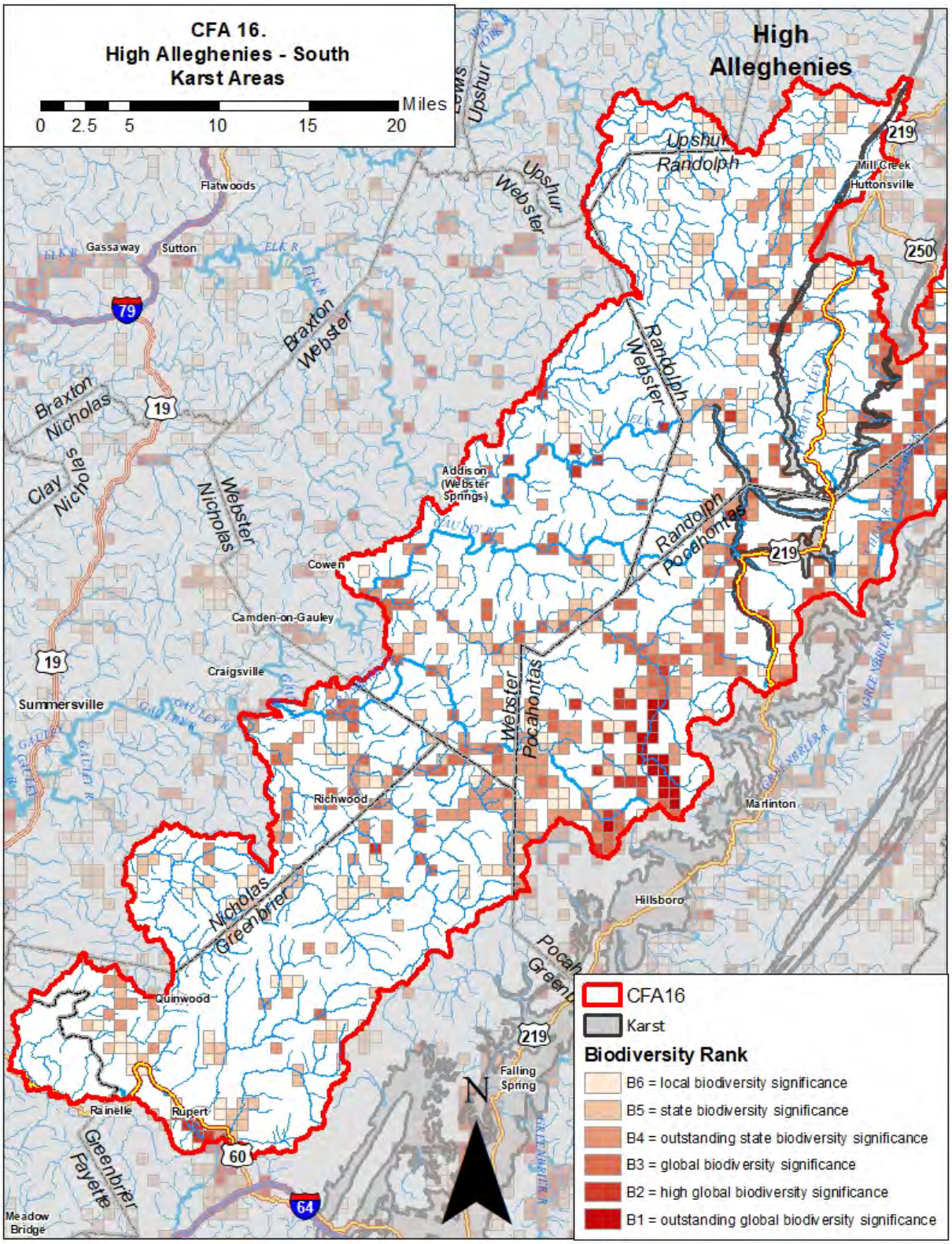
Habitat Stress	Conservation Action
Stormwater runoff, water quality degradation, sinkhole dumping	Provide educational materials to landowners, planners, partner agencies; mapping of passage and surface influences; stormwater and wastewater treatment, fencing, riparian plantings
Sinkhole dumping, passage alteration, excessive visitation	Conduct sinkhole clean ups, fencing and signage; Cave closure during important life stages.
Agriculture, deforestation around caves, climate change/warming	Protect forested cave buffers
Land use changes	Land protection, land use planning and careful management around caves

In addition to the habitat-linked stresses listed above, direct stresses to priority species include the mortality caused by excessive visitation for a variety of cave dwelling species such as the Pocahontas Cave Amphipod, Minute Cave Amphipod, Gandy Creek Cave Springtail, and the Dry Fork Valley Cave Pseudoscorpion.

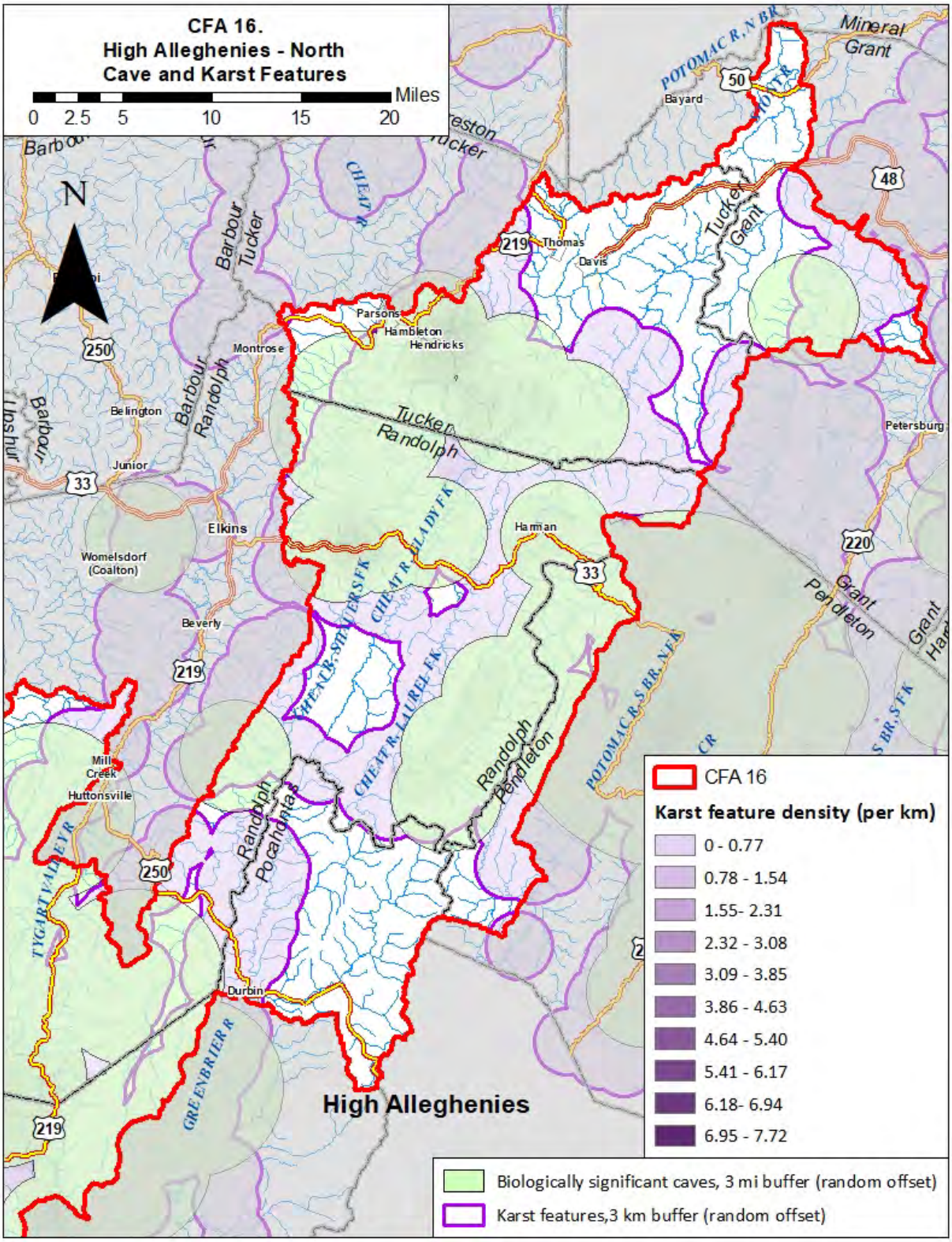
Map 23. Karst Areas and Biodiversity–North



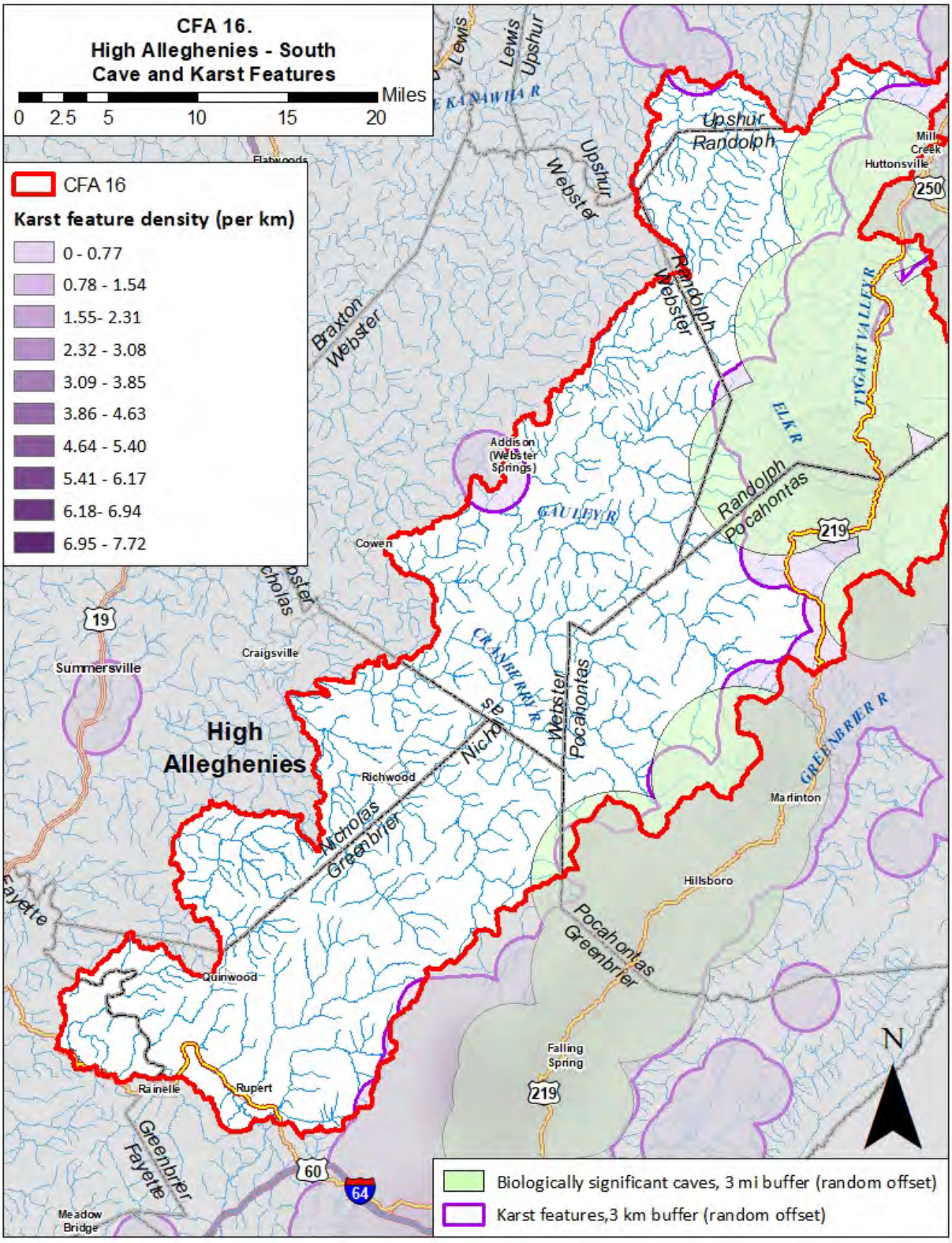
Map 24. Karst Areas and Biodiversity –South



Map 25. Karst and Cave Features – North



Map 26. Karst and Cave Features – South



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 from 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.

Below 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 24. Climate Stresses and Resilience Actions in Karst and Cave Habitats

Climate Stress:	**Habitat Resilience Action:**
• 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	• 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 karst and 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 25. Implementation Plan for Subterranean Habitats

Action	**Partners**	**Effectiveness Measures**
Land protection around caves and karst habitat: • Conservation Easements • Land Acquisition • Natural Area designation	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR	• Acres of habitat protected around caves and karst features • Abundance and diversity of priority species and habitats
Land protection around caves and karst habitat • Cost-Share Programs	• USDA FSA, NRCS	• Acres of habitat protected • Abundance and diversity of priority species and habitats
Land use planning to limit impervious surfaces around caves and karst habitat	• County Planning Commissions	• Acres of cave, karst and buffer habitat protected for public health and safety through land use planning ordinances
Restore and maintain fenced riparian buffers and resilient aquatic habitats around caves and karst	• USDA FSA & NRCS • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDEP and WVCA	• Acres or linear feet of stream buffer zones planted and fenced • Before and after comparison: abundance and diversity of priority species
Maintain resilient forests around caves and karst	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat managed • Before and after comparison: abundance and diversity of priority species
Sinkhole Cleanups, cave research and mapping, protection and landowner outreach	• NSS and regional grottos • WVACS • WVCC • CCV	• # of cave/karst resources protected or restored • # landowners participating in cave/karst protection and restoration activities
Improved wastewater and stormwater treatment around caves and karst habitat	• Counties • WVDEP • WVDHHR	• # systems installed or improved • Change in fecal and other water quality measurements • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Minimize, manage and mitigate for impacts of recreational activities, trails and other infrastructure on sensitive species and habitats	• FOB • Public Land Managers • WVDNR • WVSTA	• Acres of habitat avoided, managed or restored for priority species • 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.

Agricultural and Developed Habitats

Agricultural and Developed lands can be found scattered throughout the CFA, with the heaviest concentrations of developed areas found around Davis, Parsons, Richwood, and Rupert. Agricultural lands are found most heavily concentrated in the northeastern most areas of the CFA. Many species rely on agricultural lands, and some even rely on urbanized areas. Most agricultural areas and developed areas are in valley bottoms and floodplains. Maps 27-28 show agricultural and developed habitats, especially in Canaan Valley and the major river valleys in the northern half of the CFA. Anthropogenic grasslands and shrublands on previously mined areas provide similar habitats. There are many examples of biodiversity occurrences in and around agricultural and developed areas.

