National Fish and Wildlife Foundation

Central Appalachia Business Plan

March 2019 ***(Revised February 2021)***

Purpose of a Business Plan

The purpose of a NFWF business plan is to provide a concise blueprint of the strategies and resources required to achieve the desired conservation outcomes. The strategies discussed in this plan do not represent solely the foundation's view of the actions necessary to achieve the identified conservation goals, but instead reflect the view of the many federal, state, academic and organizational experts that consulted during plan development. This plan is not meant to duplicate ongoing efforts but rather to invest in areas where gaps might exist so as to support the efforts of the larger conservation community.

Acknowledgements

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About NFWF

The National Fish and Wildlife Foundation protects and restores our nation's wildlife and habitats. Chartered by Congress in 1984, NFWF directs public conservation dollars to the most pressing environmental needs and matches those investments with private contributions. NFWF works with government, nonprofit and corporate partners to find solutions for the most complex conservation challenges. Over the last three decades, NFWF has funded more than 16,500 projects and committed more than $4.8 billion to our conservation mission. Learn more at *www.nfwf.org*.

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Background

The National Fish and Wildlife Foundation (NFWF) launched the Central Appalachia Habitat Stewardship Program in 2017 in order to build on the success of two past species-focused business plan initiatives in the region — the eastern brook trout keystone initiative and the early successional forest initiative. These two business plans were exited after successfully demonstrating best practices and showing impact at a small scale. This new business plan and the Central Appalachia Habitat Stewardship Program are designed to take those successes to a landscape scale.

In partnership with the Richard King Mellon Foundation among others, the new program was developed based on a five-year, shared investment strategy for western Pennsylvania, guided by NFWF's business planning model. The Richard King Mellon Foundation board adopted this investment strategy in March 2015. Subsequently, NFWF launched the Central Appalachia Habitat Stewardship Program with a mix of public and private funding from the Richard King Mellon Foundation, the American Forest Foundation, and the U.S. Department of Agriculture's Natural Resources Conservation Service.

In the first two years, the Central Appalachia Habitat Stewardship Program has awarded more than $3.1 million in funding to 25 projects across the landscape. In addition, these awards include more than $4.0 million in matching contributions. Collectively, the projects will improve habitat on over 50,000 acres of forestlands and remove thirteen barriers to fish passage, opening approximately 150 miles of upstream habitat.

This business plan incorporates lessons learned and expands the western Pennsylvania five-year strategy into a ten-year, landscape-scale plan for a broader region.

In February 2021, business plan goals and outcomes were adjusted based on early successes especially related to forest habitat strategies, as well as strategies for fish passage and riparian buffer restoration.

Conservation Need

The Appalachian Mountains are the oldest mountain range in North America. Formed 480 million years ago, they once stood as high as the Rockies. After hundreds of millions of years of erosion, the highest elevations in North Carolina and New Hampshire today are just shy of 7,000 feet. Due to its age, this ancient mountain range, and its ridges and valleys, form some of the most biologically diverse ecosystems in North America.

Appalachia typically is divided into three regions — a northern region stretching from the Hudson River to Maine and into Canada, a central region spanning central New York to the New River in southern West Virginia, and a southern region that extends from North Carolina into Georgia and Alabama. This business plan focuses on the highlands of the central region.

Central Appalachia boasts some of the world's oldest river systems and most biologically diverse temperate deciduous forests. The region's forests, streams, rivers, wetlands and floodplains host a remarkable variety of flora and fauna with long evolutionary histories. For centuries local economies have relied on the region's rich and abundant natural resources — its expansive forests for logging, its fertile valleys for farming, and its abundant sources of energy (e.g., coal, iron ore, oil and gas deposits).

Farmers, miners, loggers and steel workers have long-relied on the region's natural resources for their livelihoods, and those natural resources have driven the regional economy. The population, which is decreasing, is approximately 42% rural, compared to a national average of 20%. And while the region has seen a steady reduction in poverty over the past fifty years, it has been slow to recover from the 2008 economic recession. Two-thirds of coal industry jobs have disappeared in the region since the 1990s. The average household income is 20% below the national average, and had an unemployment rate of 5.6% in 2016 compared to the national average of 4.9% (Appalachian Regional Commission).

Central Appalachia also has seen new economic opportunity. Throughout the region, the tourism sector is on the rise, supported by outdoor enthusiasts who come to explore this complex landscape. Small towns and rural communities are seeing an increase in the number of hunting and fishing lodges, white water outfitters and outposts for hikers on the extensive network of trails in the region, including the king of trails, the Appalachian Trail. The region is an outdoor wonderland that is in striking distance of major population centers in the Midwest, Northeast and Mid-Atlantic.

However, habitat loss and degradation from a range of threats, including residential, commercial and energy development, mining, agriculture and logging, collectively have impaired forest health, water quality, wildlife populations and the communities that rely on these resources. Cumulatively, these threats have limited habitat availability and restricted woodland and freshwater communities to small patches of forests and streams. The continuity of vast forests and unimpaired stream miles that once enabled these wildlife communities to migrate and successfully reproduce, have now been diminished by habitat fragmentation.

Forest Habitat

During the timber boom of the late 19th and early 20th centuries, much of the region's vast forests were cleared. Much of the land has been re-forested, and today 73% of the landscape is forested; however, these forests typically have an even-age distribution and lack the structural diversity to support bird and other wildlife populations that depend on a more complex forest system.