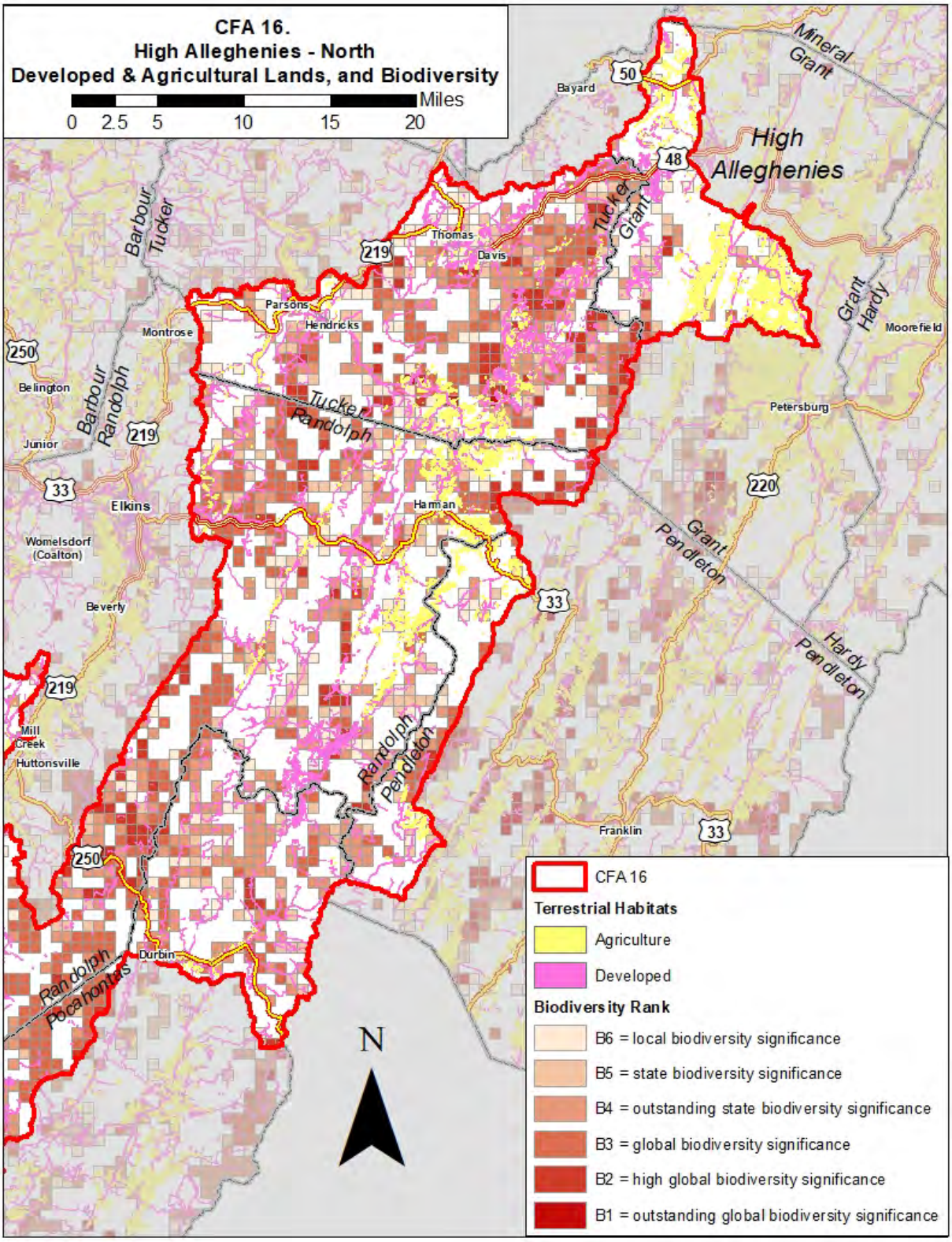
Priority Species

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. Table 26 lists priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habit, most notably for the Chimney Swift and Common Nighthawk. Henslow's Sparrow relies on Anthropogenic Grasslands and Shrublands on legacy mine sites.

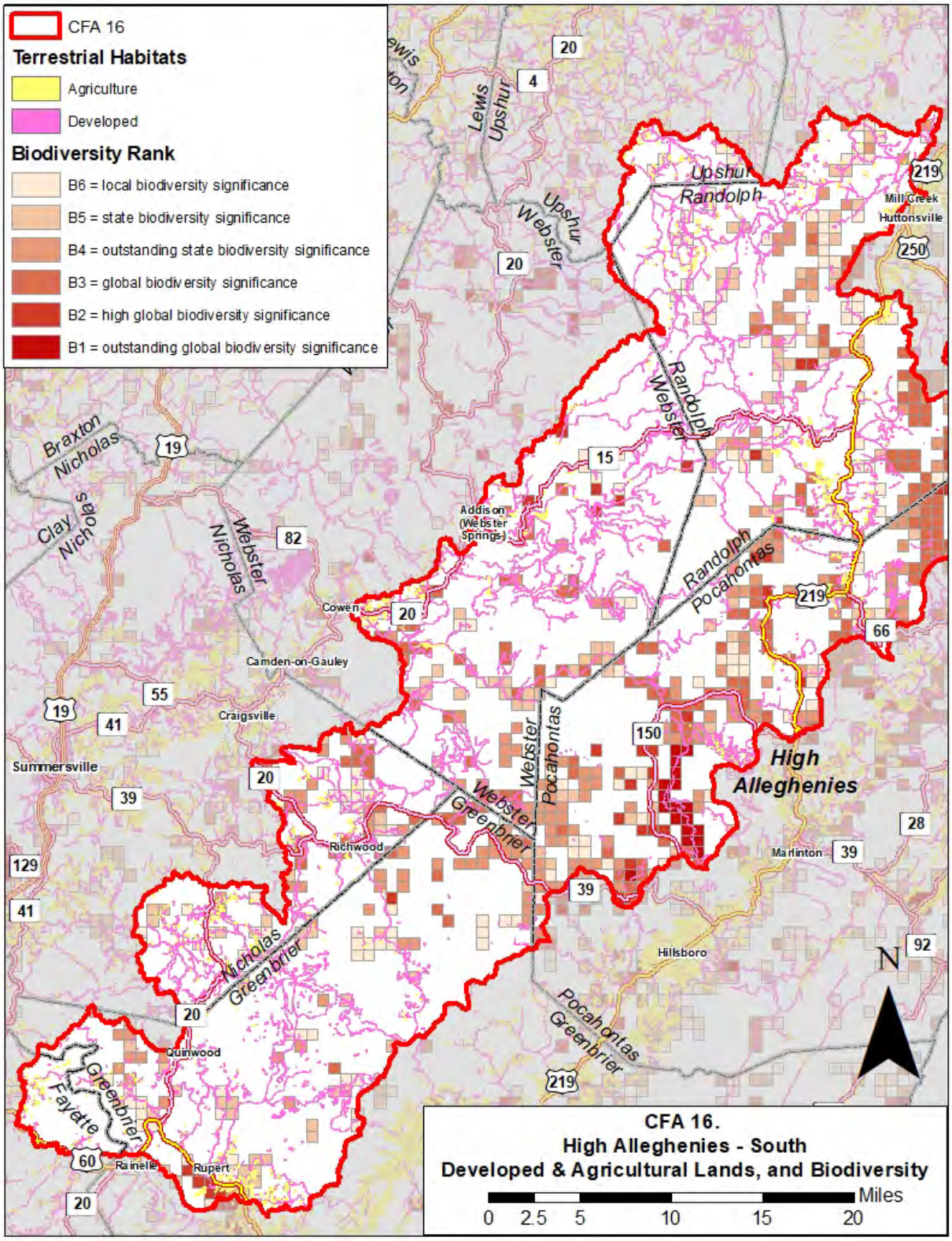
Table 26. Priority Species in Agricultural and Developed Habitats

Taxa	Scientific Name	Common Name
Bird	Ammodramus savannarum	Grasshopper Sparrow
Bird	Ammodramus henslowii	Henslow's Sparrow
Bird	Chaetura pelagica	Chimney Swift
Bird	Chordeiles minor	Common Nighthawk
Bird	Dolichonyx oryzivorus	Bobolink
Bird	Falco sparverius	American Kestrel
Bird	Scolopax minor	American Woodcock
Bird	Tyto alba	Barn Owl
Bird	Spizella pusilla	Field Sparrow
Bird	Sturnella magna	Eastern Meadowlark
Mammal	Corynorhinus townsendii virginianus	Virginia Big-eared Bat
Reptile	Opheodrys vernalis	Smooth Greensnake
Reptile	Virginia valeriae pulchra	Mountain Earthsnake

Map 27. Developed & Agricultural Lands, and Biodiversity – North



Map 28. Developed & Agricultural Lands, and Biodiversity – South



Habitat Stresses and Conservation Actions

The conversion of farmland for residential and commercial development eliminates 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, incompatible timing and short length of hay cutting intervals often drastically reduce breeding productivity of ground nesting birds. Many SGCNs also rely on habitat created by utility corridor maintenance, but the cutting of vegetation or herbicide treatment can have direct impacts on native birds and their nests. Rodenticides used to kill pests can also harm Barn Owls and other birds of prey. The table below lists stresses to wildlife habitat in agricultural areas, and conservation actions to address them.

Table 27. Habitat Stresses and Conservation Actions in Agricultural & Developed Habitats:

Habitat Stress	**Conservation Action**
Decline in suitable nest sites and migration roosts	Reduce rate of chimney capping, build chimney swift towers, retain large hollow snags
Possible decline in aerial insects	Reduce large-scale insecticide applications, install pollinator habitat and herbaceous field buffers
Insufficient early-successional habitat, fire suppression, clean farming practices, development	Manage for early-successional habitat around farmlands, maintain healthy grasses and forbs and woody structure in fields
Overgrazing	Monitor grazing impacts, assess habitat and cover
Grassland conversion; clean farming practices; loss of nest sites	Maintain & improve grassland habitat
Reduced breeding and roosting sites; clean farming practices	Install and monitor nest boxes for American Kestrels and Barn Owls
Succession on abandoned minelands; incompatible management regimes	Maintain shrublands and grasslands, replace exotic species with native correlaries

In addition to the habitat-linked stresses listed above, direct stresses to priority species include the destruction of nests due to mowing affecting the Bobolink, Eastern Meadowlark, Field Sparrow, and Grasshopper Sparrow. Other stressors include mortality from accidental consumption of rodenticide for Barn Owls and chimney capping affecting available breeding/roosting sites for Chimney Swifts.

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 notes that impervious surfaces in developed areas can exacerbate many of these impacts.

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

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

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

Table 28. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

Climate Stress:	Habitat Resilience Action:
• 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	• 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 29. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Cost-Share Programs	• USDA FSA & NRCS	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native vegetation	• USDA FSA & NRCS	• Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Maintain or create early-successional habitat in and around farmlands	• USDA NRCS	• Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats

Action	Partners	Effectiveness Measures
Prevent conversion of grasslands to croplands	• USDA FSA	• Acres of grasslands planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Adjust timing and interval of hay harvesting	• USDA FSA	• Acres of hay fields under adjusted harvest management • Change in abundance, diversity and distribution of priority species and habitats
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.	• Consulting Foresters • USDA NRCS • USFWS Partners for Wildlife Program • WVDOH • Public Land Managers	• Acres or linear feet of pollinator habitat created or maintained • Change in abundance, diversity and distribution of priority species and habitats
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	• Landowners, partners, and utility companies	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Nest box installation and monitoring	• WVDNR • Master Naturalists	• # next boxes installed • Change in abundance, diversity, and distribution of priority species
Outreach to landowners to reduce rodenticides for barn owls	• Landowners and volunteer groups	• # of landowners engaged • Reduction in use of rodenticides • Change in abundance, diversity, and distribution of priority species

Action	Partners	Effectiveness Measures
Landowner outreach, uncapping chimneys, install swift towers	• Landowners and volunteer groups	• # chimneys uncapped • # swift towers installed • Change in abundance, diversity, and distribution of chimney swifts
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	• USDA FSA & NRCS • Public Land Managers	• Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Adapt farm practices, infrastructure and land uses to changing conditions	• USDA FSA & NRCS • Public Land Managers	• # practices or acres adapted • Change in abundance, diversity, and distribution of priority species

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 high Alleghenies CFA, the SWAP included the following "Climate Friendly Conservation" action:

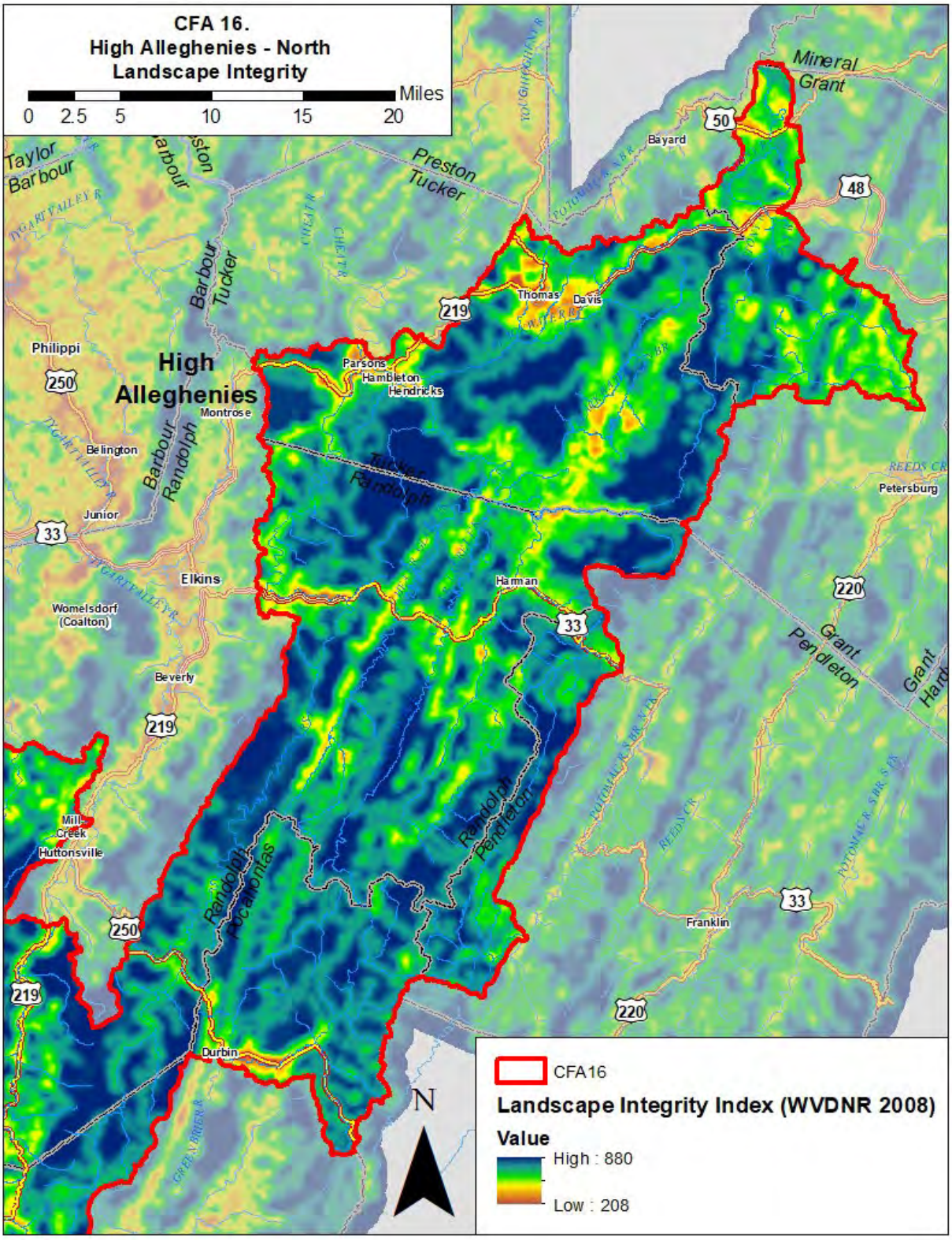
- Implement a comprehensive plan to enhance climate change resiliency through reducing other stressors (such as invasive species), identifying, maintaining, and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity.

The conservation and resilience actions described previously in this action 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. Habitat corridors include connected forest patches, intact river floodplains and small stream riparian forests. Protecting corridors of terrestrial and aquatic habitat connected to 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).

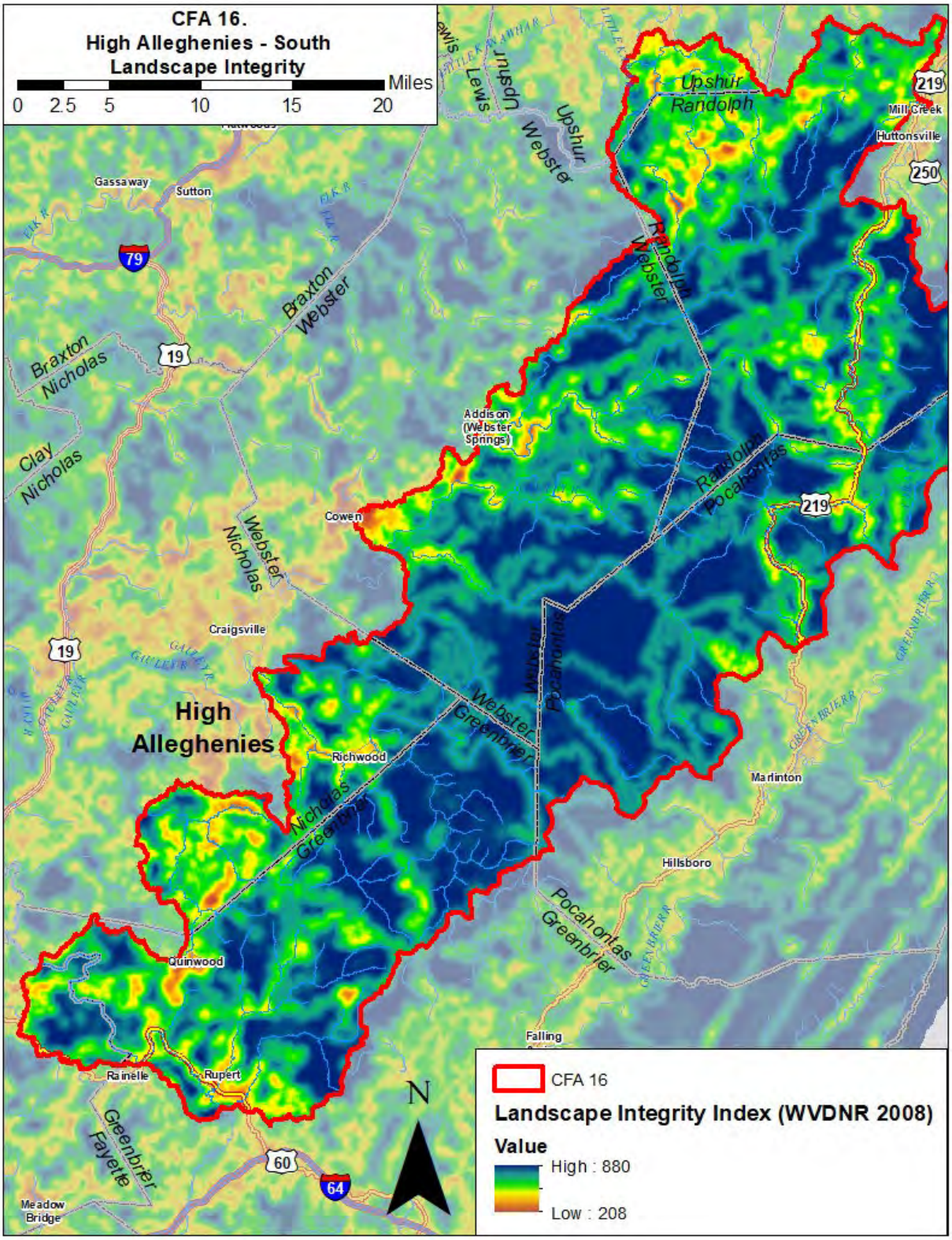
Maintaining or restoring wildlife populations in a changing climate may require conservation actions at a landscape level, across habitat types, and beyond individual habitat cores and corridors. Anderson (2016b) summarizes a wealth of current research demonstrating how the increasing frequency and severity 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. Maps 29-30 illustrate 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 Monongahela National Forest, Canaan Valley National Wildlife Refuge, State Parks, State Forests and Wildlife Management Areas protecting large forest patches in the CFA. There are also landscapes of high integrity owned by The Nature Conservancy, West Virginia Land Trust and 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 29. Landscape Integrity – North



Map 30. Landscape Integrity – South



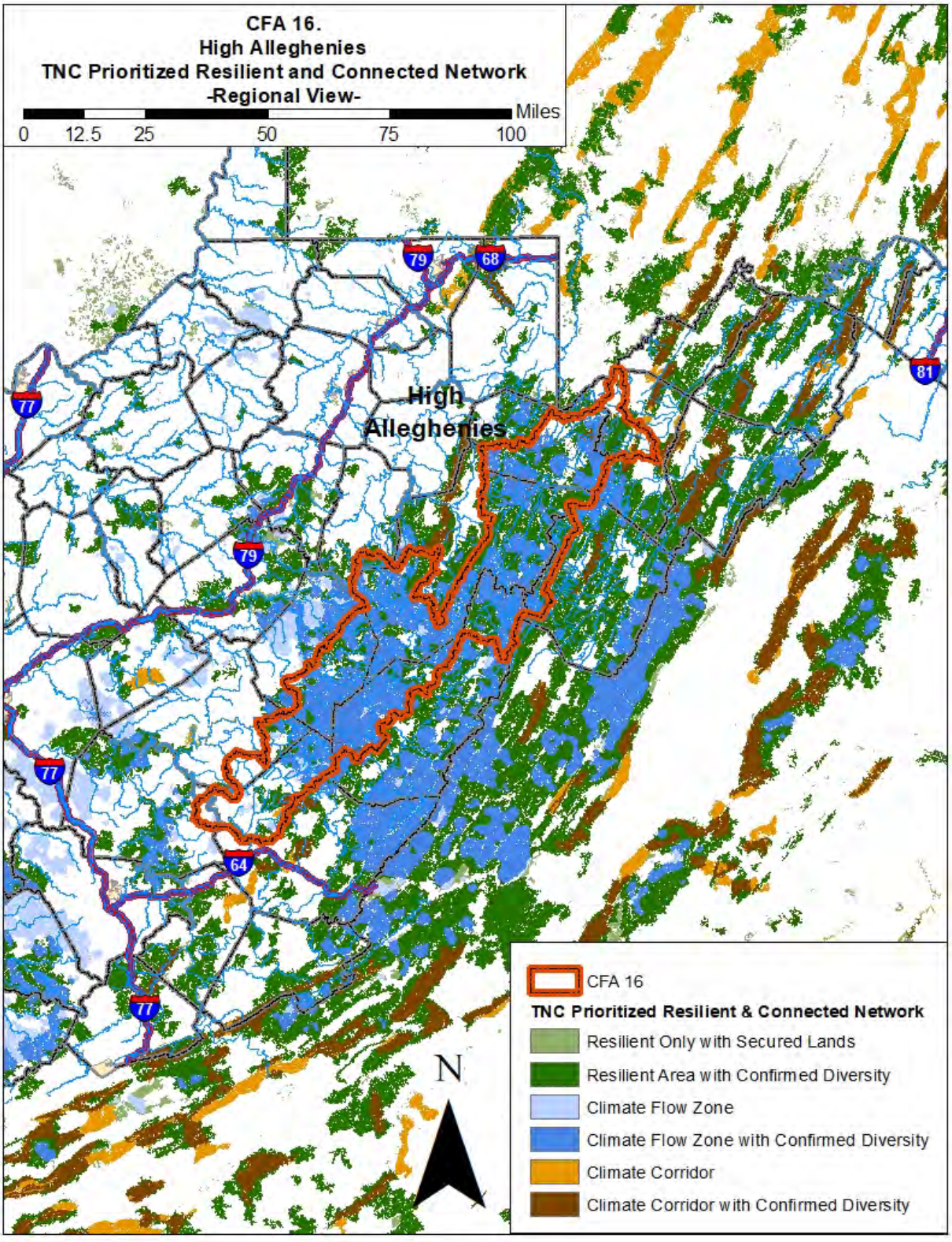
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic 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, and 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:

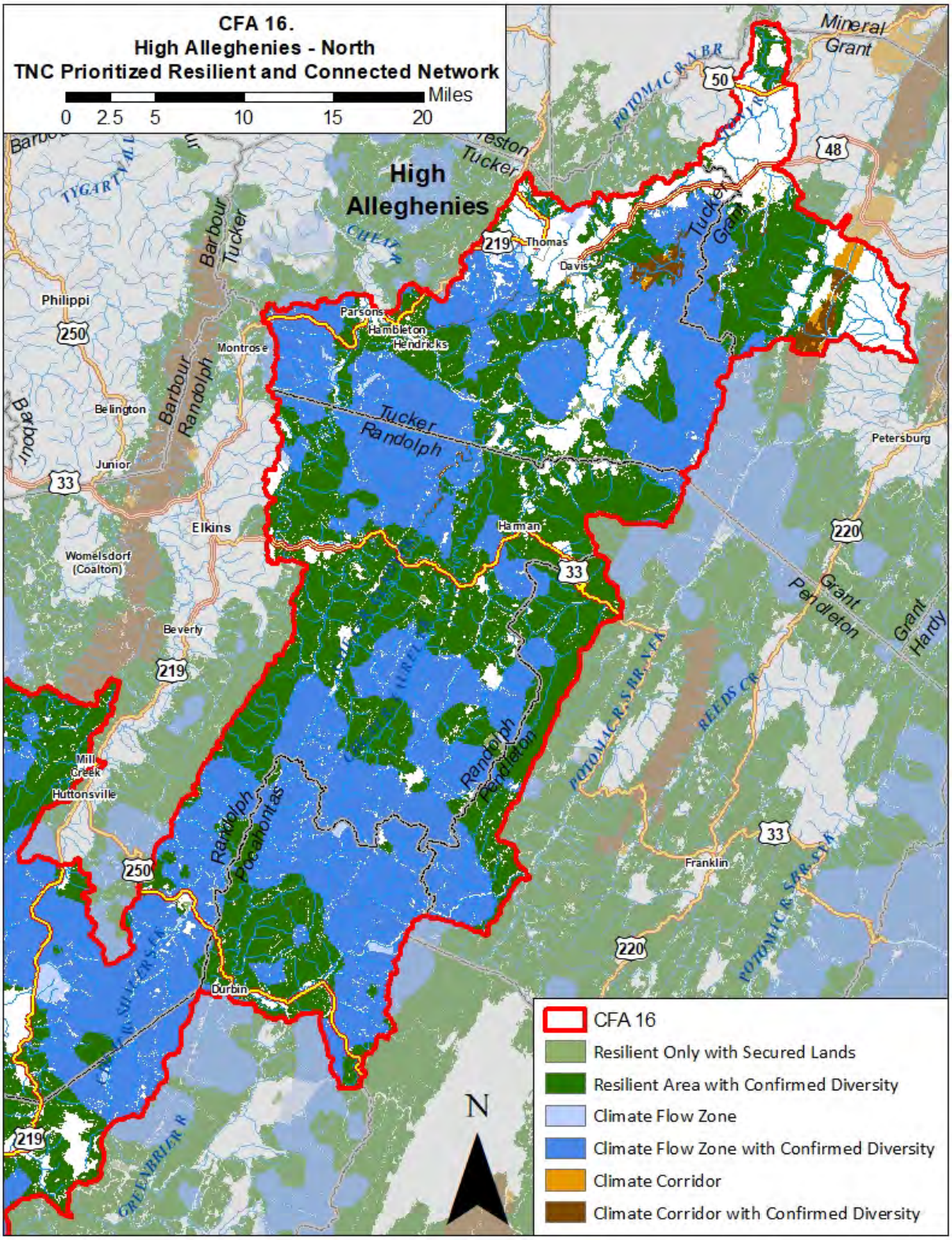
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change.
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes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

Map 31 is a regional map of priority resilient and connected landscapes illustrates that the resilient, connected landscapes in the CFA form the western side of the large hub of 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.

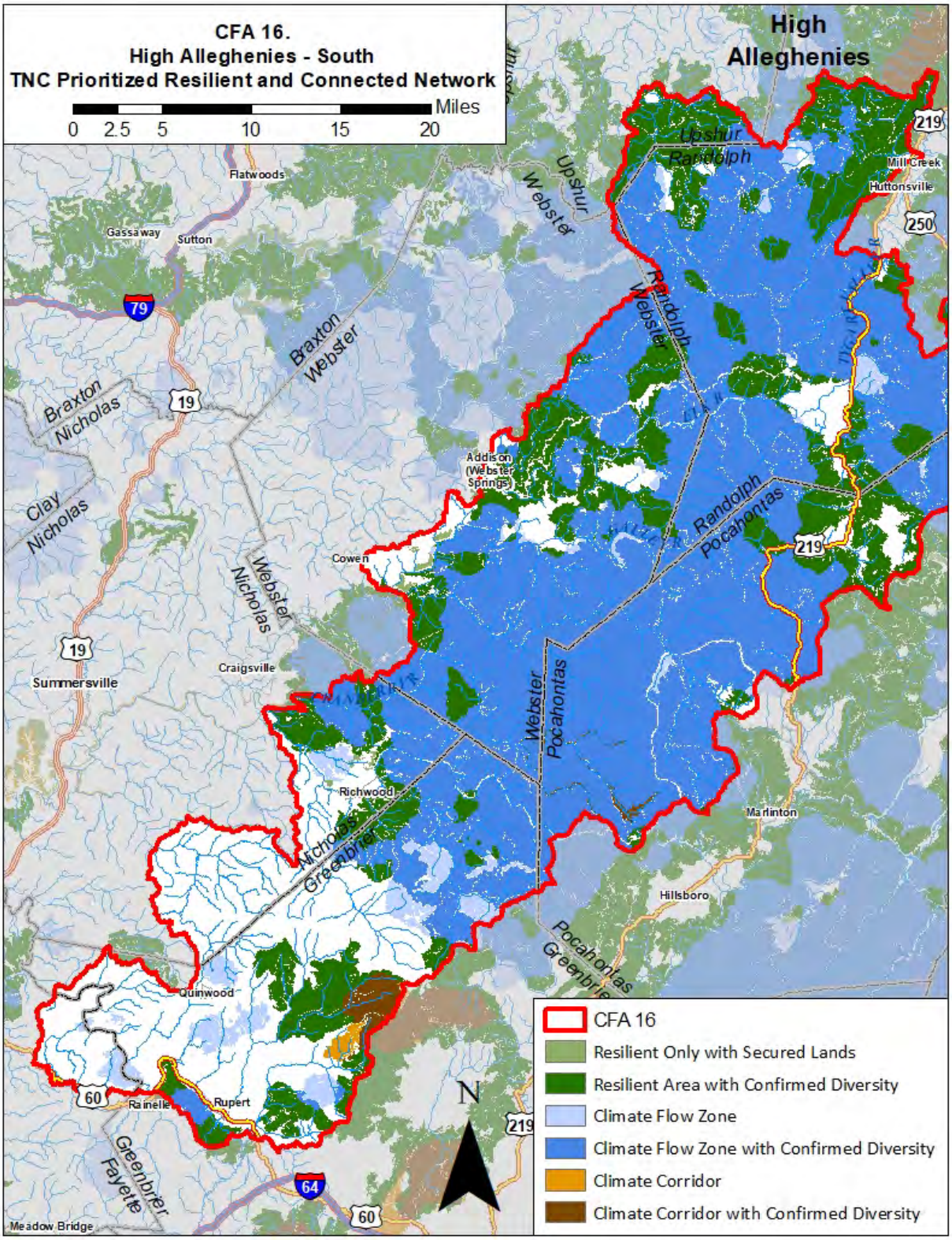
Map 31. Priority Resilient and Connected Network – Regional View



Map 32. Priority Resilient and Connected Network - Detailed View – North



Map 33. Priority Resilient and Connected Network – Detailed View – South



Maps 32-33 provide detailed views of the resilient, connected landscapes in the northern and southern halves of the High Alleghenies CFA. These priority resilient and connected landscapes contain the CFA's large forest patches and high integrity areas, several biologically significant caves and buffer areas, and most of the CFA's rock outcrop, cliff and talus, and shale barren habitats, and known biodiversity. They also include critical north-south migratory pathways along the Allegheny Front, Shavers Mountain and other mountain corridors.