Neotropical migrant bird species, in particular, are at risk from loss of habitat caused by fragmentation, incompatible land practices and/or forest management that focuses on a single attribute instead of the diverse age and structure needed within the forest. After leaving the nest, parents and dependent young move large distances and require forest conditions that often differ from nesting habitat. Three key species of forests birds exemplify the potential range of habitat requirements:

- Adult and fledgling of golden-winged warblers, which are indicators of expansive forested landscapes with adequate young forest, range on average up to 765 yards from their nest sites at 30 days post-fledging, suggesting a minimum forest block of 400 acres.
- Adult and fledgling wood thrush, which are indicators of mature forest with adequate canopy cover and structurally complex mid- and understories, will travel up to a mile from the nest site at 30 days post-fledging, suggesting a minimum forest bloc of 1,800 acres.
- Adult and fledgling cerulean warblers, which are indicators of late successional forest with a heterogeneous open canopy, can travel more than 1.5 miles from the nest at 30 days post-fledging, suggesting a minimum forest block of 5,000 acres.

Absent a mix of forest age class at sufficient scale, populations will continue to decline. Analyses of the Breeding Bird Survey (BBS data from 1966-2013) has demonstrated significant negative trends for neotropical migrants occupying eastern forests. The decline of habitat specialists including cerulean warbler (73% decline), golden-winged warbler (60% decline) and wood thrush (59% decline) are symptomatic of habitat loss and fragmentation that have dramatically reduced habitat suitability in both temperate and tropical forests. Although not within the scope of this plan, we recognize that full life cycle conservation efforts aimed at non-breeding locations will be necessary for sustaining long-term recovery of neotropical migrants.

Forest management in the landscape is further complicated by the diverse mix of landowners in the region and the range in the size of forests or woodlots under management. Of the forest lands in this landscape, approximately 20% is publicly owned, including local, state and national forests, and the remaining 80% is privately-owned. Further complicating management is the varying landowner and land manager management goals for individual parcels (e.g., timber production, recreation, wildlife management). The diversity and number of landowners presents an outreach challenge in terms of promoting wildlife-friendly forest management; however, experience and survey work have shown that these landowners often are motivated to implement such practices for a wide range of reasons, such as an appreciation of wildlife, preventing listings under the Endangered Species Act, or access to markets for sustainable forest products.

Aquatic Habitat

From the headwater streams emanating from forest, springs and ridgetops to the downstream large river systems, a continuum of water environments creates valuable and diverse habitat supporting a

wide array of aquatic life. The quality of water and in-stream habitat is critical for supporting iconic aquatic species like eastern brook trout and eastern hellbender, as well as somewhat less iconic but highly diverse freshwater mussel communities.

Eastern brook trout. Eastern brook trout persist in only the coldest and cleanest waters and are excellent indicators of good water quality and overall watershed health. The Eastern Brook Trout Joint Venture (EBTJV) estimates that only 8% of watersheds that historically supported eastern brook trout in the eastern U.S. can be classified as "intact" (i.e., at least 50% of the catchments in a HUC 12 watershed have wild trout present). Eastern brook trout (EBT) have experienced some of the greatest declines the mid-Atlantic region, where the populations that remain are concentrated in the highlands of central Appalachia highlands. Of the over 9,860 known eastern brook trout population patches range-wide, less than 15% are found in this critical landscape.

Polluted runoff from farmland and city streets, streambank erosion, acid mine drainage, road crossings, and the alteration of upland and riparian areas result in water quality, hydrology and habitat impairments that reduce brook trout populations. Increased stream temperatures and altered stream hydrology have further reduced the amount of habitat available for brook trout. Of the more than 86,000 miles of streams in the landscape, 16% have been listed under the Clean Water Act as not meeting water quality standards for one or more pollutants.

Fragmentation from dams and impassable culverts results in small, isolated eastern brook trout populations that are more vulnerable to disturbance events (e.g., floods, drought) and demographic and genetic bottlenecks. In this landscape alone, it is estimated there are close to 200,000 known barriers to fish passage, including dams and under-sized culverts, and the number of unknown barriers — including road-stream crossings, water quality and hydrologic modifications — is likely to dwarf that number.

Brook trout are also threatened by non-native trout, which out-compete the native brook trout for food and spawning sites and routinely prey upon them. As part of a range-wide catchment assessment, the EBTJV found that 33% of catchments with eastern brook trout also contained non-native rainbow and/or brown trout.

Eastern hellbender. The hellbender is the largest salamander in North America and has been known to grow up to 29 inches long. They are fully aquatic and prefer shallow, fast-flowing, rocky streams, where they spend most of their time under large, partially buried rocks and boulders. Hellbenders breathe primarily through their skin and thus rely on cool, well-oxygenated, flowing water. They are long-lived and do not reach sexual maturity until six to eight years of age. Individuals in captivity have lived up to 29 years, and they may live to 50 years or greater in the wild.

There are two subspecies of hellbender, the Ozark hellbender and the eastern hellbender. The Ozark subspecies is endangered, and the eastern hellbender, which is the focus of this business plan, is a species of concern under review for listing consideration.

Photo: eastern hellbender

The eastern hellbender's range extends from southern New York to northern Georgia; however, this range has been shrinking as a result of modification of stream habitats. Threats to this habitat include sedimentation and other forms of water pollution, impoundments to streams and rivers and other hydrologic stream modifications. While dams limit mobility, their primary impact on hellbender is that they stop swift water flow, resulting in warmer temperatures and lower oxygen levels. Where dams have been removed and water quality is otherwise high, there may be opportunities to reintroduce hellbender.

Freshwater mussels. Eastern North America is home to a diverse array of freshwater mussels. For instance, the Clinch River alone contains more freshwater mussel species than all of Europe, yet many of these have been greatly reduced in number or extirpated from large portions of the river due to poor water quality. Freshwater mussels throughout the central Appalachia are highly threatened. The Clinch is no exception, where 20 of the 46 existing freshwater mussel species are listed under the Endangered Species Act (Jones *et al.* 2014; Ahlstedt *et al.* 2016).

Recovery of freshwater mussels is important for aquatic ecosystems. Like brook trout and hellbenders, mussels are indicators of healthy streams, but can also improve water quality through filter-feeding. In addition, because freshwater mussels depend upon fish hosts for reproduction, their long-term survival requires robust fish populations.

Current Conservation Context

There are multiple state-Federal conservation partnerships addressing priorities in this region. The three that are most complementary to NFWF's priorities are the Appalachian Mountain Joint Venture, the Eastern Brook Trout Joint Venture, and Working Lands for Wildlife, which is an initiative of USDA's Natural Resources Conservation Service. All three of these initiatives involve coordination with state agencies and Federal field offices. NFWF has been substantially engaged with all three of these initiatives prior to the development of this business plan and engaged in dialogue with these partners through the development of the business plan, to ensure NFWF's goals, priorities and strategies were supportive of these efforts, and that NFWF is positioned to fill implementation gaps and leverage existing and new funding.

More specifically, the EBTJV's *Conserving the Eastern Brook Trout – Action Strategies* directly informed the development of goals and strategies, as did the Appalachian Mountain Joint Venture's on-going work to develop "birdscapes" in which to focus their work.

In addition, NFWF has continued to engage with two key funding partners who have similar investment strategies for the region – the American Forest Foundation and the Richard King Mellon Foundation — to ensure sufficient alignment to sustain these valued partnerships.

Given the outstanding conservation opportunity in the region, and the growing threats, NFWF's increased presence will allow these initiatives and their state and local partners to implement plans faster, and in a more targeted manner. NFWF's investments will also allow local actors to access other state and Federal matching funds that currently are out of reach.

Conservation Outcomes

The purpose of this business plan is to improve the quality and connectivity of forest and freshwater habitat in order to increase the distribution and abundance of fish, birds and other wildlife, as evidenced by a suite of species that collectively are indicators of forest and freshwater habitat condition (see Tables 1 and 2). For forest habitat, target species include cerulean warbler, wood thrush and golden-winged warbler which, when taken together, require forest blocks with a mosaic of mixed-aged forest. For aquatic habitat, species include eastern brook trout, eastern hellbender and native freshwater mussels which require clean, free flowing waters with a diversity of instream habitat from the Appalachia Mountains' cold, headwater streams that flow from the ridgetops to the large meandering rivers that cut the region's valleys.

Forest Birds

The goal is to support management planning on 300,000 acres of mixed-aged forest within the context of dynamic forest blocks, and with active habitat improvement occurring on half of these acres. Ultimately these dynamic forest blocks will collectively support a minimum of 2,160 golden-winged warbler breeding pairs, 6,000 wood thrush breeding pairs and 13,680 cerulean warbler breeding pairs; however, it is important to note that there are lag times to occupancy post-treatment. To achieve these goals, we will identify and begin planning for at least 12 blocks of 5,000-25,000 acres each. We will initiate on-the-ground management on a minimum of twelve blocks, with each block being managed to achieve approximately 12% early successional habitat, 50% mature forest habitat and 38% late successional forest habitat.[1]

Table 1. Target Forest Species, Habitat Preferences and Outcomes

Forest Birds	Habitat Preferences	10-Year Business Plan Goals
Golden-winged Warbler *Vermivora chrysoptera*	Breeding pairs require a complex young-forest or old field structure consisting of shrubby young forest interspersed with herbaceous areas of grasses and forbs and including widely spaced over-story trees for singing perches. Habitat typically borders mature forest and is usually set within a forested landscape.	Manage or create 18,000 acres of early successional habitat by 2029.
		Support 2,160 breeding pairs with occupancy lagging 5-6 years post treatment.
Wood Thrush *Hylocichla mustelina*	Require mature forest for establishing successful breeding territories. Found in large, relatively continuous tracts of deciduous or mixed deciduous-coniferous forests with a thick understory of shrubs and saplings and a large, closed canopy.	Manage or create 75,000 acres of mature forest habitat by 2029.
		Support 6,000 breeding pairs with anticipated lag times to occupancy post treatment.

[1] Forest starting condition and within block geography and soil conditions will shape the percentage distribution of forest classes.

Cerulean Warbler *Setophaga cerulea*	Dependent upon a heterogeneous open canopy indicative of late successional deciduous forests, with a dense understory and avoids hard edges impacted by forest fragmentation. Often located on ridgelines and steep slopes; also occur along larger streams with an open canopy.	Manage 57,000 acres of late successional forest habitat by 2029.
		Support 13,680 breeding pairs with anticipated lag times to occupancy post treatment.

Aquatic Species

Eastern brook trout. The goal is to increase the number of eastern brook trout in five targeted watersheds where we have identified priority patches. A priority patch for the purposes of this business plan is an allopatric eastern brook trout population patch that meets the criteria to be characterized as a stronghold as established in Trout Unlimited's Eastern Brook Trout conservation portfolio assessment (Fesenmyer *et al* 2017). In support of this goal, we will achieve the following:

- Improve habitat quality within at least two population patches in each targeted watershed through protection and restoration of riparian areas, stream restoration and water quality improvement projects. This represents 12% (10 out of 82) of the priority population patches.
- Increase the average size of priority population patches by approximately 25% to at least 5,000 acres within in each targeted watershed through culvert replacement, dam removal and other fish passage improvement activities, while minimizing potential impacts from introduction of non-native trout species.

Eastern hellbender. The goal is to increase eastern hellbender populations in targeted watersheds. In support of this goal, we will re-establish hellbender occupancy by bolstering populations and/or re-introducing them to 20 stream miles, and increase hellbender nesting success within 30 stream miles.

Freshwater mussels. The goal is to increase the abundance and diversity of native freshwater mussels in southwestern Virginia. It already has a 10-year recovery plan for freshwater mussels (UTRMRG 2016), and we aim to fund the Clinch River portion of this recovery plan, which will lead to the annual release of 120,000 individuals representing at least 13 species.