Protecting and maintaining these areas of high landscape integrity and the resilient areas, climate corridors and climate flow zones within the region's priority resilient and connected network is critical in order to enable priority SGCN and their habitat to adapt to climate change and persist in this CFA. These areas are priorities for conservation action within the CFA.

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

Table 30. Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	Conservation Action
• 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	• 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 31. Implementation Plan for Landscape Resilience and Connectivity

Action	**Partners**	**Effectiveness Measures**
Protection of Resilient, Connected Landscapes • Conservation Easements • Land Acquisition	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Develop and Implement Plans to Manage Resilient Connected Landscapes • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs	• AMJV • AFF, AMJV, NWTF, RGS, TNC • AFTS, FSC, SFI • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WV DNR, WVDOF	• Acres of habitat protected for priority species • Abundance and diversity 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 that are particular conservation opportunities identified by this Action Plan.

- Large, intact forest patches, climate resilient lands and corridors
- Red Spruce and Northern Hardwood forests
- Heath-grass Barrens
- High Allegheny Wetlands
- The headwaters of the New River for Candy Darter, and the East and West Forks of the Greenbrier for Candy Darter and Hellbender, and numerous cold and cool water streams for brook trout and other associated wildlife.

Additional habitat priorities include the following.

- Small areas of unique, geologically derived habitat including:
    - Acidic rock outcrops, cliffs and talus,
    - Calcareous cliffs and talus
    - Shale barrens
- Karst areas, biologically significant caves, and their buffer areas
- Special aquatic habitats, such as mussel streams and brook trout habitat patches
- 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.
- High Integrity, Resilient and Connected Landscapes and migratory corridors.

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 plant 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 habitats to maximize benefits to multiple species in areas targeted for action in ways.

Connecting Conservation Actions for Climate Resilience

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

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

Next Steps in Implementation

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

- Planning, implementing, and evaluating ongoing field surveys of priority species to document and monitor their abundance, distribution, population trends, vulnerability, and range shifts;
- Planning, implementing, monitoring, and evaluating the results of the conservation actions; and
- 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 High Alleghenies CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Amphibians	Ambystoma jeffersonianum	Jefferson Salamander	S2	G4			
Amphibians	Aneides aeneus	Green Salamander	S3	G3		S	
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3		S	
Amphibians	Desmognathus welteri	Black Mountain Salamander	S2	G4			
Amphibians	Lithobates pipiens (R. pipiens)	Northern Leopard Frog	S1	G5			
Amphibians	Necturus maculosus	Mudpuppy	S4	G5			
Amphibians	Plethodon nettingi	Cheat Mountain Salamander	S2	G2	T		
Amphibians	Plethodon wehrlei	Wehrle's Salamander	S4	G4			
Amphibians	Pseudacris feriarum	Upland Chorus Frog	S3	G5			
Amphibians	Pseudotriton montanus diastictus	Midland Mud Salamander	S1	G5		S	
Amphibians	Pseudotriton ruber ruber	(northern) Red Salamander	S3	G5			
Birds	Accipiter gentilis	Northern Goshawk	S1B,S1N	G5		S	
Birds	Actitis macularius	Spotted Sandpiper	S2B	G5			
Birds	Aegolius acadicus	Northern Saw-whet Owl	S2B,S2N	G5			
Birds	Ammodramus henslowii	Henslow's Sparrow	S1B	G4		S	
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5	R		
Birds	Anas rubripes	American Black Duck	S2B,S2N	G5			
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5			At Risk-Consrv
Birds	Aquila chrysaetos	Golden Eagle	S3N	G5			
Birds	Ardea herodias	Great Blue Heron	S3B,S4N	G5			
Birds	Asio otus	Long-eared Owl	S1B,S1N	G5		S	
Birds	Bonasa umbellus	Ruffed Grouse	S3B,S3N	G5	R		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Birds	Botaurus lentiginosus	American Bittern	S1B,S1N	G4	R		
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5			
Birds	Butorides virescens	Green Heron	S3B				
Birds	Cardellina canadensis	Canada Warbler	S3B	G5			
Birds	Carduelis pinus	Pine Siskin	S2B,S4N	G5			
Birds	Catharus fuscescens	Veery	S3B	G5			
Birds	Catharus ustulatus	Swainson's Thrush	S3B	G5			
Birds	Chaetura pelagica	Chimney Swift	S3B	G5			
Birds	Chordeiles minor	Common Nighthawk	S2B	G5	R		
Birds	Circus cyaneus	Northern Harrier	S1B,S3N	G5			
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5			
Birds	Contopus cooperi	Olive-sided Flycatcher	S1B	G4		S	
Birds	Dolichonyx oryzivorus	Bobolink	S3B	G5	R		
Birds	Empidonax alnorum	Alder Flycatcher	S3B	G5			
Birds	Eremophila alpestris	Horned Lark	S2B,S3N	G5			
Birds	Falco sparverius	American Kestrel	S3B	G5			
Birds	Gallinago delicata	Wilson's Snipe	S1B,S3N	G5			
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5	R		
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5		S	
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5	R		
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5	R		At Risk-Consrv
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5			
Birds	Limnothlypis swainsonii	Swainson's Warbler	S3B	G4			
Birds	Lophodytes cucullatus	Hooded Merganser	S1B,S4N	G5			
Birds	Loxia curvirostra	Red Crossbill	S2B,S2N	G5			
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5			
Birds	Petrochelidon pyrrhonota	Cliff Swallow	S3B	G5			

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Birds	Piranga rubra	Summer Tanager	S3B	G5			
Birds	Pooecetes gramineus	Vesper Sparrow	S2B, S2N	G5		S	
Birds	Rallus limicola	Virginia Rail	S1B,S1N	G5			
Birds	Riparia riparia	Bank Swallow	S2B	G5	R		
Birds	Scolopax minor	American Woodcock	S3B	G5	R		
Birds	Seiurus noveboracensis	Northern Waterthrush	S2B	G5			
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4		S	At Risk-Consrv
Birds	Setophaga discolor	Prairie Warbler	S3B	G5	R	S	
Birds	Spizella pallida	Clay-colored Sparrow	S1B	G5			
Birds	Spizella pusilla	Field Sparrow	S3B,S3N	G5	R		
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5	R		
Birds	Tyto alba	Barn Owl	S2B,S2N	G5			
Birds	Vermivora chrysoptera	Golden-winged Warbler	S1B	G4		S	At Risk-Consrv
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5			
Birds	Vermivora ruficapilla	Nashville Warbler	S1B	G5			
Butterflies and Moths	Boloria selene myrina	Silver-bordered Fritillary	S3	T5			
Butterflies and Moths	Celastrina lucia	Northern Spring Azure	SNR	G5			
Butterflies and Moths	Celastrina neglectamajor	Appalachian Azure	SNR	G4			
Butterflies and Moths	Celastrina serotina	Cherry Gall Azure	SNR	G5			
Butterflies and Moths	Chlosyne harrisii	Harris's Checkerspot	S2	G4			
Butterflies and Moths	Colias interior (high elev)	Pink-edged Sulphur	S1	G2			
Butterflies and Moths	Eilema bicolor	Bicolor Moth	S1	G5			
Butterflies and Moths	Erora laeta	Early Hairstreak	S2	GU		S	
Butterflies and Moths	Euphydryas phaeton	Baltimore Checkerspot	S3S4	G4			
Butterflies and Moths	Euphyes bimacula	Two-spotted Skipper	S1	G4			

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Butterflies and Moths	Glaucopsyche l. lygdamus	Silvery Blue	S4	T3			
Butterflies and Moths	Lithophane oriunda	Immigrant Pinion Moth	S1	G4			
Butterflies and Moths	Lophocampa maculata	Spotted Tussock Moth	S1	G5			
Butterflies and Moths	Lycaena hyllus	Bronze Copper	S2	G5		S	
Butterflies and Moths	Melanchra assimilis	Black Arches	S1	G5			
Butterflies and Moths	Papilio appalachiensis	Appalachian Tiger Swallowtail	SNR	G4			
Butterflies and Moths	Parrhasius m-album	White-m Hairstreak	S2	G5			
Butterflies and Moths	Phyciodes cocyta selene	Northern Crescent	S2	G4			
Butterflies and Moths	Pieris virginiensis	West Virginia White	S3	G3		S	
Butterflies and Moths	Polygonia faunus smythi	Smyth's Green Comma	S1	T3		S	
Butterflies and Moths	Polygonia progne	Gray Comma	S3	G4			
Butterflies and Moths	Pseudohermonassa tenuicula	Morrison's Sooty Dart Moth	SH	G4			
Butterflies and Moths	Satyrium edwardsii	Edwards' Hairstreak	S2	G4			
Butterflies and Moths	Speyeria atlantis	Atlantis Fritillary	S3	G5			
Butterflies and Moths	Speyeria diana	Diana Fritillary	S2S3	G3		S	
Butterflies and Moths	Syngrapha rectangula	Salt & Pepper Looper Moth	S1	G5			
Cave Invertebrates	Apochthonius paucispinosus	Dry Fork Valley Cave Pseudoscorpion	S1	G1		S	
Cave Invertebrates	Arrhopalites pavo	A Cave Springtail	S1S2	G1		S	
Cave Invertebrates	Bathyphantes weyeri	A Cave Spider	S3	G4			
Cave Invertebrates	Caecidotea cannula	An Isopod	S1	G2		S	
Cave Invertebrates	Caecidotea holsingeri	Greenbrier Valley Cave Isopod	S3	G5		S	
Cave Invertebrates	Caecidotea simonini	An Isopod	S1	G1		S	
Cave Invertebrates	Macrocotyla hoffmasteri	Hoffmaster's Cave Flatworm	S2	G3			
Cave Invertebrates	Nesticus tennesseensis	A Cave Spider	SU	G3			

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Cave Invertebrates	Phagocata angusta	A Cave Planarian	S1	G1		S	
Cave Invertebrates	Phanetta subterranea	A Spider	S3	G5			
Cave Invertebrates	Porrhomma cavernicola	Appalachian Cave Spider	S2	G5			
Cave Invertebrates	Pseudanophthalmus fuscus	A Cave Beetle	S2	G4		S	
Cave Invertebrates	Pseudanophthalmus hypertrichosis	A Cave Beetle	S3	G5		S	
Cave Invertebrates	Pseudanophthalmus montanus	Dry Fork Valley Cave Beetle	S1	G1		S	
Cave Invertebrates	Pseudanophthalmus sp. 2	A Beetle	S1	G1			
Cave Invertebrates	Pseudosinella certa	Gandy Creek Cave Springtail	S1	G1		S	
Cave Invertebrates	Pseudosinella gisini gisini	A Cave Springtail	S3	G3		S	
Cave Invertebrates	Pseudosinella sp. 8	A Springtail	S2	G2			
Cave Invertebrates	Pseudotremia fulgida	Greenbrier Valley Cave Millipede	S3	G4			
Cave Invertebrates	Rhagidia varia	A Cave Mite	S3	G5			
Cave Invertebrates	Sinella agna	A Springtail	S3	G2		S	
Cave Invertebrates	Sinella hoffmani	Hoffman's Springtail	S3	G5			
Cave Invertebrates	Sphalloplana culveri	Culver's Planarian	S1	G1		S	
Cave Invertebrates	Stygobromus culveri	Culver's Cave Amphipod	S1	G1		S	
Cave Invertebrates	Stygobromus emarginatus	Greenbrier Cave Amphipod	S3	G3		S	
Cave Invertebrates	Stygobromus franzi	Franz's Cave Amphipod	S1	G3		S	
Cave Invertebrates	Stygobromus nanus	Pocahontas Cave Amphipod	S1	G1		S	
Cave Invertebrates	Stygobromus parvus	Minute Cave Amphipod	S1	G2		S	
Cave Invertebrates	Zygonopus krekeleri	West Virginia Blind Cave Millipede	S1	G4		S	
Cave Invertebrates	Zygonopus weyeriensis	Grand Caverns Blind Cave Millipede	S2	G3		S	

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Crayfish	Cambarus chasmodactylus	New River Crayfish	S3	G4			
Crayfish	Cambarus elkensis	Elk River Crayfish	S1	G2		S	
Crayfish	Cambarus nerterius	An Underground Crayfish	S1?	G2		S	
Crayfish	Cambarus smilax	Greenbrier River Crayfish	S2	GNR		S	
Dragonflies & Damselflies	Aeshna canadensis	Canada Darner	S3	G5			
Dragonflies & Damselflies	Aeshna tuberculifera	Black-tipped Darner	S3	G4			
Dragonflies & Damselflies	Aeshna verticalis	Green-striped Darner	S2S3	G5			
Dragonflies & Damselflies	Anax longipes	Comet Darner	S3	G5			
Dragonflies & Damselflies	Argia bipunctulata	Seepage Dancer	S1	G4			
Dragonflies & Damselflies	Calopteryx amata	Superb Jewelwing	S3	G4			
Dragonflies & Damselflies	Calopteryx angustipennis	Appalachian Jewelwing	S3	G4			
Dragonflies & Damselflies	Cordulegaster obliqua	Arrowhead Spiketail	S2	G4			
Dragonflies & Damselflies	Cordulia shurtleffi	American Emerald	S4	G5			
Dragonflies & Damselflies	Enallagma annexum	Northern Bluet	S3	G5			
Dragonflies & Damselflies	Enallagma vernale	Vernal Bluet	S1	G4			
Dragonflies & Damselflies	Enallagma vesperum	Vesper Bluet	S3	G5			
Dragonflies & Damselflies	Epiaeschna heros	Swamp Darner	S3	G5			
Dragonflies & Damselflies	Epitheca canis	Beaverpond Baskettail	S3	G5			
Dragonflies & Damselflies	Gomphus abbreviatus	Spine-crowned Clubtail	SH	G3			
Dragonflies & Damselflies	Gomphus adelphus	Mustached Clubtail	S1	G4			
Dragonflies & Damselflies	Gomphus descriptus	Harpoon Clubtail	S2S3	G4			
Dragonflies & Damselflies	Gomphus quadricolor	Rapids Clubtail	S3	G3		S	
Dragonflies & Damselflies	Gomphus viridifrons	Green-faced Clubtail	S3	G3		S	
Dragonflies & Damselflies	Helocordulia uhleri	Uhler's Sundragon	S2S3	G5			
Dragonflies & Damselflies	Lanthus parvulus	Northern Pygmy Clubtail	S3	G4			
Dragonflies & Damselflies	Lestes australis	Southern Spreadwing	S3	G5			
Dragonflies & Damselflies	Lestes disjunctus	Northern Spreadwing	S3	G5			
Dragonflies & Damselflies	Lestes forcipatus	Sweetflag Spreadwing	S3	G5			