Table 2. Target Aquatic Species, Habitat Preferences and Outcomes

Target Species	Habitat Preference	10-Year Business Plan Goals
Eastern Brook Trout *Salvelinus fontinalis*	Occupies cold headwater streams, with clean, well-oxygenated water and a rocky streambed.	Increase the eastern brook trout population in five targeted watersheds by 2029.
		Increase the average priority patch size by approximately 25% to at least 5,000 acres by 2029.
Eastern Hellbender *Cryptobranchus alleganiensis*	Found in clean, larger, fast flowing streams with abundant rocks large enough to hide under.	Re-establish occupancy to 20 stream miles by 2029.
		Increase nesting success within 30 stream miles by 2029.

Freshwater Mussels *Multiple species*	Largely found in warmer, lower elevation, downstream waters. Mussels are highly susceptible to any type of water pollution, and require movement of host fish to disperse larvae.	Increase abundance and diversity in targeted watersheds by 2029.
		Release 120,000 individuals annually, representing 13 species into the Clinch River watershed.

Geographic Focus

Conservation investments will be targeted in seven focal geographies, see Figure 1. These geographies were selected by analyzing large watersheds (HUC8) for priority forest and freshwater habitat for the identified target species, with a goal of sustaining and improving large, contiguous blocks of the highest quality habitat. Local readiness, partner interest and the role for NFWF funding also were considered. Forest and aquatic habitat were assessed both separately and together to identify opportunities to leverage investments in each. Table 3 provides an overview of the prioritization process. In most but not all cases focal geographies include priority habitat for forest and aquatic species. For a more detailed description of the methodologies, see Appendix A.

The seven focal geographies shown on Figure 1 include: French Creek, the Upper-Middle Allegheny, the Pennsylvania Wilds, the Laurel Highlands, the Monongahela Forest, the Blue Ridge and Southwestern Virginia.[2]

Table 3. Focal Geography Selection

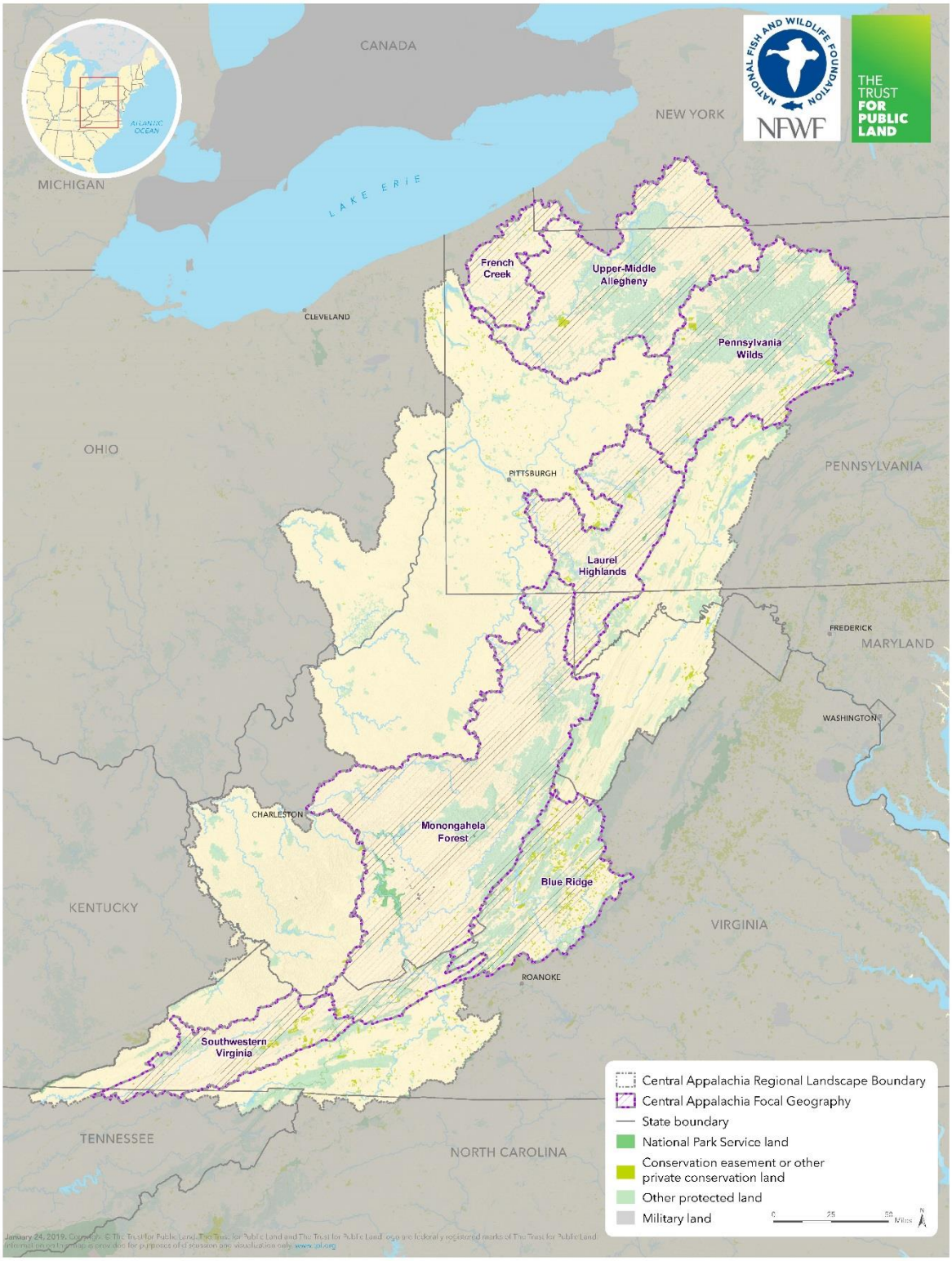
Habitat Type	Prioritization Strategy	Focal Geographies
Forest Habitat	Prioritize HUC8 watersheds with the greatest extent of large forest blocks that include priority habitat for golden-winged warbler, wood thrush *and* cerulean warbler, *or* two of the three species.	Pennsylvania Wilds, Laurel Highlands, Monongahela Forest (Blue Ridge is a secondary priority)
Aquatic Habitat	Prioritize watersheds with the greatest extent of allopatric, resilient and redundant eastern brook trout population patches that are designated "high integrity" ("priority patches").	French Creek, Upper-Middle Allegheny, Pennsylvania Wilds, Monongahela Forest, Blue Ridge, Southwestern Virginia

Specific priority habitat patches and forest blocks within these larger geographies have been identified for some focal geographies and are in development for others. Investments will be targeted to improve habitat within patches and forest blocks, and also to create connectivity between them.