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Dragonflies & Damselflies	Leucorrhinia glacialis	Crimson-ringed Whiteface	S1	G5			
Dragonflies & Damselflies	Leucorrhinia hudsonica	Hudsonian Whiteface	S3	G5			
Dragonflies & Damselflies	Libellula axilena	Bar-winged Skimmer	S2	G5			
Dragonflies & Damselflies	Libellula flavida	Yellow-sided Skimmer	S3	G5			
Dragonflies & Damselflies	Macromia illinoiensis	Illinois River Cruiser	S3	G5			
Dragonflies & Damselflies	Ophiogomphus mainensis fastigiatus	Maine Snaketail	S3	G4			
Dragonflies & Damselflies	Rhionaeschna mutata	Spatterdock Darner	S1	G4			
Dragonflies & Damselflies	Somatochlora elongata	Ski-tipped Emerald	S3	G5			
Dragonflies & Damselflies	Somatochlora forcipata	Forcipate Emerald	S3	G5			
Dragonflies & Damselflies	Somatochlora linearis	Mocha Emerald	S3	G5			
Dragonflies & Damselflies	Sympetrum internum	Cherry-faced Meadowhawk	S2	G5			
Dragonflies & Damselflies	Sympetrum obtrusum	White-faced Meadowhawk	S3	G5			
Fish	Ameiurus melas	Black Bullhead	S1	G5			
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5			
Fish	Anguilla rostrata	American Eel	S2	G4	R		
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3		S	
Fish	Cottus kanawhae	Kanawha Sculpin	S2	G4			
Fish	Etheostoma osburni	Candy Darter	S1	G3	E	S	
Fish	Exoglossum laurae	Tonguetied Minnow	S2	G4		S	
Fish	Luxilus cornutus	Common Shiner	S1S2	G5			
Fish	Margariscus margarita	Pearl Dace	S2S3	G5		S	
Fish	Notropis scabriceps	New River Shiner	S2	G4		S	
Fish	Percina gymnocephala	Appalachia Darter	S2	G4		S	
Fish	Percina peltata	Shield Darter	S1	G5			
Fish	Phenacobius teretulus	Kanawha Minnow	S1	G3		S	
Fish	Salvelinus fontinalis	Brook Trout	S5	G5	R		
Fish	Thoburnia rhothoeca	Torrent Sucker	S3	G4			

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Mammals	Condylura cristata	Star-nosed Mole	S2	G5			
Mammals	Corynorhinus townsendii virginianus	Virginia Big-eared Bat	S2	G2	E		
Mammals	Erethizon dorsatum	Porcupine	S3	G5			
Mammals	Glaucomys sabrinus fuscus	WV Northern Flying Squirrel	S2	G2		S	
Mammals	Lasionycteris noctivagans	Silver-haired Bat	S2	G5			
Mammals	Lasiurus borealis	Eastern Red Bat	S4	G5	R		
Mammals	Lasiurus cinereus	Hoary Bat	S3	G5			
Mammals	Lepus americanus	Snowshoe Hare	S3	G5			
Mammals	Microtus chrotorrhinus carolinensis	Southern Rock Vole	S2	G3		S	
Mammals	Myotis leibii	Eastern Small-footed Bat	S1	G3		S	
Mammals	Myotis lucifugus	Little Brown Myotis	S2*	G3	R	S	
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2	T		
Mammals	Myotis sodalis	Indiana Bat	S1	G2	E		
Mammals	Neotoma magister	Allegheny Woodrat	S3	G3		S	
Mammals	Perimyotis subflavus	Tricolored Bat	S2*	G3	R	S	
Mammals	Reithrodontomys humulis	Eastern Harvest Mouse	SH	G5			
Mammals	Sorex dispar	Long-tailed Shrew	S2S3	G4		S	
Mammals	Sorex hoyi winnemana	Southern Pygmy Shrew	S2S3	G4			
Mammals	Sorex palustris punctulatus	Southern Water Shrew	S1	G3		S	
Mammals	Spilogale putorius	Eastern Spotted Skunk	S1	G5		S	
Mammals	Sylvilagus obscurus	Appalachian Cottontail	S2	G4		S	
Mammals	Synaptomys cooperi	Southern Bog Lemming	S3	G5		S	
Mammals	Zapus hudsonius	Meadow Jumping Mouse	S3	G5			
Mussels	Actinonaias ligamentina	Mucket	S3	G5			
Mussels	Alasmidonta marginata	Elktoe	S1	G4		S	

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Mussels	Lasmigona subviridis	Green Floater	S2	G3		S	
Mussels	Strophitus undulatus	Squawfoot	S3	G5			
Other Invertebrates	Allocapnia frumi	A Stonefly	S2	G2			At Risk-Science
Other Invertebrates	Bombus terricola	Yellow-banded Bumble Bee	S2S3				
Other Invertebrates	Hansonoperla appalachia	Hanson's Appalachian Stonefly	S2	G3			
Other Invertebrates	Megaleuctra flinti	A Stonefly	S1	G2			At Risk-Science
Other Invertebrates	Sweltsa pocahontas	A Stonefly	S2	G2			At Risk-Science
Plants	Abies balsamea	Balsam Fir	S1	G5			
Plants	Aconitum reclinatum	White Monkshood	S3	G3			
Plants	Adlumia fungosa	Allegheny-vine	S2?	G4			
Plants	Ageratina aromatica var. aromatica	Small White Snakeroot	S1	T5			
Plants	Agrostis mertensii	Northern Bentgrass	S1	G5		S	
Plants	Amelanchier bartramiana	Oblong-fruit Serviceberry	S2	G5		S	
Plants	Andromeda polifolia var. glaucophylla	Bog-rosemary	S1	T5			
Plants	Anemone canadensis	Roundleaf Thimbleweed	S1	G5			
Plants	Anemone quinquefolia var. minima	Dwarf Anemone	S2	T3			
Plants	Betula cordifolia	Heartleaf Paper Birch	S1				
Plants	Betula papyrifera	Paper Birch	S2	G5			
Plants	Botrychium lanceolatum var. angustisegmentum	Lanceolate Grapefern	S1	T4		S	
Plants	Botrychium matricariifolium	Daisy-leaved Grape-fern	S2	G5			

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Plants	Bouteloua curtipendula var. curtipendula	Sideoats Grama	S3	T5			
Plants	Calopogon tuberosus var. tuberosus	Tuberous Grass-pink	S1	T5			
Plants	Calystegia spithamaea ssp. purshiana	Shale Bindweed	S3	T4			
Plants	Campanula rotundifolia	Bluebell Bellflower	S3	G5			
Plants	Carex aggregata	Glomerate Sedge	S2	G5			
Plants	Carex arctata	Drooping Woodland Sedge	S1	G5			
Plants	Carex atherodes	Awned Sedge	S1	G5			
Plants	Carex bromoides ssp. bromoides	Brome-like Sedge	S3	T5			
Plants	Carex bushii	Bush's Sedge	S2S3	G4			
Plants	Carex canescens	Silvery Sedge	S3	G5			
Plants	Carex comosa	Longhair Sedge	S2	G5			
Plants	Carex deflexa	Northern Sedge	S1	G5			
Plants	Carex eburnea	Bristleleaf Sedge	S3	G5			
Plants	Carex emoryi	Emory's Sedge	S2	G5			
Plants	Carex haydenii	Cloud Sedge	S1	G5			
Plants	Carex hirtifolia	Pubescent Sedge	S3	G5			
Plants	Carex interior	Inland Sedge	S1	G5			
Plants	Carex lacustris	Lake Sedge	S2	G5			
Plants	Carex lasiocarpa var. americana	Woolly-fruit Sedge	S1	T5			
Plants	Carex laxiculmis var. copulata	Spreading Sedge	S2	T4			
Plants	Carex manhartii	Manhart's Sedge	S1	G3			
Plants	Carex meadii	Mead's Sedge	S1	G4			
Plants	Carex molesta	Troublesome Sedge	S3	G4			
Plants	Carex molestiformis	Frightful Sedge	S2	G4			

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Plants	Carex normalis	Greater Straw Sedge	S3	G5			
Plants	Carex novae-angliae	New England Sedge	S1	G5			
Plants	Carex pauciflora	Few-flower Sedge	S1	G5			
Plants	Carex pedunculata	Longstalk Sedge	S2	G5			
Plants	Carex pellita	Woolly Sedge	S2	G5			
Plants	Carex projecta	Necklace Sedge	S3	G5			
Plants	Carex roanensis	Roan Mountain Sedge	S2	G3		S	
Plants	Carex straminea	Straw Sedge	S2	G5			
Plants	Carex suberecta	Prairie Straw Sedge	S1	G4			
Plants	Carex tetanica	Rigid Sedge	S1	G4			
Plants	Carex trichocarpa	Hairy-fruit Sedge	S1	G4			
Plants	Carex tuckermanii	Tuckerman's Sedge	S1	G4			
Plants	Carex utriculata	Beaked Sedge	S3	G5			
Plants	Carex vesicaria	Inflated Sedge	S2	G5			
Plants	Clematis albicoma	White-hair Leatherflower	S3	G4			
Plants	Clematis occidentalis var. occidentalis	Purple Virgin's Bower	S2	T5		S	
Plants	Coeloglossum viride var. virescens	Long-bracted Green Orchid, Satyr Orchid	S1	T5			
Plants	Coptis trifolia	Threeleaf Goldthread	S2	G5			
Plants	Corallorhiza bentleyi	Bentley's Coralroot	S1	G1		S	
Plants	Corallorhiza maculata var. occidentalis	Western Spotted Coralroot	S1	T4			
Plants	Corallorhiza trifida	Early Coralroot	S1	G5			
Plants	Cornus canadensis	Canadian Bunchberry	S2	G5			
Plants	Cryptogramma stelleri	Fragile Rockbrake	S1	G5			
Plants	Cuscuta rostrata	Beaked Dodder	S2	G4			
Plants	Cymophyllus fraserianus	Fraser's Sedge	S3	G4			

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Plants	Cypripedium reginae	Showy Lady's-slipper	S1	G4		S	
Plants	Dalibarda repens	Robin-run-away	S3	G5			
Plants	Dichanthelium meridionale	Matting Witchgrass	S3	G5			
Plants	Drosera rotundifolia var. rotundifolia	Roundleaf Sundew	S3	T5			
Plants	Eleocharis elliptica	Elliptic Spikerush	S1	G5			
Plants	Eleocharis palustris	Marsh Spikerush	S3	G5			
Plants	Elymus trachycaulus ssp. trachycaulus	Slender Wild Rye	S2	T5			
Plants	Equisetum fluviatile	Water Horsetail	S2	G5			
Plants	Equisetum sylvaticum	Woodland Horsetail	S1	G5			
Plants	Eupatorium pilosum	Rough Boneset	S2	G5			
Plants	Euphorbia purpurea	Glade Spurge	S2	G3		S	
Plants	Fraxinus nigra	Black Ash	S2	G5			
Plants	Gaultheria hispidula	Creeping Snowberry	S3	G5			
Plants	Gentianopsis crinita	Greater Fringed Gentian	S1	G5			
Plants	Geum aleppicum	Yellow Avens	S1	G5			
Plants	Geum rivale	Purple Avens	S1	G5			
Plants	Glyceria acutiflora	Creeping Mannagrass	S2	G5			
Plants	Glyceria grandis var. grandis	American Mannagrass	S2	T5			
Plants	Glyceria laxa	Mannagrass	S2S3	G5			
Plants	Goodyera repens	Dwarf Rattlesnake-plantain	S1S2	G5			
Plants	Gymnocarpium appalachianum	Appalachian Oak Fern	S2	G3		S	
Plants	Gymnocarpium dryopteris	Northern Oak Fern	S1	G5			
Plants	Hasteola suaveolens	False Indian-plantain	S3	G4		S	
Plants	Heuchera alba	White Alumroot	S2	G2		S	
Plants	Heuchera americana var. hispida	Rough Alumroot, Rough Heuchera	S2	T3			

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Plants	Hierochloe hirta ssp. arctica	Holy Grass, Sweetgrass	S1	T5			
Plants	Hypericum mitchellianum	Blue Ridge St. John's-wort	S1	G3		S	
Plants	Ilex collina	Hill Holly	S2	G3		S	
Plants	Isotria medeoloides	Small Whorled Pogonia	S1	G2	T		
Plants	Juglans cinerea	Butternut	S3	G4		S	
Plants	Juncus articulatus	Jointleaf Rush	S2	G5			
Plants	Juncus biflorus	Bog Rush	S2	G5			
Plants	Juncus dichotomus	Forked Rush	S1	G5			
Plants	Juncus filiformis	Thread Rush	S2	G5		S	
Plants	Juncus nodosus var. nodosus	Knotted Rush	S1S2	T5			
Plants	Juncus trifidus	Highland Rush	S1	G5		S	
Plants	Lilium philadelphicum var. philadelphicum	Wood Lily	S2S3	T4			
Plants	Linnaea borealis ssp. americana	Twinflower	S1	T5		S	
Plants	Liparis loeselii	Yellow Wide-lip Orchid	S3	G5			
Plants	Listera cordata var. cordata	Heartleaf Twayblade	S2	T5		S	
Plants	Listera smallii	Kidneyleaf Twayblade	S2	G4			
Plants	Lonicera canadensis	Fly Honeysuckle	S2	G5			
Plants	Luzula bulbosa	Bulbous Woodrush	S1	G5			
Plants	Lycopodiella alopecuroides	Foxtail Clubmoss	S1	G5			
Plants	Lycopodiella inundata	Northern Bog Clubmoss	S2	G5			
Plants	Lycopodium lagopus	One-cone Groundpine	S1	G5			
Plants	Lygodium palmatum	American Climbing Fern	S3	G4			
Plants	Maianthemum stellatum	Starflower False Solomon's-seal	S2	G5			
Plants	Marshallia grandiflora	Monongahela Barbara's-buttons	S2	G2		S	At Risk-Science
Plants	Matteuccia struthiopteris	Ostrich Fern	S2	G5			

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-Plants	Melanelia stygia	Stygian Black-parmelia	S2	G4			
Plants	Menyanthes trifoliata	Buckbean	S1	G5		S	
Plants	Najas gracillima	Slender Waternymph	S2	G5			
Plants	Nuttallanthus canadensis	Old-field Toadflax	S2	G5			
Plants	Oenothera argillicola	Shalebarren Evening-primrose	S3	G3			
Plants	Oenothera pilosella ssp. pilosella	Meadow Sundrops	S2	T5			
Plants	Ophioglossum pusillum	Northern Adder's-tongue	SH	G5			
Plants	Packera antennariifolia	Shalebarren Ragwort	S3	G4			
Plants	Packera paupercula	Balsam Ragwort	S2	G5			
Plants	Parnassia asarifolia	Kidneyleaf Grass-of-parnassus	S2	G4			
Plants	Paronychia argyrocoma	Silvery Nailwort	S3	G4		S	
Plants	Pedicularis lanceolata	Swamp Lousewort	S2	G5		S	
Plants	Pieris floribunda	Mountain Fetterbush	S3	G4			
Plants	Piptatherum canadense	Canada Mountain Ricegrass	S1	G5		S	
Plants	Platanthera peramoena	Pride-of-the-peak	S3	G5			
Plants	Platanthera psycodes	Lesser Purple Fringed Orchid	S1	G5			
Plants	Platanthera shriveri	Shriver's Frilly Orchid	S1	G1		S	
Plants	Poa saltuensis	Old-pasture Bluegrass	S1	G5			
Plants	Pogonia ophioglossoides	Rose Pogonia	S2	G5			
Plants	Polemonium vanbruntiae	Bog Jacob's-ladder	S2	G3		S	
Plants	Polygala cruciata var. aquilonia	Cross-leaved Milkwort	S1	T4			
Plants	Polygala curtissii	Curtiss' Milkwort	S2	G5			
Plants	Populus balsamifera ssp. balsamifera	Balsam Poplar	S1	T5			