The selection of aquatic priority watersheds was driven by eastern brook trout and alignment with large forest blocks. Although secondary considerations were given to watersheds that are thought to be important for eastern hellbenders and freshwater mussels, uniform spatial data were not available for these groups in the region. Due to the lack of data and limited existing funds, we have chosen to focus our initial investments on hellbenders and freshwater mussels in French Creek and Southwestern Virginia, where there are ongoing efforts to restore their habitat and populations.

[2] The focal geographies are inclusive of the following HUC8 watersheds: French Creek – French Creek watershed; Upper-Middle Allegheny - Upper Allegheny, Middle Allegheny-Tionesta and Clarion watersheds; Pennsylvania Wilds - Pine, Middle West Branch Susquehanna, Bald Eagle, Sinnemahoning and Upper West Branch Susquehanna watersheds; Laurel Highlands - Conemaugh and Youghiogheny watersheds; Monongahela Forest - Cheat, Tygart Valley, Elk, Gauley, Greenbrier, Lower and Middle New watersheds; Blue Ridge - Maury and Upper James watersheds; and Southwestern Virginia - Upper Clinch and North Fork Holston watersheds.

Figure 1. Central Appalachia Focal Geographies



Implementation Plan

The approach of this business plan for both forest and aquatic habitat is to invest in conserving and improving the highest quality habitat to sustain and bolster populations of target species. The plan includes four main strategies, with two each for forest habitat and aquatic habitat, that will lead to improved quantity, quality and connectivity of habitat, and ultimately increased populations of target species (see Figure 2: Central Appalachia Theory of Change).

The two forest strategies allow NFWF to approach forest management at the forest block-scale, while still engaging a broad mix of local landowners and practitioners. The overarching strategy is to create a mosaic of forest habitats that improve forests for a suite of bird (and wildlife) species that occupy different seral stages across large, contiguous forest bocks. In order to knit together appropriately-sized forest blocks, we will need to work with a mix of public and private landowners to not only tailor restoration and management activities to the land available, but also the needs and interests of landowners.



Photos: golden-winged warbler, wood thrush, cerulean warbler (credit: WikimediaCommons)

For aquatic habitat, the focus is on conserving and restoring the highest quality habitat for the target species. The strategies include an upstream-downstream approach to achieve watershed-wide, synergistic benefits throughout targeted watersheds. In the low-order, cold, headwater systems, the strategies seek to improve and expand eastern brook trout habitat through water quality improvement, and the removal of barriers between and within population patches.

In addition to improving eastern brook trout habitat in the headwaters, we anticipate these efforts to have downstream benefits as well. Where possible, we will work to bolster hellbender and mussel populations in higher order rivers and streams, where upstream restoration has the potential to improve the viability of these downstream species. Localized connectivity and water quality improvement work will be coupled with investments in re-establishing localized populations. Because we have limited population data for hellbender and mussels, this work will be conducted on a demonstration basis, with the opportunity for more wide-scale replication in the out years of the business plan, as restoration strategies are proven, and more range-wide data are available.

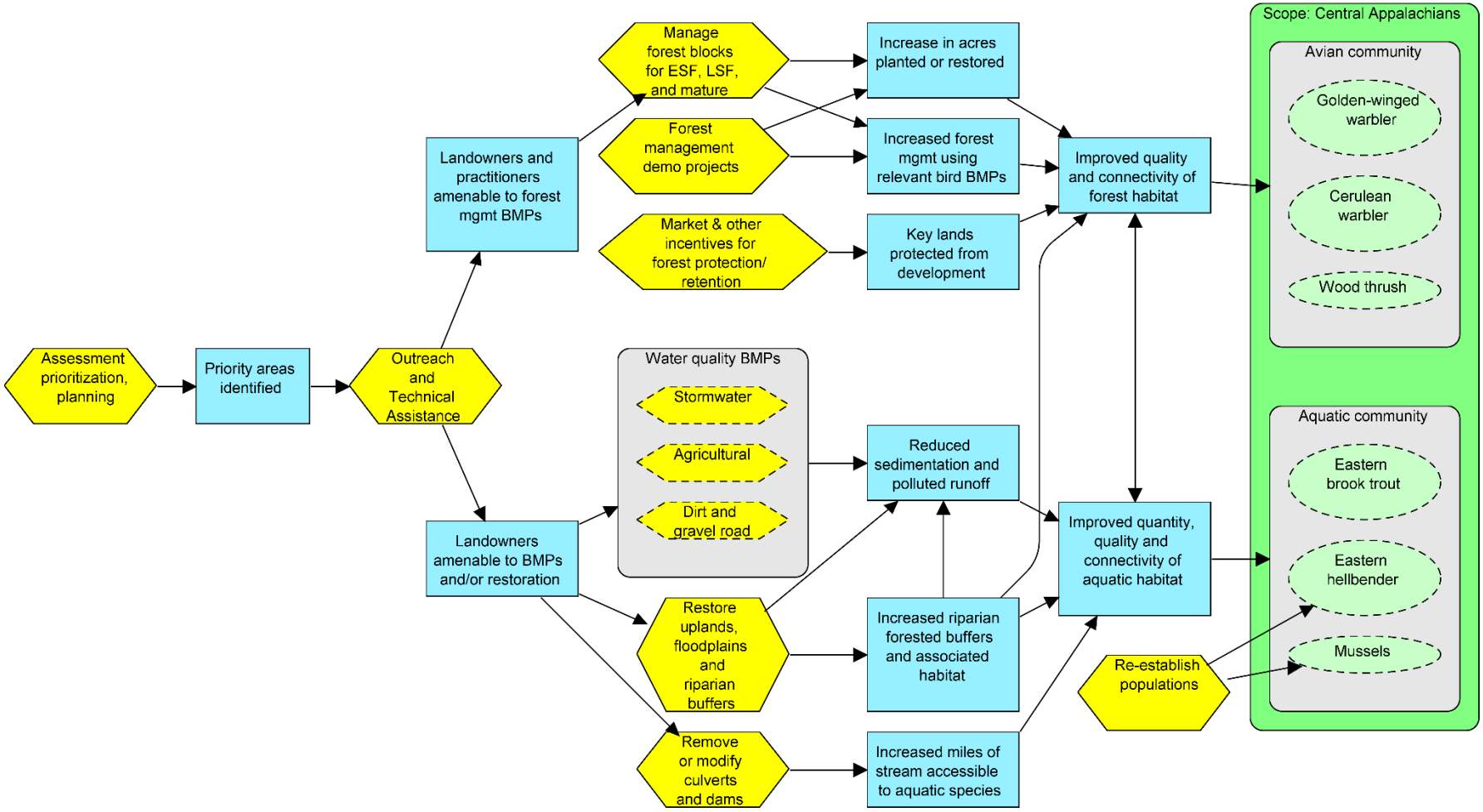


Figure 2. Central Appalachia theory of change depicting the relationship of various strategies (yellow hexagons) within the business plan to each other, to the intermediate results (blue boxes) and ultimately to the target species (green ovals).

Strategy 1: Restore and Manage Forest Blocks in Focal Geographies

1.1 Identify, plan and implement best management practices (BMPs) throughout forest blocks

Working with partners, we will identify potential forest blocks within focal geographies and initiate planning to implement forest management strategies to improve baseline condition. Work initially will focus in the Pennsylvania Wilds, Laurel Highlands and Monongahela Forest focal geographies, and expand to other focal geographies as funding and capacity grows.

The linkage between management and markets for extracted timber are a consideration as well as implementation cost, budget, capacity and existing partnerships. Big picture, within a forest block, not all of the forest will be available for management — local conditions (i.e., slope angle, wetland or riparian set back distances and stand quality) will impact harvest decisions. Forest management blocks may be dominated by public land, private land or, most likely, a mix of public and private ownership.

The strategy will utilize established BMPs on forest lands to create a mosaic of mixed-aged forest that provides suitable habitat for target species. For wood thrush, there is value in creating or establishing regional BMP guidelines; existing wood thrush BMP's were developed for northeastern forests. We will implement forest management plans following existing and potentially updated BMP's for wood thrush along with established guidelines for golden-winged warbler (developed by the Golden-winged Warbler Working Group) and cerulean warbler (developed by the Appalachian Mountain Joint Venture).

Lands will be prioritized to create contiguous blocks of forest under coordinated management, engaging public and otherwise protected forests as anchors for forest blocks. Then outreach and technical assistance will be targeted to private landowners with lands adjacent to, between and within anchor public lands, targeting family-owned woodlands, industrial/commercial forests, farmland, abandoned mine lands, land owned by water authorities and rights of way for pipelines, transmission lines and transportation corridors.

1.2 Research and monitor within the established forest blocks

Through monitoring we will establish baseline estimates using transect point count sampling (Ralph et al. 1995) or other techniques. Baseline data and the monitoring program will be used to measure changes in bird occupancy, abundance, density, diversity and productivity as forest management activities are undertaken. Through GIS land cover data and stand maps, we will track forest management goals (acres per habitat type).

Strategy 2: Target Outreach and Assistance to Key Forest Landowners and Practitioners

Throughout the focal geographies and the larger central Appalachia landscape, NFWF will invest in strategies to continue to grow the universe of willing landowners and knowledgeable practitioners in order to lay the groundwork for replication and to take the forest block approach to scale.

2.1 Create demonstration projects that target different landowner types

Outreach and technical assistance will be targeted based on predominance of landownership in communities. We will support demonstration projects that are specifically designed to engage

family-owned woodlands, to build networks of family woodlot owners committed to common outputs, industrial/commercial forests and public forests (municipal, state and national).

2.2 Target outreach to key practitioners

Where lack of knowledge and technical capacity are barriers to adoption of forest management practices, demonstration projects and outreach will be targeted to government foresters, private foresters and loggers.

2.3 Maximize incentive-based initiatives and outreach to keep forests forested

Innovative approaches will demonstrate incentives that provide value to forest landowners for creating and improving habitat, including preferential purchasing for certified forests, ecosystem service markets and land succession planning.

Strategy 3: Sustain and Improve High Integrity Habitat for Eastern Brook Trout

3.1 Assess habitat condition and threats in brook trout population patches within targeted watersheds

Eastern brook trout priority patches will be assessed within targeted watersheds in order to identify opportunities to improve habitat conditions. Patches will be assessed to identify passage barriers, water quality hot spots such as pollution discharges, streambank erosion, gaps in the riparian buffer and livestock exclusion, presence of non-native trout and invasive species, etc.

3.2 Restore uplands, riparian, in-stream habitat, water quality and hydrology in streams that support priority patches

Urban and agricultural runoff, acid mine drainage, roads and the alteration of upland and riparian areas result in water quality, hydrology and habitat impairments that reduce brook trout populations. Addressing these impairments through restoration and BMPs will support the overall resiliency of eastern brook trout-occupied streams and will help populations adapt to the added stress of increased stream temperatures and hydrologic change. Improving outreach and technical assistance to farmers and other landowners will increase adoption of agricultural BMPs and green stormwater infrastructure.