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Plants	Potamogeton tennesseensis	Tennessee Pondweed	S2	G2		S	At Risk-Science
Plants	Prenanthes crepidinea	Corymbed Rattlesnake-root	S1	G4			
Plants	Prunus alleghaniensis var. alleghaniensis	Allegheny Plum	S3	T4			
Plants	Rhamnus alnifolia	Alderleaf Buckthorn	S1S2	G5			
Plants	Rhododendron viscosum	Swamp Azalea	S1	G5			
Plants	Rhynchospora fusca	Brown Beaksedge	S1	G4			
Plants	Ribes lacustre	Bristly Black Currant	S2	G5		S	
Plants	Rubus pubescens var. pubescens	Dwarf Red Bramble	S1	T5		S	
Plants	Rudbeckia fulgida var. fulgida	Orange Coneflower	S2	T4			
Plants	Sagittaria calycina var. calycina	Long-lobe Arrowhead	S2	T5			
Plants	Salix discolor	Pussy Willow	S2	G5			
Plants	Salix lucida ssp. lucida	Shining Willow	S1	T5			
Plants	Sanguisorba canadensis	Canada Burnet	S2S3	G5			
Plants	Saxifraga michauxii	Cliff Saxifrage	S1	G4		S	
Plants	Saxifraga pensylvanica	Eastern Swamp Saxifrage	S2	G5			
Plants	Scheuchzeria palustris ssp. americana	Pod Grass	SH	T5			
Plants	Schizachne purpurascens	False Melicgrass	S1	G5			
Plants	Schoenoplectus purshianus	Clubrush, Bulrush	S3	G4			
Plants	Scirpus atrocinctus	Blackgirdle Bulrush	S3	G5			
Plants	Scirpus microcarpus	Red-tinge Bulrush	S3	G5			
Plants	Scutellaria saxatilis	Rock Skullcap	S2	G3		S	
Plants	Sericocarpus linifolius	Narrowleaf Whitetop Aster	S1	G5			
Plants	Sibbaldiopsis tridentata	Mountain-cinquefoil	S2	G5			
Plants	Solidago arguta var. harrisii	Shalebarren Goldenrod	S3	T4			

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Plants	Sparganium androcladum	Branched Bur-reed	S2S3	G4			
Plants	Spiraea virginiana	Virginia Spiraea	S1	G2	T		
Plants	Spiranthes lucida	Shining Ladies'-tresses	S1S2	G5			
Plants	Stachys tenuifolia	Smooth Hedge-nettle	S3	G5			
Plants	Stellaria borealis ssp. borealis	Northern Stitchwort	S1	T5		S	
Plants	Symphyotrichum laeve var. concinnum	Smooth Blue American-aster	S2	T4			
Plants	Symphyotrichum novi-belgii	New Belgium American-aster	S2S3	G5			
Plants	Taenidia montana	Mountain-pimpernel	S3	G3		S	
Plants	Taxus canadensis	Canada Yew	S2S3	G5		S	
Plants	Thalictrum clavatum	Mountain Meadowrue	S2	G4			
Plants	Thelypteris simulata	Bog Fern	S1	G4			
Plants	Thuja occidentalis	Northern White-cedar	S2	G5			
Plants	Torreyochloa pallida var. fernaldii	Mannagrass	S2	T4			
Plants	Torreyochloa pallida var. pallida	Pale False Mannagrass	S1	T5			
Plants	Toxicodendron vernix	Poison-sumac	S2	G5			
Plants	Triantha glutinosa	Sticky Bog-asphodel	S1	G4		S	
Plants	Trichomanes boschianum	Appalachian Bristle Fern	S1	G4		S	
Plants	Trifolium stoloniferum	Running Buffalo Clover	S3	G3	E		
Plants	Trillium nivale	Snowy Trillium	S2	G4			
Plants	Triphora trianthophora	Threebirds	S2	G3		S	
Plants	Vaccinium macrocarpon	Large Cranberry	S3	G4			
Plants	Vaccinium oxycoccos	Small Cranberry	S3	G5			
Plants	Veronica scutellata	Grassleaf Speedwell	S2	G5			
Plants	Viburnum lentago	Nannyberry	S1S2	G5			

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Plants	Viburnum opulus var. americanum	Highbush Cranberry	S1	T5		S	
Plants	Viburnum rafinesquianum	Downy Arrow-wood	S2	G5			
Plants	Viola blanda var. palustriformis	Violet	SH	T4			
Plants	Viola nephrophylla	Northern Bog Violet	SH	G5			
Plants	Viola septentrionalis	Northern Blue Violet	S2	G5			
Plants	Vittaria appalachiana	Appalachian Shoestring Fern	S1	G4			
Plants	Woodsia appalachiana	Allegheny Cliff Fern	S2	G4			
Plants	Woodwardia areolata	Netted Chainfern	S2	G5		S	
Plants	Xyris torta	Slender Yellow-eyed-grass	S2	G5			
Plants	Zigadenus leimanthoides	Pine Barren Deathcamas	S2	G4			
Reptiles	Agkistrodon contortrix mokasen	Northern Copperhead	S5	T5			
Reptiles	Carphophis amoenus	Wormsnake	S3	G5			
Reptiles	Coluber constrictor constrictor	Northern Black Racer	SNR	T5			
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4		S	
Reptiles	Glyptemys insculpta	Wood Turtle	S3	G4	R	S	At Risk-Consrv
Reptiles	Heterodon platirhinos	Eastern Hog-nosed Snake	S2	G5	R		
Reptiles	Liochlorophis vernalis	Smooth Greensnake	S5	G5			
Reptiles	Plestiodon anthracinus anthracinus	Northern Coal Skink	S2	G5			
Reptiles	Plestiodon laticeps	Broad-headed Skink	S2	G5			
Reptiles	Regina septemvittata	Queen Snake	S4	G5			
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	T5	R		
Reptiles	Thamnophis sauritus	Eastern Ribbonsnake	S2	G5			
Reptiles	Virginia valeriae pulchra	Mountain Earthsnake	S2	G3		S	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFS Region 9	USFWS At Risk
Snails	Discus catskillensis	Angular Disk	S2				
Snails	Euchemotrema leai	Lowland Pillsnail	S3				
Snails	Fontigens tartarea	Organ Cavesnail	S2			S	
Snails	Glyphyalinia cumberlandiana	Hill Glyph	S3				
Snails	Glyphyalinia picea	Rust Glyph	S2				
Snails	Helicodiscus shimeki	Temperate Coil	S3				
Snails	Hendersonia occulta	Cherrystone Drop	S3				
Snails	Inflectarius inflectus	Shagreen	S2				
Snails	Lucilla singleyana	Smooth Coil	S2				
Snails	Mesodon aff. Andrewsae	Balsam Globe	S1				
Snails	Mesomphix perlaevis	Smooth Button	S3				
Snails	Nesovitrea electrina	Amber Glass	S3				
Snails	Paravitrea lamellidens	Lamellate Supercoil	S2				
Snails	Paravitrea pontis	Natural Bridge Supercoil	S2				
Snails	Stenotrema simile	Bear Creek Slitmouth	S2				
Snails	Striatura exigua	Ribbed Striate	S2				
Snails	Striatura ferrea	Black Striate	S3				
Snails	Striatura milium	Flat-ribbed Striate	S2				
Snails	Triodopsis picea	Spruce Knob Threetooth	S3				
Snails	Triodopsis vulgata	Dished Threetooth	S2				
Snails	Vallonia costata	Costate Vallonia	S2				
Snails	Vallonia excentrica	Iroquois Vallonia	S3				
Snails	Vallonia perspectiva	Thin-lip Vallonia	S3				
Snails	Ventridens arcellus	Golden Dome	S3				
Snails	Ventridens virginicus	Split-tooth Dome	S3				
Snails	Zonitoides elliotti	Green Dome	S2				
Tiger Beetles	Cicindela ancocisconensis	Appalachian Tiger Beetle	S3	G3		S	
Tiger Beetles	Cicindela splendida	A Tiger Beetle	S1	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.

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

USFS Region 9 Sensitive Species: S = Sensitive.

USFWS Priority At Risk (2021): Consrv = need management attention, Science = need more research.

Appendix 2. Priority SGCN, Stresses and Actions

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Cheat Mountain Salamander	• Climate change. • Loss of red spruce habitat.	• Spruce plantings, spruce release, • Maintain/preserve large blocks of spruce habitat.
Green Salamander	• Climate change. • Tree thinning near rocks.	• Restore and protect forest buffers around rock outcrops.
Black-billed Cuckoo	• Forest maturation. • Degradation of riparian habitat. • Clean farming practices. • Reduced caterpillar abundance.	• Create early-successional habitat. • Reduce aerial application of pesticides. • Manage farms for wildlife.
Broad-winged Hawk	• Habitat loss from energy and other development. • Unsuitable forest structure.	• Manage mature forests for gaps while retaining mature trees. • Develop state-level guidance for energy infrastructure.
Canada Warbler	• Incompatible forest management. • Direct habitat loss. • Climate change. • Acid deposition. • Deer overabundance.	• Manage high elevation forests for mature overstories with canopy gaps and well-developed understories. • Reduce deer abundance where applicable.
Cerulean Warbler	• Forest fragmentation and loss from development. • Incompatible forest structure.	• Implement management guidelines at suitable locations on public lands. • Implement guidelines on private lands via CERW RCPP/farm bill programs.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Golden Eagle	• Habitat loss from energy and other development.	• Develop state-level guidance on siting and construction of energy infrastructure to Buffer populations from potential direct impacts fragmentation of core forests.
Golden-winged Warbler	• Forest maturation. • Incompatible forest structure. • Habitat loss on wintering grounds.	• Implement management guidelines at locations on public lands. • Implement guidelines on private lands via GWWA WLFW/farm bill programs.
Long-eared Owl	• Unknown status and distribution in WV.	• Develop and implement protocol for surveying population.
Northern Goshawk	• Timber harvesting. • Climate change.	• Conduct surveys prior to management. • Buffer populations from potential direct impacts as needed.
Ruffed Grouse	• Forest fragmentation, maturation, and incompatible forest structure.	• Create early-successional habitat through forest management within core forests.
Wood Thrush	• Forest fragmentation and loss. • Incompatible forest structure. • Deer overabundance.	• Maintain and improve core forests with scattered openings and well-developed understories. • Reduce local deer populations.
Angular Disk	• Development. • Deforestation.	• Maintain large intact forest blocks. • Conserve mature forest tracts as the species needs hardwood logs at advanced stages of decay that old growth can provide.
Balsam Globe	• Climate change (microclimate). • Acid deposition. • Forest disturbance.	• Maintain large intact blocks of high elevation forest tracts.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Bear Creek Slitmouth	• Climate change (microclimate). • Acid deposition. • Forest disturbance.	• Prevent forest fragmentation. • Retain rocky hillslopes as refuges.
Green Dome	• Climate change (microclimate). • Acid deposition.	• Forest practices that maintain healthy forest structure and composition and create or allow decaying logs.
Ribbed Striate	• Forest hydrology disturbance. • Climate change. • Acid deposition.	• Prevent forest fragments and conserve high elevation bogs.
Rust Glyph	• Climate change (microclimate). • Acid deposition.	• Maintain high elevation, contiguous forested tracts.
Spruce Knob Threetooth	• Climate change (microclimate). • Acid deposition. • Forest disturbance.	• Maintain large intact blocks of high elevation forest tracts. • Retain rocky substrates within forest.
Smyth's Green Comma	• Unknown - in WV theorized microhabitat degradation due to loss of hemlock from adelgid and climate change.	• Maintain integrity and resilience of high elevation habitats.
West Virginia White	• Garlic mustard is toxic decoy larval host - species uses this instead of native mustards. • Forest fragmentation.	• Control/eradicate garlic mustard. • Maintain integrity of forest habitats.
Allegheny Woodrat	• Forest fragmentation. • Lack/loss of mast trees.	• Retain forested ridgetops. • Promote mast producing trees.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Appalachian Cottontail	• Climate change. • Deforestation.	• Forest practices that allow for winter browse vegetation of Vaccinium and Photinia spp. (among others). • Implement forest practices that provide/promote spruce cover. • Institute prescribed fire program to stimulate ericaceous vegetation.
Eastern Red Bat	• Development, agriculture, deforestation. • forest management practices/poor habitat quality.	• Promote forestry practices that create or maintain mature forest habitat in contiguous forested areas.
Hoary Bat	• Development, agriculture, deforestation. • forest management practices/poor habitat quality.	• Promote forestry practices that Create or maintain mature forest habitat in contiguous forested areas.
Long-tailed Shrew	• Climate change (rock microclimate). • Stream destruction/pollution. • Habitat loss.	• Maintain cool, moist subterranean environments through riparian corridor buffers and preservation of talus habitat. • Additional habitat research.
Northern Myotis	• Development, agriculture. • Lack of complexity in forest stand (i.e. snags/early-successional trees).	• 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.
Indiana Bat	• Deforestation, agriculture, industry	• Maintain forest cover • USFWS requires management actions within 10 miles of "Priority 1/2" Indiana Bat caves.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Silver-haired Bat	• Deforestation. • Food shortage during migration.	• Maintain large intact forest blocks.
Snowshoe Hare	• Forest maturation (loss of adequate cover). • Deer over browsing.	• Implement forest practices that provide abundant understory cover. • Institute prescribed fire program to stimulate ericaceous vegetation. • Create small canopy gaps in high canopy cover areas for browse, emulating natural disturbances.
Southern Rock Vole	• Forest succession without red spruce/yellow birch. • Climate change.	• Promote new growth of yellow birch and red spruce while retaining rocky substrates at high elevations.
Southern Water Shrew	• Climate change. • Gypsy moth spraying. • Acid deposition/food shortage. • Forest defoliation.	• Maintain or create riparian buffers. • Reduce & monitor impacts of gypsy moth spraying.
Virginia Big-eared Bat	• Agriculture. • Deforestation.	• Protect caves and limit human disturbance (i.e. not during hibernation/breeding).
WV Northern Flying Squirrel	• Climate change. • Deforestation.	• Restore, protect or buffer contiguous, mature forest habitat at high elevations.
Appalachian Oak Fern	• Taxonomic uncertainty.	• Identify non-hybrid populations.
Beaked Dodder	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Bentley's Coralroot	• Canopy and ground disturbance, including logging and burning.	• Conduct surveys to determine distribution. • Buffer populations from potential direct impacts.
Bristly Black Currant	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Canada Mountain Ricegrass	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Canada Yew	• Excessive deer herbivory.	• Encourage hunting in yew habitat. • Consider deer exclusion fencing.
Corymbed Rattlesnake-root	• Nonnative invasive plants. • Ground disturbance. • Canopy closure.	• Buffer populations from potential direct impacts in occupied habitat. • Consider creating small canopy gaps in known populations areas to encourage flowering.
Drooping Woodland Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Dwarf Rattlesnake-plantain	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
False Melicgrass	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Lanceolate Grapefern	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Long-bracted Green Orchid, Satyr Orchid	• Altered light regime. • Invasive weeds introduced by logging.	• Buffer populations from potential direct impacts disturbing occupied habitat. • Conduct surveys to determine distribution and habitat requirements.
Manhart's Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
New England Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Northern Oak Fern	• Taxonomic uncertainty.	• Identify non-hybrid populations.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Old-pasture Bluegrass	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
One-cone Groundpine	• Trampling. • Unknown status.	• Conduct surveys to determine distribution and threats.
Purple Virgin's Bower	• Extremely small population size.	• Conduct surveys to determine distribution and threats.
Roan Mountain Sedge	• Invasive weeds introduced by logging.	• Buffer populations from potential direct impacts.
Running Buffalo Clover	• Altered disturbance regime (too much or too little).	• Develop BMP's to promote population viability and possibly encourage new populations.
Shriver's Frilly Orchid	Forest management activities	• Conduct project clearance rare plant surveys. • Avoid disturbing habitat.
Small Whorled Pogonia	• Poorly understood habitat requirements. • Vulnerable to habitat disturbance.	• Develop habitat suitability models to better understand habitat and potential distribution. • Incorporate modeling and survey methodology into project planning.
Snowy Trillium	• Invasive weeds introduced by logging.	• Buffer populations from potential direct impacts disturbing occupied and potentially occupied habitat.
Threebirds	• Altered light regime. • Invasive weeds introduced by logging.	• Buffer populations from potential direct impacts disturbing occupied and potentially occupied habitat.
White Monkshood	• Invasive weeds introduced by logging. • Altered hydrology.	• Buffer populations from potential direct impacts disturbing occupied and potentially occupied habitat. • Buffer headwater seeps.