3.3 Sustain and restore connectivity within and between population patches

In order to sustain connectivity and prevent further fragmentation, this strategy involves proactively engaging federal and state transportation agencies, local townships and municipalities to design road-crossings that enable fish passage and prevent road blowouts from extreme storm events. We will work with governmental partners to ensure that interventions in response to flood damage maintain or enhance lateral and longitudinal stream connectivity.

In order to improve connectivity within priority patches, we will remove small dams and replace impassable culverts to allow for fish passage throughout patches.

We also will identify opportunities to re-connect priority patches through the removal of structural barriers such as dams and failing culverts, and/or remedying water quality impairments that create barriers to fish movement, such as stream segments impacted by acid

mine drainage. Removing such impediments will increase the average patch size within targeted watersheds.

3.4 Establish a robust monitoring program to identify new eastern brook trout populations and to measure changes in population abundance within priority patches

Many streams in the region have not been surveyed for fish. Residential, commercial and energy-related development, including road-stream crossings, are expected to continue and possibly accelerate, impacting high-quality brook trout populations through land conversion and hydrologic alteration. Assessment programs will target streams likely to support eastern brook trout (but where fish populations have not been previously identified).

For priority patches, we will develop adequate and spatially explicit monitoring to measure eastern brook trout population response (or lack thereof) to restoration investments. A monitoring program will be designed and implemented establishing a baseline population size. This baseline will be used to measure population over time as restoration activities are undertaken. This technique may be paired with other monitoring work that state agencies are performing.

Strategy 4: Restore Mussel and Hellbender Habitat and Increase Occupancy

4.1 Re-establish eastern hellbender occupancy

Improve hellbender nesting habitat in targeted watersheds where eastern hellbender have recently gained access to high quality habitat resulting from a dam removal, or where significant water quality improvement projects have recently been completed.

4.2 Improve the quality of eastern hellbender habitat

Where localized sedimentation or barriers to movement may limited hellbender nesting success, habitat restoration will be implemented to minimize threats. Remedies may include riparian forest buffer restoration, flood plain restoration, or dam removals.

4.3 Re-establish freshwater mussel occupancy

Freshwater mussel species will be re-introduced to targeted watersheds, especially those that have had recent significant dam removals or flow regime changes that would increase potential for mussel reproductive success.

4.4 Improve habitat for freshwater mussels and their host species

We will work with federal partners to alter flow regimes below large dams and remove smaller dams when possible to restore hydrology and improve connectivity for freshwater mussels and their host species. Restoration will remedy water quality impairments that create barriers to movement, such as stream segments impacted by acid mine drainage or increased temperature from lack of a forested buffer.

Risk Assessment

Risk is an uncertain event or condition which, if it occurs, could have a negative effect on a program's desired outcome. Seven risk event categories were assessed to determine the extent to which they could impede progress towards the stated business plan strategies and goals for the central Appalachia landscape during the next 10 years (Table 4).

Table 4. Risk Assessment Summary

Risk Category	Rating	Risk Description	Mitigating Strategies
Regulatory Risks	**Low**	No significant risks.	
Financial Risks	**Moderate**	Approximately 40 percent of funds still need to be raised. Heavy reliance on appropriated dollars in current budget.	Budget plan includes fundraising strategies to target additional public and private funding sources. Plan strategies take into account modest funding stretch goals.
Environmental Risks	**Low**	Contaminants entering streams from accidents (e.g., vehicle collision).	Plan has flexibility to shift work to other parts of the focal area if one site becomes contaminated before work has been completed. Strategy is being applied in distinct focal areas, so any impact to one focal area is unlikely to impact the others.
Scientific Risks	**Low**	Gaps exist in our scientific understanding of focal species (e.g., threats to mussels/hellbenders, EBT stream carrying capacity, impacts to birds on their international wintering grounds).	Species goals take scientific uncertainties into consideration. Plan strategies emphasize approaches known to be effective (e.g., improving water quality). Periodic monitoring will allow for learning and making course corrections, as needed.
Social Risks	**Low**	Risk of increased parcelization of forestland from both inter-generational transfer of forest land or increased development, such as for second homes.	Plan includes strategies, such as outreach, demonstration sites and exploring economic incentives, to engage landowners in more conservation practices. Scale of aquatic focal geographies allows flexibility to shift to sites where landowners are more willing to participate.
Economic Risks	**Moderate**	Rapid expansion of energy development in the region could increase habitat loss, fragmentation and water pollution, and could impact landowner willingness to engage in conservation practices.	Aquatic strategies are targeted to areas with increased existing protections due to presence of wild trout. Locations for potential energy industry expansion (e.g., unbuilt well pads, wind) have been identified to understand possible threats and redirect efforts as needed.
Institutional Risks	**Low**	If infrastructure funding becomes available, lack of technical understanding may lead to culvert replacements that are not appropriately sized for fish passage. These would be missed opportunities to right-size culverts but will not impact plan goals. Fish stocking programs may introduce non-native species into priority EBT patches.	Potential opportunity--If infrastructure bill passes, NFWF will further emphasize outreach activities to generate effective culvert right-sizing projects in focal geographies. NFWF will coordinate with state agencies to minimize risks posed by stocking programs.

Monitoring & Evaluating Performance

To track program performance and conservation outcomes, NFWF will monitor progress at the project and program scales. Table 5 summarizes the core metrics for tracking overall progress on meeting the stated conservation goals. Where possible, monitoring efforts will be coordinated across species and within each habitat category.

At a key stage in the program's lifecycle, NFWF might commission a third-party evaluation to examine the factors that have facilitated and hindered successful program implementation to inform future decision-making and adaptively manage. In some cases these course corrections may warrant increased investment; however, it is also possible that NFWF would reduce or eliminate support if periodic evaluation indicates that further investments are unlikely to achieve intended outcomes or conversely if goals are met ahead of schedule.

Table 5. Metrics for Measuring Progress towards Conservation Goals

Forest Habitat	Strategies and Outcomes	Metrics	Baseline (2019)	Goal (2029)	Data Sources
Golden-winged warbler, wood thrush and cerulean warbler	At least twelve forest blocks are covered by dynamic forest plans that strive to create a mosaic of mixed-aged forest within focal geographies	# of forest blocks managed	0	12	NFWF staff
		# of acres covered by dynamic forest plans	0	300,000	NFWF staff
		# of acres with improved forest habitat	0	150,000	Project level reporting by grantees including GIS land cover data and forest stand maps
	Improve forest habitat on 150,000 acres within dynamic forest blocks with 12% early successional habitat, 50% mature forest habitat, and 38% late successional forest habitat.	Acres of early successional forest habitat improved	0	18,000	Project level reporting by grantees including GIS land cover data and forest stand maps
		# of golden-winged warbler breeding pairs	0[3]	2,160	Project level reporting by grantees or contracted monitoring
		Acres of mature forest habitat improved	0	75,000	Project level reporting by grantees including GIS land cover data and forest stand maps
		# of wood thrush breeding pairs	0	6,000	Project level reporting by grantees or contracted monitoring
		Acres of late successional forest habitat improved	0	57,000	Project level reporting by grantees including GIS land cover data and forest stand maps
		# of cerulean warbler breeding pairs	0	13,680	Project level reporting by grantees or contracted monitoring

[3] Baselines are estimated to be zero ("0") for the number of breeding territories for each bird species. By 2020, these baselines will be adjusted based on pre-monitoring data collected at treatment sites and within forest blocks.

Aquatic Habitat	Strategies and Outcomes	Metrics	Baseline (2019)	Goal (2029)	Data Sources
Eastern brook trout	Increase the eastern brook trout population in five targeted watersheds	# of targeted watersheds with an increase in eastern brook trout	0	5	Commission survey
		% increase in # of eastern brook trout within targeted watersheds	0	TBD[4]	Commission survey
	Improve habitat quality within priority patches in targeted watersheds	# of priority patches with improved habitat quality	0	10	NFWF staff
		# of acres with BMPs to reduce nutrients or sediment	0	15,000	Project level reporting by grantees
		Miles of riparian forest buffer restored	0	100	Project level reporting by grantees
		# of barriers to fish passage removed within patches	0	60	Project level reporting by grantees
		Miles of stream opened to fish passage within patches	0	350	Project level reporting by grantees
	Increase the average size of priority patches in each targeted watershed	# of barriers to fish passage removed between patches	0	10	Project level reporting by grantees
		increase in average size of priority patches within targeted watersheds	4,075	5,000	Commission analysis
Eastern hellbender	Re-establish hellbender occupancy by bolstering populations and/or re-introduction	# of stream miles occupied by hellbender	0	20	Project level reporting by grantees
	Increase hellbender nesting success	% of stream miles with increased hellbender nest success	0	30	Virginia Tech
Freshwater mussels	Stock and re-establish populations to the Clinch River and French Creek along with water quality improvements to enhance survival	# of species established	0	13	Virginia Department of Game and Inland Fisheries (VDGIF); USFWS; grantees
		# of individuals released annually	0	120,000	VDGIF; USFWS; grantees

[4] A goal for the percentage increase in eastern brook trout populations in targeted watersheds will be established by 2021 after patch assessments are completed under strategy 3.1.

Budget

The following budget shows the estimated costs to implement the activities identified in this business plan. This budget reflects NFWF's anticipated engagement over the business plan period of performance; however, it is *not* an annual or even cumulative commitment by NFWF to invest. We acknowledge that in many cases the activities laid out in the plan build upon efforts funded by other organizations. This budget assumes that the current trajectory of funding by those other organizations continues over this program's time frame.

Table 6. Budget for Central Appalachia Business Plan

BUDGET CATEGORY		Years 1-5	Years 6-10	Total
Strategy 1. Restore and Manage Forest Blocks in Focal Geographies				
1.1	Identify, plan and implement BMPs throughout forest blocks	$5,000,000	$8,500,000	$13,500,000
1.2	Research and monitor within the established forest blocks	$100,000	$500,000	$600,000
Strategy 2. Target Outreach and Assistance to Key Landowners				
2.1	Create demonstration projects that target different landowner types	$500,000	$250,000	$750,000
2.2	Target outreach to key practitioners	$150,000	$150,000	$300,000
2.3	Maximize incentive-based initiatives and outreach	$150,000	$150,000	$300,000
Strategy 3. Sustain and Improve High Integrity Habitat for Brook Trout				
3.1	Assess habitat condition and threats in EBT patches	$200,000	-	$200,000
3.2	Restore uplands, riparian, in-stream, water quality and hydrology	$1,650,000	$1,650,000	$3,300,000
3.3	Sustain and improve connectivity within and between EBT patches	$2,000,000	$2,100,000	$4,100,000
3.4	Establish a robust monitoring program for EBT patches	$275,000	$275,000	$550,000
Strategy 4. Restore Freshwater Mussel and Hellbender Habitat and Occupancy				
4.1	Re-establish hellbender occupancy	$300,000	$300,000	$600,000
4.2	Improve the quality of hellbender habitat			
4.3	Re-establish mussel occupancy	$400,000	$400,000	$800,000
4.4	Improve habitat for mussels and their host species			
Other				
	Program Assessment and Evaluation	$70,000	$130,000	$200,000
	TOTAL BUDGET	**$10,795,000**	**$14,405,000**	**$25,200,000**

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Appendix

Provided as separate document.