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Mountain Earthsnake	• Loss of early-successional habitat. • Fire suppression. • Overgrazing.	• Manage for early-successional habitat. • Create forest openings. • Restore fire regime to maintain healthy grasses and forbs in openings. • Monitor grazing impacts, assess habitat and cover.
Northern Coal Skink	• Very little known about habitat or life history.	• Conduct surveys to determine distribution, habitat, life history requirements.
Timber Rattlesnake	• Loss of basking/ gestation/ denning habitat	• Create forest openings. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Develop den avoidance guidance.

Agricultural and Developed Areas		
Common Name	**Local Stress**	**Action**
Chimney Swift	• Decline in suitable nest sites and migration roosts. • Possible decline in aerial insects.	• Reduce chimney capping • Mitigate loss of nest and roost sites through constructing dedicated towers. • Retain large hollow snags.

Agricultural and Developed Areas		
Common Name	**Local Stress**	**Action**
Common Nighthawk	• Natural succession on rocky barrens. • Habitat loss from construction of wind energy facilities.	• Conduct surveys to better understand breeding on rocky barrens. • Investigate use of fire as a management tool. • Work with wind energy industry on facility siting.
American Kestrel	• Insufficient nest sites. • Clean farming practices. • Decline in area of grasslands.	• Implement a nest box program. • Encourage landowners to enroll in farm bill practices that improve grassland habitat.
Bobolink	• Incompatible field and pasture management. • Conversion to crop agriculture.	• Implement farm bill practices that improve grassland and maintain habitat for species.
Grasshopper Sparrow	• Incompatible field and pasture management. • Conversion to crop agriculture.	• Implement farm bill practices that improve grassland and maintain habitat for species.
Eastern Meadowlark	• Incompatible field and pasture management. • Conversion to crop agriculture.	• Implement farm bill practices that maintain or improve grasslands.
Field Sparrow	• Incompatible field and pasture management. • Conversion to crop agriculture.	• Implement farm bill practices that retain or create woody structure in fields.
Henslow's Sparrow	• Succession on abandoned mine lands. • Incompatible management regimes.	• Implement management practices on public lands (e.g. CVNWR); work with private landowners for same goal.
American Woodcock	Habitat loss from: • Forest succession. • Clean farming practices. • Industrial and residential development.	• Increase implementation of management guidelines on public and private lands. • Increase acreage managed for GWWA on private lands.

Agricultural and Developed Areas		
Common Name	**Local Stress**	**Action**
Barn Owl	• Reduced breeding and roosting sites. • Clean farming practices.	• Install and monitor nest boxes on private and public lands.
Virginia Big-eared Bat	• Agriculture. • Deforestation.	• Protect caves and control human access (i.e. not during hibernation/breeding).
Mountain Earthsnake	• Loss of early-successional habitat. • Fire suppression. • Overgrazing.	• Manage for early-successional habitat. • Create and maintain forest openings. • Institute prescribed fire regime to maintain healthy grasses and forbs in openings. • Monitor grazing impacts, habitat, and cover.
Smooth Greensnake	• Loss of early-successional habitat. • Fire suppression. • Overgrazing.	• Manage for early-successional habitat. • Create and maintain forest openings. • Fire regime to maintain healthy grasses and forbs in openings. • Monitor grazing impacts to habitat and cover.

Cliffs and Barrens		
Common Name	**Local Stress**	**Action**
Allegheny Woodrat	• Agriculture. • Forest fragmentation. • Poor mast sources.	• Buffer and protect rocky outcrops/talus slope habitats to allow for metapopulation dispersal.
Appalachian Cottontail	• Fire suppression. • Climate change.	• Forest practices that allow for winter browse vegetation of Vaccinium and Photinia spp. (among others). • Forest practices that promote ericaceous cover: prescribed fire is one suggested technique.
Northern Coal Skink	• Very little known about habitat or life history.	• Conduct survey to determine distribution, habitat, life history requirements.
Timber Rattlesnake	• Loss of basking/ gestation/ denning habitat.	• Use forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Develop den avoidance guidance for WV projects.
Fragile Rockbrake	• Residential development.	• Habitat protection through conservation easement or purchase.
Canada Mountain Ricegrass	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Drooping Woodland Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Mountain-cinquefoil	• Small clifftop populations may be threatened by trampling.	• Route trails to limit access to cliff tops.

Caves and Karst		
Common Name	**Local Stress**	**Action**
Little Brown Myotis	• Deforestation. • Cave disturbance. • Climate change (cave needs to be cool, humid).	• Conserve cave locations with known hibernacula including cave gating, limiting human access, etc.
Virginia Big-eared Bat	• Agriculture. • Deforestation.	• Since caves can serve as both hibernation and maternity sites, efforts should be placed to preserve cave locations and limit human access (i.e. not during hibernation/breeding).
Indiana Bat	• Deforestation, agriculture, industry	• Maintain forest cover • USFWS requires management actions within 10 miles of "Priority 1/2" Indiana Bat caves.
Allegheny Woodrat	• Agriculture. • Forest fragmentation. • Lack of mast trees.	• Winter bat cave visit restrictions will minimize disturbance to woodrat populations in caves.
A Cave Springtail	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Develop educational materials for landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
A Springtail	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.

Caves and Karst		
Common Name	**Local Stress**	**Action**
An Isopod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Culver's Cave Amphipod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Dry Fork Valley Cave Pseudoscorpion	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Franz's Cave Amphipod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.

Caves and Karst		
Common Name	**Local Stress**	**Action**
Gandy Creek Cave Springtail	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Greenbrier Cave Amphipod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Minute Cave Amphipod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.
Pocahontas Cave Amphipod	• Stormwater entering cave systems. • Degraded water quality. • Sinkhole dumping. • Cave passage alteration. • Human disturbance (excessive visitation).	• Provide educational materials to landowners, planners, partner agencies. • Conduct sinkhole clean ups. • Install fencing and signage. • Mapping of passage and surface influences.

Stream and River Habitats		
Common Name	**Local Stress**	**Action**
Eastern Hellbender	• Loss of riparian buffers. • Increased sediment.	• Restore and protect riparian buffers. • Fence livestock out of streams.
American Eel	• Overharvesting. • Migration impediments.	• Remove passage barriers. • Install Eel ladders.
Appalachia Darter	• Increased water temperature. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Black Bullhead	• Water quality. • Increased sediment.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Brook Trout	• Increased water Increased water temperature. • Passage impediments. • Increased sediment.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
&Brown Bullhead	• Degraded water quality. • Increased sediment.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Candy Darter	• Increased water temperature. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Common Shiner	• Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.

Stream and River Habitats		
Common Name	**Local Stress**	**Action**
Kanawha Minnow	• Increased water temperature. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Kanawha Sculpin	• Increased water temperature. • Increased sediment.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
New River Shiner	• Increased water temperature. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Pearl Dace	• Increased water temperature.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Redside Dace	• Increased water temperature.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Shield Darter	• Increased sediment. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Tonguetied Minnow	• Increased water temperature. • Degraded water quality.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Torrent Sucker	• Increased water temperature.	• Riparian restoration • Develop BMPs for activities in riparian habitats.

Stream and River Habitats		
Common Name	**Local Stress**	**Action**
Elktoe	• Climate change. • Habitat degradation and fragmentation.	• Restore instream habitat • Propagate and stock young to augment population.
Green Floater	• Habitat impacts from stream restoration.	• Incorporate habitat requirements in restoration plans. • Survey and salvage before restoration activities.
Forcipate Emerald	• Degraded wetland habitat.	• Restore or maintain wetland integrity and resilience.
Maine Snaketail	• Degraded water quality (organic and chemical pollutants, Increased sediment, dredging).	• Enforce pollution control measures. • Installation of sewage infrastructure. • Improve sediment control (construction, recreation, timber harvest).
Mustached Clubtail	• Degraded water quality (organic and chemical pollutants, Increased sediment, dredging).	• Enforce pollution control measures • Installation of sewage infrastructure • Improve sediment control (construction, recreation, timber harvest).
Northern Pygmy Clubtail	• Degraded water quality (organic and chemical pollutants, Increased sediment, dredging).	• Enforce pollution control measures • Installation of sewage infrastructure • Improve sediment control (construction, recreation, timber harvest).

Stream and River Habitats		
Common Name	**Local Stress**	**Action**
Rapids Clubtail	• Degraded water quality (organic and chemical pollutants, Increased sediment, dredging).	• Enforce pollution control measures. • Installation of sewage infrastructure. • Improve sediment control (construction, recreation, timber harvest).
Ski-tipped Emerald	• Degraded wetland habitat.	• Restore or maintain wetland integrity and resilience.
A Stonefly	• Deforestation, • Oil and gas development, • Recreation.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats. • Monitor populations in areas of high recreation activities.
Appalachian Stonefly	• Agriculture. • Oil and gas development. • Impoundment. • Surface water pollution.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats. • Impoundment at Beech Fork has extirpated one population-monitor for return, survey other areas.
Monongahela Snowfly	• Deforestation. • Agriculture. • Oil & gas development. • Aquatic pollution.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.

Stream and River Habitats		
Common Name	**Local Stress**	**Action**
Shenandoah Needlefly	• Deforestation. • Climate change.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats. • Avoid logging or development near spring runs.

Floodplains and Riparian Habitats		
Common Name	**Local Stress**	**Action**
Louisiana Waterthrush	• Forest and riparian habitat degradation from agricultural activities and development.	• Buffer stream/riparian corridors; improve implementation and enforcement of runoff mitigation measures.
Virginia Rail	• Natural succession of wetlands in Canaan Valley. • Climate change.	• Maintain sufficient habitat to support a breeding population; manage wetlands as per the 2017 CVNWR habitat management plan.
Balsam Globe	• Climate change (microclimate). • Acid deposition. • Forest disturbance.	• Prevent forest fragments (maintain contiguous sections) and conserve high elevation forest tracts.
West Virginia White	• Toxic decoy larval host - species uses invasive garlic mustard instead of native mustards. • Forest fragmentation.	• Control/eradicate garlic mustard. • Maintain integrity of forest habitats.
Eastern Red Bat	• Deforestation- development and agriculture. • Forest management practices - poor habitat quality.	• Reduce agricultural runoff in cave watersheds. • Create or maintain mature forest habitat in contiguous forested areas.

Floodplains and Riparian Habitats		
Common Name	**Local Stress**	**Action**
Hoary Bat	• Deforestation- development and agriculture. • Forest management practices - poor habitat quality.	• Reduce agricultural runoff in cave watersheds. • Create or maintain mature forest habitat in contiguous forested areas.
Little Brown Myotis	• Agricultural runoff (kills or bioaccumulates in insects).	• Restore and protect riparian buffers.
Northern Myotis	• Residential development. • Agriculture. • Lack of complexity in forest stand (i.e. snags/early-successional trees).	• Reduce agricultural runoff in cave watersheds. • Create or maintain mature forest habitat in contiguous forested areas.
Southern Bog Lemming	• Climate change (hydrology). • Forest maturation.	• Retain mossy boulders and wet meadows.
Southern Water Shrew	• Climate change. • Gypsy moth spraying & acid deposition - food shortage. • Forest defoliation.	• Create or maintain riparian buffers • Improve water quality. • Reduce & monitor impacts of gypsy moth spraying. • Management for brook trout that overlap these areas should benefit both species.
Mountain Earthsnake	• Loss of early-successional habitat. • Fire suppression. • Overgrazing.	• Manage for early-successional habitat & forest openings. • Institute prescribed fire regime to maintain healthy grasses and forbs in openings. • Monitor grazing impacts to habitat and cover. • Develop grazing BMP's that conserve species habitat.

Floodplains and Riparian Habitats		
Common Name	**Local Stress**	**Action**
Smooth Greensnake	• Loss of early-successional habitat. • Fire suppression. • Overgrazing.	• Manage for early-successional habitat & forest openings. • Institute prescribed fire regime to maintain healthy grasses and forbs in openings. • Monitor grazing impacts to habitat and cover.
American Mannagrass	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Black Ash	• Invasive insect pests. • Altered hydrology	• Buffer populations from potential direct impacts. • Monitor populations for mortality and resistance to emerald ash borer.
Blue Ridge St. John's-wort	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Cloud Sedge	• Pipeline maintenance. • Unknown status and threats.	• Monitor known populations. • Conduct surveys to determine distribution and threats.
Cross-leaved Milkwort	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Fly Honeysuckle	• Excessive deer herbivory.	• Construct deer exclosures in verified habitat.
Hairy-fruit Sedge	• Altered hydrology and stream morphology due to climate change.	• Monitor populations and floodplain habitat.
Hill Holly	• Altered hydrology and stream morphology due to climate change	• Monitor populations and floodplain habitat.
Inflated Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.

Floodplains and Riparian Habitats		
Common Name	**Local Stress**	**Action**
Kidneyleaf Grass-of-parnassus	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Kidneyleaf Twayblade	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Lesser Purple Fringed Orchid	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Mead's Sedge	• Altered hydrology and stream morphology due to climate change.	• Monitor populations and floodplain habitat.
Monongahela Barbara's-buttons	• Altered hydrology and stream morphology due to climate change.	• Monitor populations and floodplain habitat.
Narrowleaf Whitetop Aster	• Altered hydrology and stream morphology due to climate change.	• Monitor populations and floodplain habitat.
New Belgium American-aster	• Altered hydrology and stream morphology due to climate change. • Unknown status and threats.	• Monitor populations and floodplain habitat. • Conduct surveys to determine distribution and threats.
Northern Adder's-tongue	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Northern Bentgrass	• Taxonomic questions. • Altered hydrology and stream morphology due to climate change and instream construction.	• Monitor populations and floodplain habitat. • Buffer populations from potential direct impacts.
Northern Stitchwort	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Old-pasture Bluegrass	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.

Floodplains and Riparian Habitats		
Common Name	**Local Stress**	**Action**
Purple Avens	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Rigid Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Roundleaf Thimbleweed	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Running Buffalo Clover	• Altered disturbance regime (either too much or too little).	• Develop BMP's to promote population viability and possibly encourage new populations.
Shriver's Frilly Orchid	• Forest management activities.	• Conduct project clearance rare plant surveys. • Avoid disturbing habitat.
Sticky Bog-asphodel	• Altered hydrology and stream morphology due to climate change	• Monitor populations and floodplain habitat.
Tennessee Pondweed	• Stream degradation. • Increased siltation. • Altered hydrology.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Yellow Avens	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
American Bittern	• Limited distribution- breeding occurrence now entirely limited to wetlands of Canaan Valley. • Climate change.	• Implement 2017 CVNWR habitat management plan. • Conduct surveys on private lands in the valley and nearby wetlands.
Northern Harrier	• Natural succession of wetlands and other open areas in Canaan Valley. • Climate change.	• Maintain sufficient habitat to support a breeding population • Manage open areas as per 2017 CVNWR habitat management plan.
Northern Waterthrush	• Highly restricted distribution. • Climate change.	• Minimize disturbance in high elevation headwaters and forested swamps. • Continue red spruce restoration.
Olive-sided Flycatcher	• Currently limited to Cranberry Glades. • Climate change.	• Maintain current site conditions. • Identify locations of historical occurrence where management actions could improve habitat. • Survey suitable habitats.
Baltimore Checkerspot	• Degradation and loss of wetland, riparian, and wet meadow habitat. • Deer browse on host plant.	• Protection of preferred habitats on public land. • Deer management.
Two-spotted Skipper	• Degraded wetland habitat - mining, draining, disturbance on private land.	• Maintain or restore integrity and resilience of wetland habitat. • Report wetland violations, enforce Clean Water Act.
Little Brown Myotis	• Contaminant runoff (kills or bioaccumulates in insects).	• Restore and protect riparian buffers.
Southern Bog Lemming	• Forest maturation/overgrowth.	• In areas with Southern rock voles, timber harvests/clearcuts will create pockets of lower forest/ground cover, allowing both species to coexist.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Spatterdock Darner	• Degraded wetland habitat.	• Maintain or restore integrity and resilience of wetland habitat.
Crimson-ringed Whiteface	• Climate change.	• Maintain or restore integrity and resilience of wetland habitat.
Forcipate Emerald	• Degraded wetland habitat.	• Maintain or restore integrity and resilience of wetland habitat.
Seepage Dancer	• Degraded sphagnum wetland habitat.	• Maintain or restore integrity and resilience of wetland habitat.
Ski-tipped Emerald	• Degraded wetland habitat.	• Maintain or restore integrity and resilience of wetland habitat.
Alderleaf Buckthorn	• Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
American Mannagrass	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Awned Sedge	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Balsam Fir	• Nonnative invasive insects. • Altered hydrology. • Excessive deer herbivory.	• Buffer populations from potential direct impacts. • Monitor populations and consider chemical treatment for insect pest. • Promote hunting in balsam fir habitats. • Build deer exclusion fences.
Balsam Poplar	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Beaked Dodder	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Black Ash	• Nonnative insect pests. • Altered hydrology.	• Buffer populations from potential direct impacts. • Monitor populations for mortality and resistance to emerald ash borer.
Blue Ridge St. John's-wort	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Bog Fern	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Bog Jacob's-ladder	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Bog-rosemary	• Small population size.	• Monitor population and surrounding wetland habitat.
Bristly Black Currant	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Buckbean	• Unknown status and threats. • Excessive deer herbivory.	• Conduct surveys to determine distribution and threats. • Consider deer exclusion fences.
Bulbous Woodrush	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Bush's Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Canada Yew	• Excessive deer herbivory.	• Excessive deer herbivory. • Encourage hunting in yew habitat.
Cloud Sedge	• Pipeline maintenance. • Unknown status and threats.	• Monitor known populations and conduct surveys to determine distribution and threats.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Dwarf Rattlesnake-plantain	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Dwarf Red Bramble	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Early Coralroot	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Eastern Swamp Saxifrage	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Few-flower Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Fly Honeysuckle	• Excessive deer herbivory.	• Construct deer exclusion fences in verified habitat.
Foxtail Clubmoss	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Glade Spurge	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Greater Fringed Gentian	• Invasive plants. • Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Heartleaf Twayblade	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Highbush Cranberry	• Excessive deer herbivory.	• Construct deer exclusion fences in verified habitat.
Hill Holly	• Stream disturbance. • Road crossings. • Trampling.	• Inform landowners about the population and provide conservation recommendations. • Buffer populations from potential direct impacts.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Inflated Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Kidneyleaf Grass-of-parnassus	• Unknown status and threats. Most occurrences are historical.	• Conduct surveys to determine distribution and threats.
Kidneyleaf Twayblade	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Lake Sedge	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Lesser Purple Fringed Orchid	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Long-lobe Arrowhead	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Mannagrass	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Mead's Sedge	• Stream disturbance. • Road crossings. • Trampling.	• Inform landowners about the population and provide conservation recommendations. • Buffer populations from potential direct impacts.
New Belgium Americanaster	• Stream disturbance. • Road crossings. • Trampling.	• Inform landowners about the population and provide conservation recommendations. • Buffer populations from potential direct impacts.
Northern Adder's-tongue	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Northern Bentgrass	• Stream disturbance. • Road crossings. • Trampling.	• Inform landowners about the population and provide conservation recommendations. • Buffer populations from potential direct impacts.
Northern Bog Clubmoss	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Northern Oak Fern	• Unknown status and threats. • Taxonomic uncertainty.	• Conduct surveys to determine distribution and threats. • Identify non-hybrid populations.
Northern Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Northern Stitchwort	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Oblong-fruit Serviceberry	• Unknown status and threats. Most occurrences are historical.	• Conduct surveys to determine distribution and threats.
Pale False Mannagrass	• Altered hydrology due to climate change.	• Monitor populations.
Pine Barren Deathcamas	• Altered hydrology due to climate change.	• Monitor populations.
Purple Avens	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts. • Control invasive plants as needed.
Showy Lady's-slipper	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.

Wetland Habitats		
Common Name	**Local Stress**	**Action**
Sticky Bog-asphodel	• Stream disturbance. • Road crossings. • Trampling.	• Inform landowners about the population and provide conservation recommendations. • Buffer populations from potential direct impacts.
Tennessee Pondweed	• Stream degradation. • Increased siltation. • Altered hydrology.	• Restore and protect riparian buffers. • Develop BMPs for activities in riparian habitats.
Thread Rush	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.
Tuberous Grass-pink	• Altered hydrology due to climate change.	• Monitor populations.
Twinflower	• Trampling from cattle.	• Exclude cattle.
Western Spotted Coralroot	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
White Monkshood	• Altered hydrology from roads and logging.	• Buffer populations from potential direct impacts to headwater seeps.
Woodland Horsetail	• Invasive plants. • Altered hydrology. • Canopy and ground disturbance.	• Buffer populations from potential direct impacts.
Woolly-fruit Sedge	• Unknown status and threats.	• Conduct surveys to determine distribution and threats.
Yellow Avens	• Altered hydrology. • Ground disturbance.	• Buffer populations from potential direct impacts.

Appendix 3. Terrestrial and Aquatic Habitats in Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
Beaver Dam Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Moderate Gradient, Cool
*Becky's Creek Wildlife Management Area	**Forest and Woodland** • Dry Oak (-Pine) Forests • Northern Hardwood Forests	• N/A

Public Land	Terrestrial Habitat	Aquatic Habitat
*Blackwater Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Calcareous Forests, Woodlands, and Glades • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Other Dry Oak Forests and Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Moderate Gradient, Cool • Medium River, Low Gradient, Warm • Medium River, Moderate Gradient, Warm
*Cheat Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Developed	• Headwater Creek, Moderate Gradient, Cold • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Moderate Gradient, Cool • Small River, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
*Cranberry Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Low Gradient, Warm • Small River, Moderate Gradient, Cool • Small River, Moderate Gradient, Warm • Small River, High Gradient, Cool • Small River, High Gradient, Warm
Handley Wildlife Management Area	**Forest and Woodland** • Northern Hardwood Forests **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool
Little Canaan Wildlife Management Area	**Forest and Woodland** • Northern Hardwood Forests • Red Spruce Forests **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Headwater Creek, Moderate Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
*Little River Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cold • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Cool
*Meadow River Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests **Aquatic, Floodplain, and Riparian** • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Small River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
*Otter Creek Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Calcareous Forests, Woodlands, and Glades • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Moderate Gradient, Cool • Small River, High Gradient, Cool • Medium River, Low Gradient, Warm • Medium River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
*Potomac Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Montane Red Oak Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus • Heath - Grass Barrens **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Cool • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cold • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool
Slaty Fork Wildlife Management Area	**Forest and Woodland** • Mixed Mesophytic Forests **Aquatic, Floodplain, and Riparian** • Small Stream Riparian Habitats **Agricultural and Developed** • Developed	• Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
*Tea Creek Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Cool • Small River, Moderate Gradient, Cool
Kumbrabow State Forest	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Open Water • Small Stream Riparian Habitats **Agricultural and Developed** • Developed	• Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
Blackwater Falls State Park	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Cool • Small River, High Gradient, Cool
Canaan Valley Resort State Park	**Forest and Woodland** • Mixed Mesophytic Forests • Northern Hardwood Forests • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus • Heath - Grass Barrens **Aquatic, Floodplain, and Riparian** • High Allegheny Wetlands • Open Water • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool
*Cass Scenic Railroad State Park	N/A	• Headwater Creek, High Gradient, Cold

Cave and Karst Features in Public Lands

Public Land	Karst Feature Count	Area Type
Beaver Dam Wildlife Management Area	6	Wildlife Management Area
Becky Creek Wildlife Management Area	3	Wildlife Management Area
Blackwater Wildlife Management Area	72	Wildlife Management Area
Cheat Wildlife Management Area	21	Wildlife Management Area
Cranberry Wildlife Management Area	3	Wildlife Management Area
Little River Wildlife Management Area	27	Wildlife Management Area
Otter Creek Wildlife Management Area	155	Wildlife Management Area
Potomac Wildlife Management Area	103	Wildlife Management Area
Slatyfork Wildlife Management Area	6	Wildlife Management Area
Tea Creek Wildlife Management Area	24	Wildlife Management Area
Kumbrabow State Forest	3	State Forest
Canaan Valley Resort State Park	7	State Park

Appendix 4. Partners and Assistance Provided

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

Partner	Role/Assistance Provided
Appalachian Mountains Joint Venture (AMJV) https://amjv.org/	• 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.
American Forest Foundation (AFF) https://www.forestfoundation.org/ https://www.familyforestcarbon.org/	• 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)
Cave Conservancy of the Virginias (CCV) https://caveconservancyofvirginia.org/	• 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 *Project Underground* environmental education program to promote a better understand of caves and karst lands.

Partner	Role/Assistance Provided
Central Appalachian Spruce Restoration Initiative (CASRI) http://restoreredspruce.org/	• A partnership of private, state, federal and non-governmental organizations seeking to restore historic red spruce-nothern hardwood ecosystems across the high elevation landscapes of Central Appalachia. • Seeks funding to restore key areas • Coordinates ecosystem restoration activities
Consulting Foresters https://wvforestry.com/forestry-consultants/	• 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/	• 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
Green Forests Work https://www.greenforestswork.org/	• Restores healthy and productive forests on formerly mined lands in Appalachia and beyond to create a renewable and sustainable multi-use resource that will provide economic opportunities while enhancing the local and global environment.

Partner	Role/Assistance Provided
Forest Certification Programs: • American Tree Farm System (ATFS) https://www.treefarmsystem.org/ • Sustainable Forestry Initiative (SFI) https://www.forests.org/ https://www.wvfa.org/sfi/ • Forest Stewardship Council (FSC) https://fsc.org/en	• Resources, assistance and certification for sustainable forest management on public and private lands
Friends of the Blackwater https://saveblackwater.org/our-organization/	• Friends of Blackwater works to protect and promote natural beauty, diverse creatures, unique heritage, and the outdoor recreation economy in the Mid-Atlantic Allegheny Highlands -- home to the magnificent, 10,000-acre Blackwater Canyon.
Friends of the Cheat https://www.cheat.org/	• Friends of the Cheat's mission is to restore, preserve, and promote the outstanding natural qualities of the Cheat River watershed
Friends of the 500th https://www.facebook.com/Friendsofthe500th/	• The Friends of the 500th is a nonprofit that supports the conservation and public use of Canaan Valley National Wildlife Refuge, the nation's 500th refuge
Master Naturalists Program http://mnofwv.org/	• 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

Partner	Role/Assistance Provided
National Speleological Society (NSS) https://caves.org/	• 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.
National Wild Turkey Federation (NWTF) https://www.nwtf.org/	• 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
Outdoor Heritage Conservation Fund (OHCF) https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/	• 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.
Ruffed Grouse Society/American Woodcock Society (RGS) https://ruffedgrousesociety.org/#	• 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. https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/

Partner	Role/Assistance Provided
The Conservation Fund (TCF) https://www.conservationfund.org/where-we-work/west-virginia	• 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.
The Nature Conservancy (TNC) https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/	• 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
Trout Unlimited (TU) • http://www.wvtu.org/ • http://www.tu.org/	• 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

Partner	Role/Assistance Provided
US Department of Agriculture, Farm Service Agency (FSA) https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP) • State Acres for Wildlife Enhancement (SAFE) • Farmable Wetlands Program (FWP) • Grasslands Reserve Program (GRP)	• 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
US Department of Agriculture, Natural Resources Conservation Service (NRCS): https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/ Environmental Quality Incentive Program (EQIP) • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP)	• 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
US Department of Interior, Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program https://www.fws.gov/northeast/ecologicalservices/partners.html	• 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
US Department of Interior, Office of Surface Mining Reclamation and Enforcement (OSMRE) https://www.osmre.gov/index.shtm Appalachian Regional Reforestation Initiative (ARRI) https://arri.osmre.gov/About/AboutARRI.shtm	• 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
West Virginia Association for Cave Studies (WVACS) https://www.wvacs.org/	• Contributes to cave surveys and research • Hosts cave scientists and graduate students pursuing cave research at field stations in Greenbrier County

Partner	Role/Assistance Provided
West Virginia Cave Conservancy https://wvcc.net/	• 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
West Virginia Conservation Agency (WVCA) and Conservation Districts http://www.wvca.us • Ag Enhancement Program (AgEP) • Non-Point Source Program • Stream Partners Program	• 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
West Virginia Department of Environmental Protection (WVDEP) • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/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	• 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 • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects
West Virginia Department of Health and Human Resources (WVDHHR) • On-Site Sewage Program https://www.wvdhhr.org/phs/sewage/index.asp	• 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.

Partner	Role/Assistance Provided
West Virginia Division of Forestry (WVDOF) http://www.wvforestry.com/	• 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
West Virginia Division of Natural Resources (WVDNR) http://www.wvdnr.gov/wildlife/wdpintro.shtm	• 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
West Virginia Highlands Conservancy https://wvhighlands.org/	• The West Virginia Highlands Conservancy promotes, encourages, and works for the conservation – including both preservation and wise management – and appreciation of the natural resources, focusing primarily on the Highlands Region of West Virginia.
West Virginia Land Trust (WVLT) https://www.wvlandtrust.org/	• 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
West Virginia Scenic Trails Association (WVSTA) https://www.wvscenictrails.org/	• Serves the outdoor community by building and maintaining the Allegheny Trail and other trails in partnership and cooperation with landowners, managers, and others. • Maintains, preserves, protects, and promotes this challenging and scenic foot trail (that will exceed 300 miles) running southward from the Mason-Dixon Line through WV and VA to the Appalachian Trail. • Furthers the conservation of wild pristine lands and wildlife and protect areas of natural beauty and historic interest through stewardship
West Virginia University Extension Service (WVU Extension): • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife	• 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.

Watershed based plans for impaired streams in the Cheat River and Tygart Valley River basins, as well as the Elk Headwaters and Upper Meadow River are available at: https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx
Long Range Plans for the Elk, Tygarts Valley and Greenbrier 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
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. https://www.allaboutbirds.org/bbimages/clo/pdf/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/
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
Fighting Invasive Plants in West Virginia http://www.wvnps.org/FightingInvasives.pdf
American Forest Foundation: Woodland owners planning tool for forest management https://mylandplan.org/
The Nature Conservancy Resilient Land Mapping Tool and Documents: http://maps.tnc.org/resilientland/
USDA Forest Service, Northern Research Station's Climate Change Atlas: documentation of current and possible future distribution of 134 tree species and 147 bird species in the Eastern United States https://www.fs.fed.us/nrs/atlas/
Rudnick, D.A. et al. 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America. https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities
Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science: https://adaptationworkbook.org/

U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information, and subject matter expertise to build climate resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location. https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice
Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition, 2016, published by the USDA Forest Service, Northern Research Station https://www.nrs.fs.fed.us/pubs/52760
Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture. https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf