Piney Creek

Ecosystem Restoration

Continuing Authorities Program

Section 206 Feasibility Study

With Integrated Environmental Assessment

June 2021

Executive Summary

This study examines Aquatic Ecosystem Restoration on Piney Creek in accordance with Section 206 of the Water Resources Development Act of 1996. Piney Creek is a tributary of the Hatchie River. The Piney Creek watershed lies entirely in Tennessee and is more than 37,500 acres. Approximately 50 years ago, several miles of the downstream end of Piney Creek were bypassed and replaced with a ditch. The middle portion was also straightened and enlarged to alleviate agricultural flooding, but is stable at this time. Extensive timber harvesting in the upland areas increased runoff and caused gullying and erosion. The area has been reforested, but the small tributaries have not stabilized.

The ditch is the largest sediment source to the Hatchie River and conditions in the Hatchie downstream from the ditch are degraded. The historic meanders of Piney Creek are cut off. Stagnant water around the old meanders is killing bottomland hardwoods and reducing the quality of the forested swamp habitat for a variety of native species.

The Hatchie River is the only undammed and unchannelized tributary to the Lower Mississippi River. The Hatchie River contains the largest forested floodplain in Tennessee. There are two National Wildlife Refuges (Hatchie National Wildlife Refuge and Lower Hatchie National Wildlife Refuge) and two State Parks (Big Hill Pond and Chickasaw). The Hatchie, including the lower end of Piney Creek, is a Class 1 Scenic River under the Tennessee Wild and Scenic Rivers Act. Steamboats plied the Hatchie until the early 20th century and the historic head of navigation was at Bolivar, TN near the mouth of Piney Creek.

The Tentatively Selected Plan would excavate an approximate 2.6-mile natural channel to replace the 0.85-mile of canal. The plan includes a mix of different types of grade control structures for a total of fourteen. The plan includes tree planting to fill in gaps in the existing canopy and replace any trees that have to be removed for construction. The estimated cost of construction is $14.5 million.

The Tentatively Selected Plan would improve the hydrologic function and geomorphic character of Piney Creek and would likely contribute to preservation and restoration of biodiversity in the watershed. The plan has a net gain of 293 average annual habitat units.

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I. INTRODUCTION

This study will examine Piney Creek, a tributary of the Hatchie River. The Piney Creek watershed lies entirely in Tennessee and covers more than 37,500 acres. Approximately 50 years ago, several miles of the downstream end of Piney Creek were bypassed and replaced with a ditch. Today, the historic meanders of Piney Creek remain cut off. Stagnant water around the old meanders is killing bottomland hardwoods and reducing the quality of the forested swamp habitat for a variety of native species.

For this assessment, Lower Piney Creek extends from its mouth at the Hatchie upstream to the edge of the contiguous bottomland forest; located approximately 0.8 mile downstream of Walnut Grove Road. Most of this reach lies within the bottomland hardwood floodplain of the Hatchie River. Going upstream, Middle Piney Creek extends from the edge of the bottomland hardwood forest upstream approximately 9 miles to the town of Silerton. Like Lower Piney Creek, the middle portion was also straightened and enlarged to alleviate agricultural flooding, but is stable now. The channel upstream of Silerton is designated Upper Piney Creek. Much of the Upper Piney Creek area was harvested for timber but the forest has regrown and part of it is now Chickasaw State Park. The small streams outside the Park are deep gullies that are headcutting and producing a considerable amount of sediment.

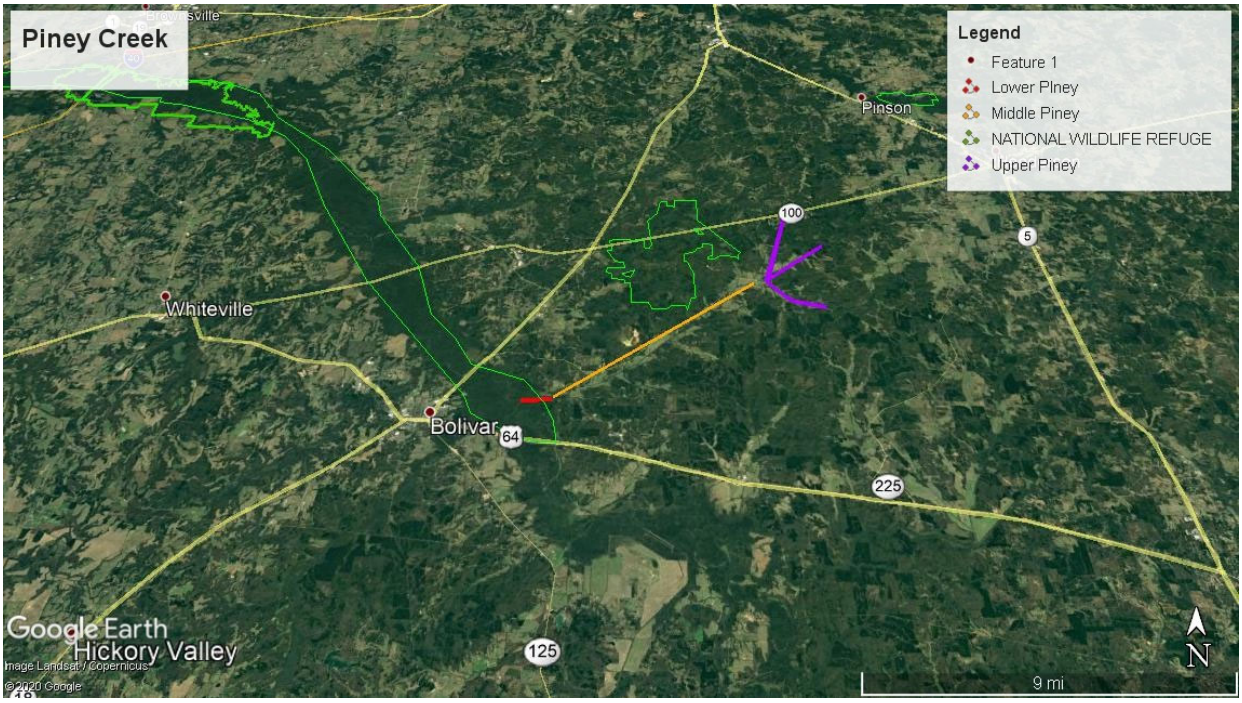

Figure 1 Aerial view of the study area (Hatchie NWR at upper left, Hatchie Wild and Scenic River Corridor from Hatchie NWR to Bolivar, Chickasaw SP in the center and Big Hill Pond SP near Pinson.

Piney Creek is the largest sediment source to the Hatchie River. Accordingly, the Hatchie downstream of the Piney Creek outlet is environmentally degraded and shows some signs of being unstable. (Diehl 2000). The Hatchie River is the only undammed and unchannelized tributary to the Lower Mississippi River. The Hatchie River contains the largest forested floodplain in Tennessee.

There are two National Wildlife Refuges (Hatchie National Wildlife Refuge and Lower Hatchie National Wildlife Refuge) and two State Parks (Big Hill Pond and Chickasaw). The Hatchie, including the lower end of Piney Creek, is a Class 1 Scenic River under the Tennessee Wild and Scenic Rivers Act. Steamboats plied the Hatchie until the early 20th century and the historic head of navigation was at Bolivar, TN near the mouth of Piney Creek.

The Hatchie River and its tributaries are a high priority area for habitat restoration among state and federal agencies and non-governmental organizations. The ecosystem provides habitat for more than 100 species of fish including 11 species of catfish, which is possibly the most of any North American River; 50 species of mammals; 35 species of mussels; 250 species of birds including migrating birds; along with many reptiles, amphibians and invertebrates. Many of the Hatchie River's 36 tributaries have been channelized or altered. The habitat quality in these tributaries is poor and they deliver sediment to the Hatchie (Keck & Etnier 2005). The increased sediment from the tributaries creates valley plugs and shoals in the Hatchie. The habitat for freshwater mussels, crayfish, fish, amphibians, reptiles, mammals, and birds is degraded. Numerous scientific studies have documented population declines to all of these resources (Benz and Collins 1997).

Streams throughout the area were channelized starting in the 1920's. Habitat degradation is extensive in the Hatchie tributaries like Piney Creek. The tributaries are unstable and unlikely to recover without intervention. Degradation of bottomland hardwood) BLH systems is exacerbated in the loess belt region of the LMAV (Lower Mississippi Alluvial Valley), which includes portions of western Tennessee and northern Mississippi (Saucier 1994). The geology of the region and past land-use practices have resulted in extreme rates of gully erosion in the uplands areas of this region. Increased transport capacity of channelized streams has facilitated the transport of large quantities of eroded sediment into the lower reaches of these altered systems. Degradation, head-cutting, and bank failure of channelized reaches has also contributed to greater sediment loads. These processes have led to the formation of valley plugs and shoals throughout many of the altered systems in western Tennessee (Diehl 2000) and northern Mississippi (Happ et al. 1940). Valley plugs are within-channel geomorphic features that completely block the channel with accumulating sediment. Shoals are within-channel geomorphic features, at the confluence of two streams, that accumulate sediment causing a decrease in channel depth but not a complete blockage of the channel (Diehl 2000).

The Hatchie River is a tributary of the Mississippi River. Other studies have noted the importance of such tributaries on the health and function of the Mississippi. A majority of Lower Mississippi River tributaries have been altered to facilitate drainage (Benz & Collins 1997). Channelization has reduced or eliminated natural stream functions such as providing habitat for freshwater mussels, crayfish, fish, amphibians, reptiles, mammals, and birds. Habitat loss has caused population declines to all of these (Benz & Collins 1997). Geomorphic changes in tributary rivers have altered sediment dynamics in the Mississippi River. Large rainfall runoff volumes are quickly drained from the floodplain changing flood pulses (Baker et al. 2004) and reducing nutrient attenuation.

Study Scope

The study examines the feasibility of implementing aquatic ecosystem restoration within and along Piney Creek in Hardeman County, TN. See Figure 1 above.

Authority

Section 206 of the Water Resources Development Act of 1996, as amended, "the Secretary may carry out an aquatic ecosystem restoration and protection project if the Secretary determines that the project— (1) will improve the quality of the environment and is in the public interest; and (2) is cost-effective." Section 206 is part of the Continuing Authorities Program and is covered under USACE guidance in EP 1105-2-58. It has a federal limit of $10,000,000.

Prior Reports

2009 Memphis Metro Stormwater Reconnaissance Report
This report examined the entire Memphis Metro authority area to assess federal interest in ecosystem restoration. The study provided a conceptual plan for restoration of several rivers in the area including the lower reaches of the Hatchie. The report did not address the area of the Hatchie within Hardeman County.

1985 Initial Appraisal Report Section 208 Hatchie River Alcorn, County, MS.
This report addressed part of the Hatchie River upstream of the current project area.

II. PROBLEMS AND OPPORTUNITIES [PURPOSE AND NEED]

Lower Piney Creek was channelized. Historically it was a meandering stream with a healthy bottomland hardwood forest that was connected to the Hatchie River Forest. The historic meanders are now cut off from Piney Creek and the forest is constantly inundated. The forest is stressed and many trees are dead or dying. The current Lower Piney Creek channel is only 4,500 feet long; historically it was 2-3 miles long. During high water, the water is trapped in the channel and cannot spread out over the floodplain. Lower Piney Creek contains poor aquatic habitat. The stream is entrenched so there is very little vegetation along the water's edge and no rooted aquatic vegetation. Fish and mussel habitat is poor.

Middle Piney Creek flows through an upland area. This reach was also straightened and some of the land was cleared for agriculture; most is now in pasture. There are a few homes along this reach and roads and bridges. The channel is slightly entrenched, but not as severely as the Lower Piney Creek channel. It does not have many pool riffle complexes, but is mostly stable with an intact riparian buffer. There is some minor scouring at bridges.

Upper Piney Creek overlies an area that was harvested for timber. The area is reforested, but the past activities caused gullying and headcutting which has not been arrested. This area generates much of the sediment that is seen farther downstream.

Sedimentation in the upper reaches produces excess sand in Piney Creek. The Middle and Lower portions of the channel are shortened and do not meander. The channel is entrenched so that the sand-laden water cannot spread across a floodplain and allow some of the sediment to deposit. These factors combine to make Piney Creek the largest sediment source to the Hatchie River. Conditions in the Hatchie downstream from the Piney Creek outlet ditch are degraded (Diehl 2000). Shoals are associated with signs of channel instability. In the reach of the Hatchie River with depth measurements, only 10 meander cutoffs have formed since the first editions of topographic maps (generally based on 1947 photographs) were printed. Of these 10 cutoffs, 5 are clustered in the shoal reach below the mouth of Piney Creek (Diehl 2000).

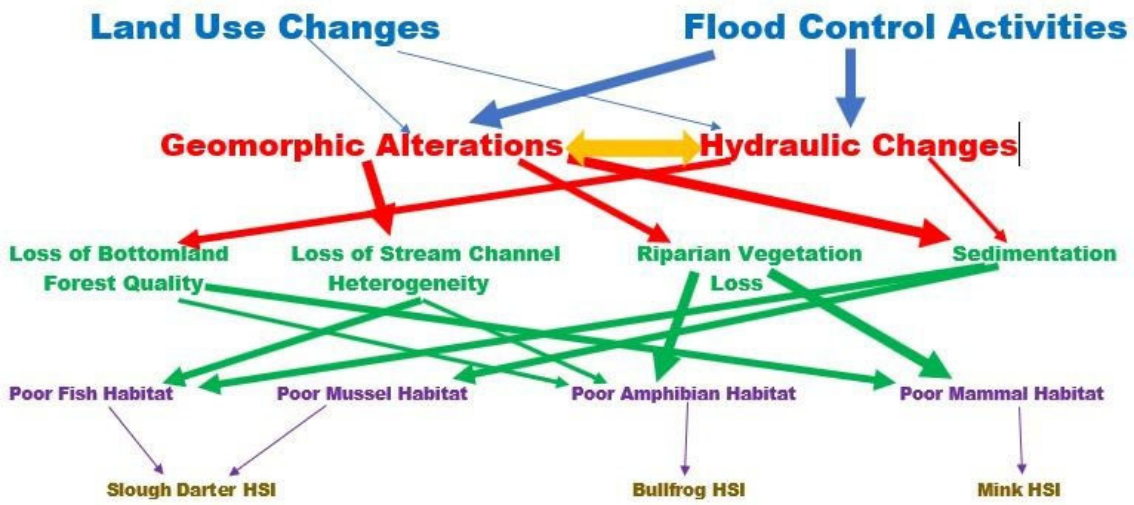

Figure 2 Conceptual Ecological Model for Piney Creek

The conceptual ecological model above is a graphic summary of the problems and effects in Piney Creek. The direct changes to the channel for flood control changed the geomorphic and hydraulic character of the system. The historic land use destabilized the small headwater channels. The Piney Creek floodplain no longer functions to direct water to the channel, to allow sediment to deposit, or to support healthy riparian and bottomland vegetation. Fish, mussel, amphibian and mammal habitat are all degraded.

The problems in Piney Creek are typical of channelized rivers and are common in the region. Most of the major streams in West Tennessee and Mississippi, in addition to their tributaries, have been channelized. These include the Obion, Forked Deer, Loosahatchie, and Wolf Rivers in western Tennessee, and the Cold Water, Tippah, Tallahatchie, Yocona, Skuna, and Yalobusha Rivers in Mississippi. Deforestation during the late 1800s and poor soil-conservation practices caused channels to fill with sediment in the early part of the 20th century. Channelization was widespread during the 1920s and 1930s. These projects reduced seasonal flooding and removed channel obstructions that created shallow swamps covering large areas of the floodplains (Shankman 1996).

Channelization is one of the major factors causing stream habitat loss and degradation, and is a serious threat to biodiversity of running water ecosystems (Muotka et al. 2002). Studies have documented a wide range of problems including poor fish recruitment (Jurajda 1995), reduced fish abundance and diversity (Horlte and Lake 1983), problems retaining and decomposing coarse particulate matter (Lepori et al. 2005), degradation of riparian vegetation (Nakamura et al. 1997), floodplain habitat losses and changes in sedimentation patterns (Wyzga 2001), and even spider population collapses (Paetzold et al. 2008). Brookes et al. (1983) found that over 16,500 miles of streams in the U.S. had been channelized. The impacts of channelization have been studied in many areas (D'Ambrosio et al. 2014, Bukaveckas 2007, Frissell 2002, Toth et al. 1995, Erikson et al. 1979 & Emerson 1971).

Figure 3 Lower Piney Creek showing entrenchment and lack of shoreline vegetation

Restoration of channelized rivers demonstrates that ecosystem processes, and structures can recover. Studies show that restored streams are able to break down and store nutrients better than unrestored streams (Bukaveckas 2007, Lepori et al. 2005). Benthic invertebrates (Muotka et al. 2002), and macroinvertebrates (Nakano et al. 2008) respond well to restoration. Physical habitat and floral communities recovered to near pre-disturbance patterns in the Kissimmee River in Florida (Toth 1995). Studies in north Mississippi found fish abundance, richness and diversity improved with restoration (Shields et al. 1995a, Shields et al. 1995b, Shields et al. 1998). Primary productivity, invertebrates, riparian vegetation, hydraulic processes and fish communities can recover from channelization.

Collectively, the study area problems diminish biological diversity, water quality, environmental sustainability, and recreation values. A successful project on Piney Creek could lead to other similar work to restore ecosystem structure and function on other tributaries throughout the Hatchie River watershed. The Mississippi River Commission's 200-Year Vision seeks to balance the nation's need for environmental sustainability with national economic priorities such as infrastructure, efficient transportation, flood risk management and clean water. There are opportunities in the Piney Creek Watershed to advance these and other goals through watershed based ecosystem restoration and recreation planning.

Specific Problems

1. Lack of aquatic habitat in the Lower Piney Creek ditch.
    - Entrenchment eliminates shoreline vegetation.
    - Sediment load is too high to provide stable substrate.
    - Channel is 1/3 the length of the historic channel.
    - No pool-riffle complexes.

2. Degraded bottomland forest around the historic Piney Creek meanders.
    - Permanent standing water is killing trees.
    - The historic meanders are not connected to the main channel so fish cannot access them.

3. Upper Piney Creek is a sediment source.

Opportunities

There is an opportunity for Lower Piney Creek to have good habitat and a wider variety of aquatic species where it connects to the Hatchie River and to provide nursery habitat for larger species in the river. Today, it is an alluvial fan and discharges sand into the Hatchie River creating a shoal. In fact, this is one of the shallowest spots in the Hatchie and in summer is only passable in an airboat.

The forested area along Piney Creek is contiguous with the Hatchie Bottoms which is the largest continuous forest in Western Tennessee. There is an opportunity to restore the forest that is stagnated in an early successional phase with box elder, and sycamore; some areas of cypress; and some area of dead and dying timber.

Specific Opportunities

1. To restore aquatic habitat in Lower Piney Creek.
    - Reestablish pool-riffle complexes.
    - Recreate meanders.
    - Reduce entrenchment to allow rooted aquatic plants.
    - Regain channel length.

2. To restore natural channel functions to enhance floodplain habitat and bottomland hardwoods.
    - Restore a flowing channel and reduce standing water that kills trees.

3. To reduce sedimentation from headcutting in gullies.
    - To facilitate a natural, resilient, meandering system with gentler slope.
    - To reduce sand input to the Hatchie River to reduce shoaling.

Planning Goal and Objectives

The goal of ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Restored ecosystems should mimic, as closely as possible, conditions which would occur in the area in the absence of human changes to the landscape and hydrology. Indicators of success would include the presence of a large variety of native plants and animals, the ability of the area to sustain larger numbers of certain indicator species or more biologically desirable species, and the ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention.

Objective 1: Restore sustainable riverine habitat for the benefit of native fishes and mussels in Piney Creek. The Slough Darter Habitat Suitability Index will be used to calculate habitat units to measure this objective.

Objective 2: Enhance shoreline and transitional habitat for the benefit of native species. The Bullfrog Habitat Suitability Index will be used to calculate habitat units to measure this objective.

Objective 3: Restore sustainable habitat for species that use bottomland habitats in the Piney Creek watershed. The Mink Habitat Suitability Index will be used to calculate habitat units to measure this objective.

The HSI models and the reasons for selecting these specific ones are addressed in Section III of this report.

Planning Constraints

There are no known planning constraints.

The area is in the potential range for listed Indiana and northern long-eared bats. There may be limitations on the construction season and tree clearing in the implementation phase, but these limits will not impact plan formulation.

III. INVENTORY AND FORECAST CONDITIONS

Existing Conditions [Affected Environment]

Piney Creek is a tributary of the Hatchie River and is within the Mississippi Valley Loess Plains ecoregion. Stream beds in West Tennessee consist of sands and silts with sporadic clay lenses. Channel erosion is very common especially in areas with man-induced changes. Streams in this region are typically low gradient and turbid with sand/silt bottoms and wide floodplains. Piney Creek ranges in width from approximately 5 feet at the upper end of the project area to around 60 feet in the middle section and 20 feet at the downstream end. Approximately 50 years ago, several miles of the downstream end of Piney Creek were bypassed and replaced with a ditch. The ditch filled with sediment and has been replaced with new ditches several times. Piney Creek is a sediment source to the Hatchie River and conditions in the Hatchie downstream from the mouth are degraded. The Lower Piney Creek ditch has little value for habitat. The historic meanders of Piney Creek are cut off and do not provide habitat for fish or other aquatic species. The banks are erodible and do not support a healthy vegetative community on the edges (Figure 1). Stagnant water around the old meanders is killing bottomland hardwoods and reducing the quality of the forested swamp habitat for a variety of native species. Water velocity, depth, and substrate are uniform which is unsuitable for many forms of aquatic life. The water is too shallow for many native species during the drier seasons. Excessive sedimentation and nutrients degrade water quality and cause further habitat losses.

Figure 4 Standing Water around the historic meanders of Piney Creek. Note the lack of mature BLH.

Fish and Wildlife

West Tennessee provides habitat for a wide range of species. The Hatchie River ecosystem encompasses bottomland hardwood forests, canebrakes, swamps, sloughs, rivers and lakes. These habitats support more than 100 species of fish, including 11 species of catfish, and 35 species of mussels. About 250 species of birds use the Hatchie's forests at some point during the seasons. Swainson's and cerulean warblers are some of the rarer birds found in its forests. Among other wildlife found along the Hatchie are river otters, beavers, white-tailed deer, and eastern box turtle. The State of Tennessee lists 9 rare aquatic species that are known to occur in Hardeman County and 6 others that may use aquatic environments. These include fish, amphibians, birds, mollusks, crustaceans, insects, and plants. Piney Creek was sampled in 2016 and 2017 and a total of 36 species of fish were identified. Keck and Etnier (2005) compiled results from historic surveys and that with the recent sampling identify a total of 56 species in Piney Creek. The historic information does not note time of year or equipment used. There is no indication that any species that was once present has been lost. The recent surveys found no non-native species. The only rare species found are the scaly sand and naked sand darters.

The riparian zone is wide and forested with an extensive floodplain. Riparian vegetation along Piney Creek includes birch, box elder, elm, sweet gum, sycamore, locust, pawpaw, tulip poplar, willow, river cane, wild grape, poison ivy, and grasses.

The federally listed long-eared (*Myotis septentrionalis*) and Indiana (*M. sodalis*) bats may occur in the project area.

Figure 5. Fish Species found in Piney Creek - Orangefin Shiner, Piebald Madtom, Harlequin Darter and Longear Sunfish. (Photos from University of Florida Museum, Tennessee Aquarium, Lower Mississippi Conservation Committee)

There are 11 species of darter known to occur in the project area. Slough darters (*Etheostoma gracile*) were not found in the most recent surveys, but have been found previously. Slough darters range from Alabama to Texas, as far north as central Illinois and as far west as Kansas. They are typically found in pools and oxbows of lowland streams. They prefer warm, turbid waters with little or no flow and mud or silt substrates. The Slough Darter model was used to assess existing habitat conditions in the main channel of Piney Creek and predict future conditions both with and without a project. Similar models for freshwater mussels are not available, but mussels are dependent on fish for part of their life cycle so this model also represents conditions for mussels.

There is approximately 4,500 feet of habitat in Lower Piney Creek. The slough darter habitat model analyzes habitat quality based on the water quality (dissolved oxygen, turbidity, pH and temperature), substrate, slope, pools, and velocity. Piney Creek scores well for pH, temperature, slope and velocity but it lacks pools and there are areas with poor dissolved oxygen in the summer. The existing habitat has an average Habitat Suitability Index (HSI) of 0.56 and 1.16 average annual habitat units (AAHU). See Appendix A.

The bullfrog (*Rana catesbeiana*) occurs in the project area. It is a large, aquatic frog that commonly inhabits permanent bodies of standing or slow-moving water. Conant (1975) states that the natural range of the bullfrog extends from Nova Scotia to central Florida, west to Wisconsin and across the Great Plains to the Rocky Mountains. Bullfrogs are usually found on or near shorelines, but move a number of meters into the water when water temperature is higher than air temperature in the fall (Willis et al. 1956). Males move away from the shore in spring and summer for mating choruses (Howard 1978). The bullfrog model was used to assess the edge and riparian habitat along Piney Creek and predict future conditions with and without project.

There is approximately 4,500 feet of habitat in the lower end of Piney Creek. The bullfrog habitat model analyzes habitat quality based on vegetative cover, water level, turbidity, temperature, substrate, and velocity. Piney Creek scores well for pH, temperature, and velocity but it lacks in channel cover and connectivity to shoreline cover. The existing habitat has an average Habitat Suitability Index (HSI) of 0.80 and 25.36 average annual habitat units (AAHU). Appendix A.

Figure 6 Bullfrog (Photo Courtesy US Fish and Wildlife Service)

Mink (*Mustela vison*) occurs in the project area. The mink is a predatory, semiaquatic mammal that is generally associated with stream and river banks, lake shores, fresh and saltwater marshes, and

marine shore habitats (Gerell 1970). Mink are chiefly nocturnal and remain active throughout the year (Marshall 1936); Gerell 1969; Burgess 1978). Natural stream channels, when compared to ditched or channelized stream segments, typically are more diverse and provide higher quality and more habitat for aquatic invertebrate, fish and amphibian species. Natural channels generally support a wider variety and greater abundance of aquatic species which serve as prey/forage for mink. In addition to generally providing less prey/forage of mink, stream ditching or channelization reduces the amount of habitat available by reducing the length of the stream.

There is approximately 4,500 feet of habitat in the lower end of Piney Creek. The mink habitat model analyzes habitat quality based on vegetative cover, permanence of water and naturalness of the channel. Piney Creek scores poorly on most of these indices. The existing habitat has an average Habitat Suitability Index (HSI) of 0.36 and 37.188 average annual habitat units (AAHU). See Appendix A.

Figure 7 Mink (Photo Courtesy US Fish and Wildlife Service).

Piney Creek is on the state 303(d) list for habitat alteration/channelization. Water chemistry was measured in June 2017. Dissolved oxygen ranged from 5.87 to 7.35 ppm, pH from 7.31 to 7.78, and temperature from 74.3 to 77.7 degrees Fahrenheit.

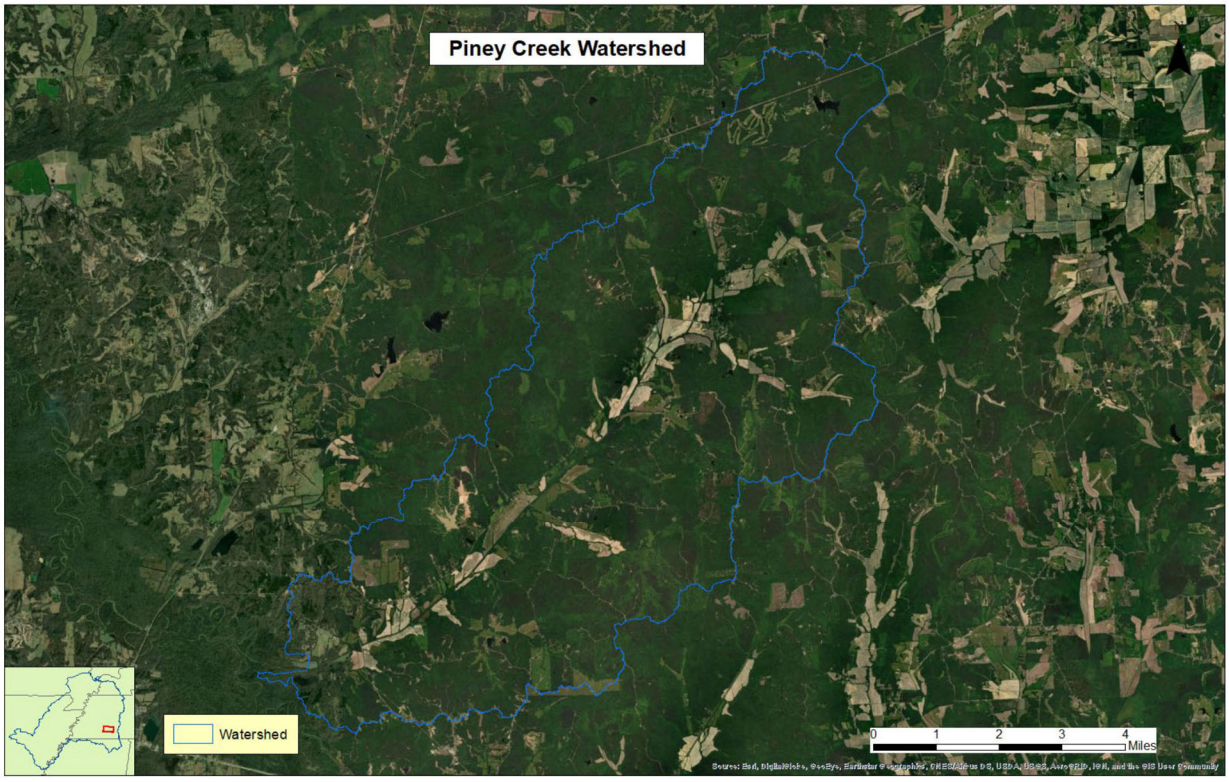

Figure 8 Piney Creek Watershed

Land Use and Infrastructure

Most of the watershed is forested, but there are areas of pasture in the valley bottoms (see Figure 4). Chickasaw State Park overlies the northwest portion of the watershed. There is no USDA classified prime farmland. Three bridges cross the main stem of Piney Creek in the study area and there are small culverts on the ditches and tributaries. The bridges are in good condition but there is some minor scouring around three of them. The scouring does not threaten the integrity of the bridges. Some of the culverts on the small tributaries and ditches have sediment blockages and are intermittent barriers to fish passage. These areas are small and do not provide significant habitat.

Socioeconomic Considerations

Hardeman County has approximately 25,000 residents. Bolivar is the largest town in the county and has approximately 5,000 residents. The population is declining slowly. According to 2014 U.S. Census Bureau estimates, 55% of the residents are White and 42% are African-American. The main project area is approximately 2.5 miles from Bolivar.

The Hatchie River is popular for recreation, especially fishing and paddling. Piney Creek supports some fishing, mostly near bridges. Deer, turkey and duck hunting are popular in the Piney/Hatchie watershed.

Chickasaw State Park is situated on some of the highest terrain in west Tennessee. Of the park's 14,384 acres of timberland, 1,280 acres are used for recreation. Chickasaw State Park offers more

than 4 miles of easy to moderate hiking trails and bicycle-friendly roads. Rowboats and pedal boats are available for rent on Lake Placid. The park has 13 historic WPA cabins. The park is also home to one of the few wrangler campgrounds in Tennessee, designed for visitors with horses.

Future Without Project Conditions

Lower Piney Creek will continue to degrade over time and carry large sediment loads to the Hatchie River. The rate of decline in Lower Piney Creek is slow and no major, detectable changes are likely. The Middle Piney Creek channel is stable and able to transport its sediment load. Therefore, sediment form Upper Piney Creek moves through this without significant deposition here. There is active erosion in the small tributary ditches of Upper Piney that will continue without a project. These eroding channels do not provide significant habitat, but will continue to be a significant sediment source to Piney Creek. There are no plans for any major development projects in the Piney Creek watershed.

Fish and Wildlife

The bottomland hardwood forest will continue a slow decline in quality, but in general the future conditions are not expected to change greatly from the existing. The more flood tolerant species will slowly become more dominant. The habitat suitability indices for slough darter and mink are not forecasted to change. The habitat suitability for bullfrog is forecasted to decline from 0.80 to 0.75 as the channel entrenches further, separating the vegetated shoreline from the water's edge. Habitat units would decline from 25.36 to 23.78.

Land Use and Infrastructure

No changes to land use or infrastructure are anticipated in the reasonably foreseeable future. The minor issues around bridges and culverts will continue, but none are expected to become significant.

Socioeconomic Considerations

The population around the project area is stable to slightly declining. There are no initiatives or known plans that would alter this trend. The average age of the population in the area is likely to increase, but no other changes are anticipated.

Outdoor recreation like hiking, biking, paddling and visiting State Parks is increasing in Tennessee, while fishing remains stable, and hunting is decreasing. The Hatchie watershed and floodplain will likely see some increases in public recreation and remain stable for fishing and hunting because it is a destination. The sandy shoal at the mouth of Piney Creek is an obstacle for boaters, especially at low water, and could be hazardous if boaters approach it at high speed. Aluminum fishing boats with trolling motors and canoes are the most common vessels.

IV. FORMULATE ALTERNATIVE PLANS

Management Measures

Measure 1. Meander Restoration in Lower Piney Creek

Restore a meandering channel in the lower portion of Piney Creek using one of the methods described below. The lower end of Piney Creek was channelized and is now full of sediment and does not have a well-defined channel.

a. Clear forested vegetation and excavate a full-sized channel. This option was screened because it will be expensive, require extensive tree clearing and will take a longer period to restore vegetation and gain the habitat benefits.

b. Use explosives to create a pilot channel. This method would be inexpensive, however it is harder to control and could result in damage to existing vegetation. The soils in the area are somewhat unconsolidated and do not lend themselves to this approach. This option was also screened out.

c. Use an amphibious trackhoe to establish a pilot channel. This option is less expensive than a fully excavated channel. The soils in the area are appropriate for this approach. This will avoid damage to most existing trees and accelerate recovery and accumulation of project benefits.

Measure 2. Grade Control

Channelization has caused some stream instability with eroding banks. The high bedload is contributing to shoaling in the Hatchie River. Grade control weirs are a proven method to reduce instream scour and sedimentation. Weirs reduce stream slope and flow velocity and stabilize the banks and bed of the channel. They prevent and arrest head cut formation and channel bed erosion (Abt et al. 1992, Bormann & Julien 1991, Shields et al. 1998, Simon & Darby 2002).

Measure 3. Tree Planting

Replanting high quality bottomland hardwoods along the stream channel would increase the quality of the forested habitat.

Measure 4. Meander Restoration in Middle Piney Creek

This measure would remeander an additional area of Piney Creek. It would excavate a new channel as far upstream as Silerton. Only a fully excavated channel would be considered because the area is more developed and has homes, roads and bridges. The channel could not be allowed to adjust on its own.

Screening of Measures

Measures were screened based on their contribution to achieving the objectives, and the probability of being a key part of a complete, sustainable plan. Relative cost of measures was also considered.

Measure 1 c. is retained. Reestablishing a meandering channel will increase aquatic habitat quantity and quality. The pilot channel approach would be the lowest impact, most cost effective method.

Measure 2 is retained. The areas that are most actively eroding are along the tributary ditches. These areas do not have much potential for habitat improvement because they are small and not connected, but reducing sedimentation is necessary for the success of meander restoration. Grade control will be considered in combination with meander restoration.

Measure 3 is retained. Replanting high quality bottomland hardwoods without resolving the issues with standing water will not provide benefits as the trees are not likely to survive. Tree planting in addition to meander restoration will help the area recover faster.

Measure 4 is screened out. Middle Piney Creek does lack meanders and good pool-riffle complexes, but it is stable. The forests in the area are more upland types rather than bottomland hardwoods. The area is outside the Hatchie bottomlands. The riparian corridor is intact and the trees and other vegetation are healthy. Remeandering would require replacement of four bridges, realigning roads, and possibly relocating homes and other structures. The construction and real estate costs would be high. There would be some moderate in channel benefits, but not enough to justify the costs. Local residents and agencies would be unlikely to support the project. Remeandering this section is not necessary to improve conditions in the Hatchie.

Formulation Strategy

Table 1 shows all of the measures and possible combinations. It includes Measure 1 a., but that measure will only be considered as part of an alternative for the cost effectiveness analysis.

Geomorphic changes are the root of habitat degradation in Piney Creek. Alternatives must include measures that address the primary geomorphic issue - channelization. Other measures are considered to increase the effectiveness of the plan.

Each of the single measure Alternatives was considered. Three of the possible combinations were not considered in depth because they did not address the primary issue or they left out significant benefits.

Table 1. Measures and Alternatives Matrix

	Measure 1 C – Meander Restoration	**Measure 1 A – Full Excavation**	**Measure 2 – Grade Control**	**Measure 3 – Tree Planting**	
	High Direct Benefits, Medium Cost	Same Benefits as Measure 1, higher cost	High Cost, few Direct Benefits	Low Cost, Good Benefits	
No Action					Retained
Unnamed Alt	X		X		Dropped - tree planting is low cost and should be included
Unnamed Alt	X			X	Dropped – Meander Restoration without sediment control is not sustainable
Unnamed Alt			X	X	Dropped – Meander Restoration provides the highest benefits
Alternative W	X				Screened – Sediment Source must be addressed
Alternative X		X	X	X	Screened – Used for Cost Effectiveness/Incremental Cost Analysis (CE/ICA)
Alternative Y				X	Screened – Does not address cause of forest loss
Alternative Z			X		Screened - Grade Control is expensive and provides few direct benefits in Piney Creek
Alternative 2	X		X	X	Retained – Addresses primary issues, provides sustainability and maximizes benefits

Final Array of Alternative Plans

Alternative 1. No Action

USACE would not construct an ecosystem restoration project in the Piney Creek watershed. The Hatchie River is a high priority ecosystem for The Nature Conservancy and others. U.S. Geological Survey (USGS) and universities would continue research in the area, but none of them have the means to effect a restoration project.

Alternative 2. Meander Restoration with Grade Control and Tree Planting

This alternative would replace the lower 4,500 feet of Piney Creek with 13,725 feet of meandering channel. Grade control weirs would be installed upstream to reduce the volume of sediment in the meandering channel and trees would be planted in areas along the channel that do not have live, high quality bottomland hardwoods. Section VII Tentatively Selected Plan describes the Alternative in detail.

Alternatives Eliminated from Detailed Analysis

Alternative W. Meander Restoration Only

Restoring the meanders in the lower end of Piney Creek would provide some short term, localized benefits. However, if the sources of the sediment in the system are not addressed, the newly meandering section would clog with sediment and create a valley plug or new shoal.

Alternative X. Fully Excavated Meandering Channel with Grade Control and Tree Planting

Measure 1 a. above was screened out because it is comparatively more expensive than 1c. and does not achieve more benefits. A rough cost was calculated for this and it will appear in the Cost Effectiveness/Incremental Cost Analysis (CE/ICA) later for comparison, but this alternative was not considered in detail.

Alternative Y. Tree Planting Only

The endemic species are stressed and dying because water is not effectively moving through the channels and the trees are inundated too often for too long. More flood tolerant species could be introduced, but this would not restore the native forest. The hydraulic and geomorphic conditions must be addressed to allow replanting of locally native species.

Alternative Z. Grade Control Only

Grade control is primarily needed in the small tributary channels. Such grade control may provide some localized benefits, but would not be sufficient to restore a significant ecosystem.

V. EVALUATE ALTERNATIVE PLANS

Alternative 1. The impacts of this alternative are described in the Future Without Project Conditions Section.

Alternative 2. Section VII Tentatively Selected Plan describes the Alternative in detail.

Piney Creek would return to more natural geomorphic and hydraulic conditions. Erosion and headcutting in the upper reaches would be reduced and less sediment would be delivered downstream. The new meandering channel would be longer, connected to its floodplain, and better able to manage sediment. Less sediment would be delivered to the Hatchie River, and over time the shoal near the existing mouth of Piney Creek would dissipate. Grade control structures would improve local conditions in the small tributaries and remove barriers to fish movement. The bottomland hardwood forest quality would improve and newly planted trees would supplement the remaining ones to ensure the forest regains a diverse mix of species.

Fish and Wildlife

The project would increase the length of Lower Piney Creek from approximately 4,500 feet to 13,725 feet. The slough darter HSI would improve to 0.78 for a total gain of average annual habitat units of 3.75. The habitat improvement would come from improved dissolved oxygen (less stagnant water) and more pools. Other elements of fish and mussel habitat would also improve, such as canopy cover, allochthonous inputs and more stable substrates.

The increase in the length of the channel would increase edge habitats which are valuable for bullfrogs. Bullfrog habitat quality (HSI) would increase from 0.80 to 0.87 and acres from 32 to 94.5 for a gain of 58.44 AAHUs. The gain in habitat quality stems from increased canopy cover, distance to the shoreline, and shoreline cover. Mink habitat would also increase in quantity and quality. It will increase from 103 to 315 acres and the HSI will improve to 0.85 for a gain of 230.56 AAHUs. See Appendix A.

The project would ameliorate the conditions that contribute to Piney Creek's inclusion on the State 303(d) list for sedimentation and channel alteration. Removing the stream from the 303(d) list is not an objective of this project, and the process for assessing it is outside the scope of this analysis.

Land Use and Infrastructure

This alternative would not change land use in the watershed. Grade control structures are planned downstream of three bridges on Piney Creek and this will reduce scouring there, but the scouring is not critical. The grade control structures in Upper Piney Creek will address some of the local fish passage problems and open small pockets of fish habitat.

Socio Economic Considerations

The population around the project area is stable to slightly declining. There are no initiatives or known plans that would alter this trend. The average age of the population in the area is likely to increase, but no other changes are anticipated.

Outdoor recreation like hiking, biking, paddling and visiting State Parks is increasing in Tennessee, while fishing remains stable, and hunting is decreasing. The Hatchie watershed and floodplain will likely see some increases in public recreation and remain stable for fishing and hunting because it is a destination. This alternative would improve forest conditions in the Hatchie Wild and Scenic corridor. The shoal at the mouth of Piney Creek would dissipate over time and be less of a problem for boaters.

VI. COMPARE ALTERNATIVE PLANS

Several different sets of criteria were used to compare the alternative plans**.** The first presented here is from Engineer Regulation (ER) 1105-2-100 Appendix C on Ecosystem Restoration Significance. The second is from the 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The third is the output from the Institute of Water Resources Cost Effectiveness Incremental Cost Analysis Model (CE/ICA). Fourth is the system of accounts also from the P&G. The last table compares other pertinent information for the alternatives.

SIGNIFICANCE OF THE ALTERNATIVES – ER 1105-2-100

USACE Ecosystem Restoration policy acknowledges the challenge of dealing with non-monetized benefits and uses qualitative statements of significance to help decision-makers evaluate whether the value of the resources are worth the costs. "The significance of restoration outputs should be recognized in terms of institutional, public, and/or technical importance. This basically means that someone, some entity, some law/policy/regulation, or scientific evidence indicates that a particular resource is important."

Technical Importance

The Hatchie River is one of the most studied rivers in the region. The References Section lists 38 scientific studies that focused on the Hatchie River and there are many more. Many of the studies focused on the channel also discuss Piney Creek specifically. The Hatchie is unique among lower Mississippi River tributaries and is a valuable site for research.

Scarcity: Bottomland hardwood (BLH) habitat once covered as much as 24.7 million acres throughout the Mississippi Alluvial Valley. This area has experienced an 80% decline over the last 200 years with the most rapid changes occurring within the last 70 years. Channelization has played a major role in this degradation. The Hatchie River is the only undammed, unchannelized Lower Mississippi River tributary, but many of its tributaries, like Piney Creek were channelized. There is standing water around the historic meanders of Piney Creek and BLHs are dying and not recruiting. BLHs provide habitat for amphibians, reptiles, mammals, and birds. Numerous scientific studies have documented population declines to all of these resources as a result of habitat loss (Benz and Collins, 1997). Alternative 1 would have no effect. Alternative 2 would lengthen the lower end of Piney Creek, recreate the lost meanders, reduce standing water in the forest, reattach the stream to its floodplain, and reduce the sediment coming from the upstream areas. This will reduce the amount of sand Piney Creek discharges into the Hatchie.

Status and Trends: Aquatic habitat in Piney Creek and the Hatchie River will continue to degrade unless restoration projects are implemented. Piney Creek is one of only two tributaries creating a shoal in the river and is the largest contributor of sand to the Hatchie. streams are shorter than meandering streams. Soils in the area are too erodible to allow streams to reestablish equilibrium and begin to recover on their own. Riparian vegetation cannot reestablish unless the stream bank reaches equilibrium. Alternative 1 would have no effect. Alternative 2 would restore some of the hydrologic and geomorphic conditions in Piney Creek and stabilize the banks.

Connectivity: The project has the potential to restore connectivity within Piney Creek and its floodplain. Restoring connectivity would provide numerous ecological benefits and interactions between the creek and its floodplain. This restored connection would provide valuable habitat for fish, amphibians, reptiles, mammals, and birds and allow movement and dispersal of species throughout the area. Likewise, establishment of riparian vegetation would provide a connection between isolated patches of forested areas that occur within the floodplain. Rivers, waterways, and riparian forests serve as highly functional habitat corridors, and aquatic ecosystems inherently serve a connective function to other waterways and terrestrial landscapes. Alternative 2 addresses the geomorphic and hydraulic conditions in Lower Piney Creek. The forested areas in the Piney Creek floodplain are part of the Hatchie River floodplain.

Biodiversity: The Hatchie River ecosystem encompasses bottomland hardwood forests, canebrakes, swamps, sloughs, rivers and lakes. These habitats support more than 100 species of fish, including 11 species of catfish, and 35 species of mussels. About 250 species of birds use the Hatchie's forests at some point during the seasons. Swainson's and cerulean warblers are some of the rarer birds found in its forests. Among other wildlife found along the Hatchie are river otters, beavers, white-tailed deer, and eastern box turtle. The State of Tennessee lists 9 rare aquatic species that are known to occur in Hardeman County and 6 others that may use aquatic environments. These include fish, amphibians, birds, mollusks, crustaceans, insects, and plants. At least 56 native species of fish have been found in Piney Creek and even recent surveys found no non-natives.

The federally listed long-eared (*Myotis septentrionalis*) and Indiana (*M. sodalis*) bats may be in the area. Restoration of forested habitats and restoring the Piney Creek channel and BLH forest will ensure long term habitat for bats.

Institutional Importance

Restoration of Piney Creek could further the goals set forth in several federal and state laws, and agency policies. Notable among these are:

Clean Water Act – Piney Creek is on the 303(d) list of impaired waters for habitat alteration. Alternative 1 would have no effect. Alternative 2 would improve hydrologic and geomorphic conditions to address sedimentation and habitat alteration.

EO 11988 – Floodplain Management – This EO states: "Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The Piney Creek watershed is rural and includes pasture and forest with few structures. It does not have any significant flood damages, but Lower Piney Creek is entrenched and does not have a functional floodplain. Standing water that does not connect to the stream is impairing the quality of the bottomland hardwood forest. Alternative 1 would not change the floodplain. Alternative 2 would reconnect Piney Creek to a functioning floodplain.

TN Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 – It is the policy of this state to manage certain nongame wildlife to insure their perpetuation as part of ecosystems, for scientific purposes, and for human enjoyment. Species or subspecies of wildlife indigenous to this state which may be found to be endangered or threatened within the state should be accorded protection in order to maintain and, to the extent possible, enhance populations. Alternative 2 would improve habitat for scaly and naked sand darters and several other rare species.

Public Importance

The Hatchie River is the only undammed and unchannelized tributary to the Lower Mississippi River. The Hatchie River contains the largest forested floodplain in Tennessee. Within the Hatchie watershed, there are two National Wildlife Refuges (Hatchie National Wildlife Refuge and Lower Hatchie National Wildlife Refuge) and two State Parks (Big Hill Pond and Chickasaw). The Hatchie, including the lower end of Piney Creek, is a Class 1 Scenic River under the Tennessee Wild and Scenic Rivers Act. Steamboats plied the Hatchie until the early 20th century and the historic head of navigation was at Bolivar, TN near the mouth of Piney Creek.

The non-federal sponsor which is the State of Tennessee, through the West Tennessee River Basin Authority (WTRBA), supports Alternative 2. Other agency views will be documented during the review process.

The Hatchie River is a popular destination for outdoor activities and is often featured in internet videos and news articles that cover a range of topics from catfishing to environmental quality, canoeing, bridge design, birding, hunting and even videos about the Bigfoot of the Hatchie.

The Southeast Aquatic Resources Partnership was established to protect, conserve, and restore aquatic resources and habitats throughout the Southeast, for the continuing benefit, use, and enjoyment of the American people. Alternative 2 would improve aquatic habitat.

Table 2. Comparison of Significance of Alternatives.

Significance Criteria	Alternative 1, No Action	Alternative 2
Technical		
Scarcity	**0**	+
Status and Trends	**0**	+
Connectivity	**0**	++
Biodiversity	**0**	+
Institutional		
Clean Water Act	**0**	++
EO 11988	**0**	+
TN Non Game	**0**	++
Public		
Public Interest	**0**	++
Agency support	**0**	++
SARP	**0**	++

0=no change; -= negative impact; += generally positive impact; ++= specifically positive impact

P & G CRITERIA

Table 3. Comparison of Alternatives using the P&G Criteria

Criteria	Alternative 1	Alternative 2
Completeness	This alternative provides no benefits.	This alternative is complete. The plan does not depend on any other actions to address the source of sediment in Upper Piney and the altered geomorphic and hydraulic conditions in Lower Piney Creek.
Effectiveness	This alternative will not alleviate any problems or achieve any opportunities.	This alternative addresses the problems in the project area. It addresses the source of sediment in Upper Piney and the altered geomorphic and hydraulic conditions in Lower Piney Creek.
Efficiency	Although this alternative has no cost, habitat conditions will decline. It is not efficient.	This plan is the most efficient and costs $1,800 per average annual habitat unit.
Acceptability	There are no obstacles to implementing this plan, but it provides no solution to the identified problems.	This alternative is implementable and will address the identified problems. The plan is compatible with the priorities of state and federal agencies and non-governmental organizations.

CE/ICA RESULTS

For environmental planning, where traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units, two analytical methods are used to assist Corps planners in the decision process. First, cost effectiveness (CE) analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. Subsequent incremental cost analysis (ICA) of the cost effective solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analysis are valuable tools to assist in decision making.

It is important to keep in mind that the most useful information developed by these two methods is what it tells decision makers about the relative relationships among solutions – that one will likely produce greater output than another, or one is likely to be more costly than another – rather than the specific numbers that are calculated. Furthermore, these analyses will usually not lead, and are not intended to lead, to a single best solution (as in economic cost-benefit analysis); however, they will improve the quality of decision making by ensuring that a rational, supportable approach is used in considering and selecting alternative methods to produce environmental outputs.

To perform the CE/ICA, use was made of the IWR Planning Suite Decision Support Software developed by the US Army Corps of Engineers Institute for Water Resources (IWR). IWR Planning Suite has been developed to assist with plan comparison by conducting cost effectiveness and incremental cost analyses, identifying the plans which are the best financial investments ("Best Buys"), and displaying the effects of each on a range of decision variables. The software is available via the IWR Planning Suite Internet. The latest version (2.0.9.1) has been certified for use by USACE Headquarters, meaning that it has been reviewed and certified by the appropriate Planning Center of Expertise (PCX) and represents a corporate approval that the model is sound and functional.

Cost Effective Solutions (CE)

In cost effectiveness analysis, it is necessary to filter out plans that produce the same output level as another plan, but cost more; or cost the same amount or more than another plan, but produce less output. This CE analysis was performed by the IWR planning model.

Table 4 displays the expected environmental outputs in terms of average annual habitat units along with the total cost and average annual cost for each of the restoration alternatives and no action plans. In this instance only Alt 2 is cost effective.

Cost Effective and Incrementally Justified (Best Buy Plans)

The final step in the analysis is to determine which subset of the cost effective solutions is also incrementally justified. These solutions, also known as Best Buy Plans or Best Buy Alternatives, are those plans that provide increases in benefits at the lowest average cost (per habitat unit). The IWR Planning model was run to make the necessary calculations producing the results shown in Table 5. In this case, Alt 2 is the Best Buy Plan.

Included in Table 5 are the incremental costs per habitat unit for the Best Buy Plan. Incremental cost is calculated by dividing the difference between the solution's costs by the difference between the solution's outputs. Reviewing this table with the incremental cost information now allows the decision maker to make the following comparisons of alternative restoration plans and to progressively ask "Is it worth it?"

As noted previously, neither cost effectiveness analysis nor incremental cost analysis will tell the decision maker what choice to make. However, the information developed by both analyses will help the decision maker make a more-informed decision and, once a decision is made, better understand its consequences in relation to other choices. Figure 9 shows the full range of solutions and highlights the non-cost effective solutions and the incrementally justified (Best Buy) solution.

Table 4 Summary of Outputs (AAHUs) and Costs

Name of Alternative	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Cost Effective
Alt 1 (No Action)	$0	$0	$0	0	-
Alt 2	$13,913,170	$ 423,778	$533,081	293	**Yes**
Alt X	$16,210,237	$ 493,743	$620,758	293	No

Note: Costs are shown at the 2020 price level and were annualized using the current FY20 Federal discount rate of 2.75 percent over a 50-year period of analysis.
Annual O&M costs are $2,000 for the 50-year period of analysis.
Costs include Study Cost

Table 5 Cost per Average Annual Habitat Unit

Name of Alternative	First Cost	Interest During Construction	Average Annual Cost	AAHUs	Average Annual Cost per Habitat Unit	Incremental Cost (per AAHU)
No Action	$0	$0	$0	0	$ 0	$ 0
Alt 2	$13,913,170	$423,778	$533,081	293	$1,821	$1,821

Note: Costs are shown at the 2020 price level and were annualized using the current FY20 Federal discount rate of 2.75 percent over a 50-year period of analysis.
Annual O&M costs are $2,000 for the 50-year period of analysis.

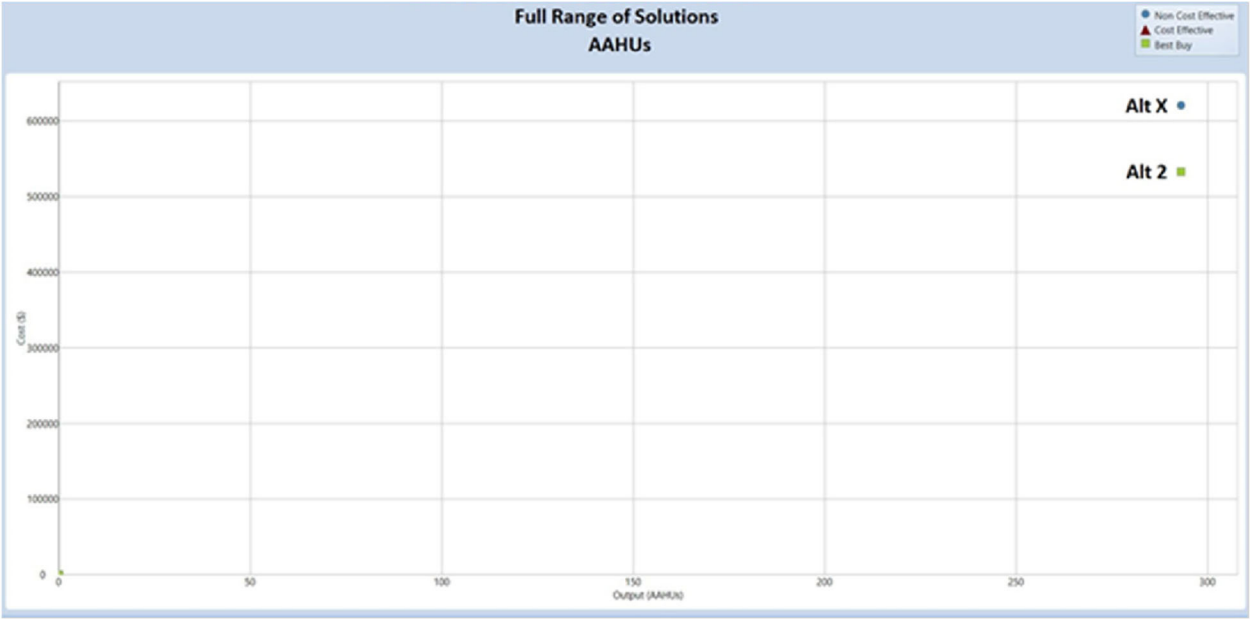

Figure 9. Results of CE/ICA Analysis

SYSTEM OF ACCOUNTS

The National Economic Development (NED) account displays changes in the economic value of national output of goods and services. The Environmental Quality (EQ) account displays nonmonetary effects on significant natural and cultural resources. The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity. The Other Social Effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

Table 6. System of Accounts Comparison

Account	Alternative 1, No Action	Alternative 2
NED	No Impact.	No Impact
EQ	This alternative would not alleviate any problems or achieve any opportunities.	This alternative would restore 2.4 miles of meandering habitat in Piney Creek within the Hatchie River Wild and Scenic Corridor. It would reduce sedimentation to the Hatchie River and improve the bottomland hardwood forest.
RED	No impact.	There would be some temporary RED benefits from the ($10 mil) construction activity. The rock for the structures will be sourced from Missouri or Alabama, but the wages, fuel purchases, equipment rental and other incidentals would likely be purchased locally.
OSE	There would be no improvement in the appearance of Piney Creek or the Hatchie River. There would be no construction noise. There would be no disruption of community activities, travel or cohesion.	The structures near bridges may be visible from roadways, but all of these areas already have riprap around them. Other structures would only be visible from private land and are not clustered. The health of the riparian forest would improve. Overall aesthetics would improve. There would be some construction noise, but it would be temporary and only during daylight hours. There would be no disruption of community activities, travel or cohesion. The project over time will allow the shoal in the Hatchie River to dissipate and improve boating conditions in that area.

VII. Tentatively Selected Plan

Alternative 2 is a Best Buy and is the most efficient alternative. It is the National Ecosystem Restoration (NER) plan and the Tentatively Selected Plan.

The plan would excavate an approximate 2.6-mile natural channel to replace the 0.85-mile of canal. The canal replacement will provide approximately 1.5 feet of vertical control. Combined with the upstream structures, the channel meander will restore historical conditions, improve habitat, and reduce sediment loads to the Hatchie. Most of the historic channel remains and will only need blockages removed rather than full excavation of the entire length. An amphibious trackhoe will remove the blockages and create a pilot channel, at least 20 feet wide. The pilot channel alignment shown is based on LiDAR and aerial photography. The exact locations of blockages will be ground-truthed. The channel excavation will avoid damaging healthy trees to the extent practicable. Excavated material will be used on the inside bends of the new channel to help direct the meanders. The upstream end of the channel will require more excavation than the rest and the material will be used to block the upstream end of the existing canal. The canal will be left open at the downstream end and Hatchie River backwater will fill it much of the year. Trees will be planted in areas along the channel where the existing tree cover is thin. Over time the channel will widen and reestablish a more natural morphology.

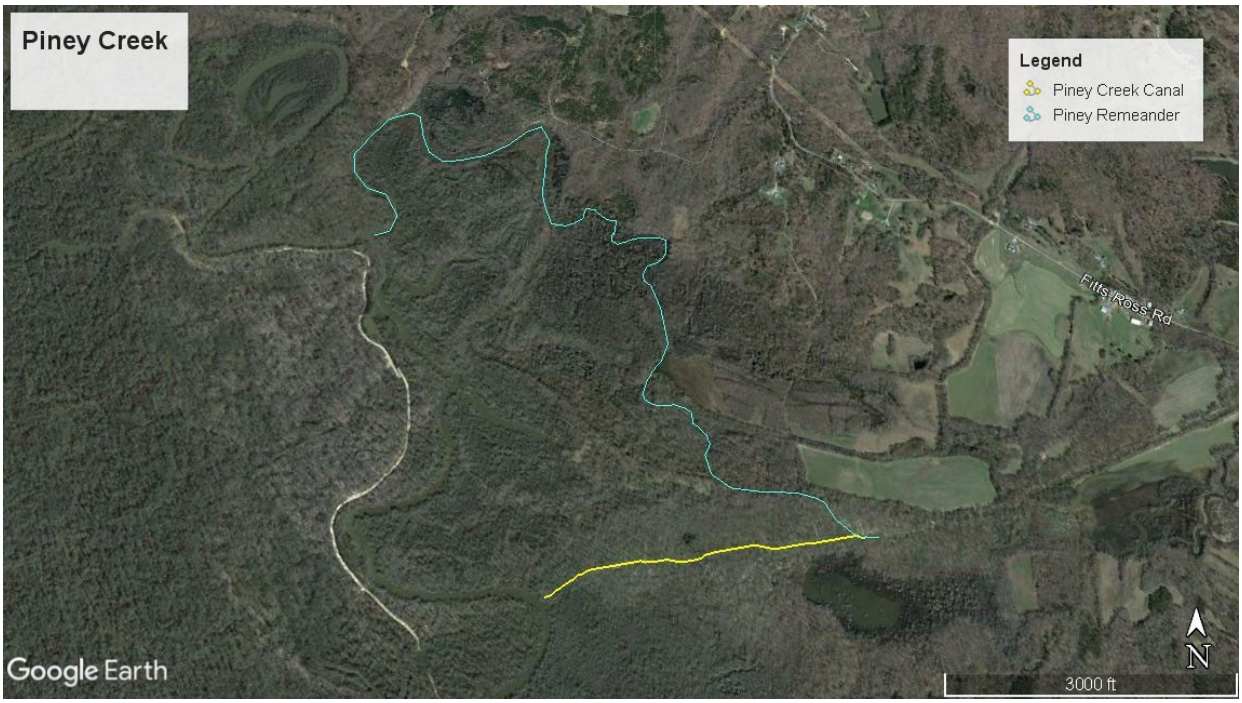

Figure 10 Piney Creek Remeander.

The Hydraulics and Hydrology analysis (Appendix C) determined that grade control would be necessary in Piney Creek to reduce sedimentation and establish an equilibrium slope. The plan includes a total of 14 grade control structures. Three different types of grade control structures are proposed for Piney Creek and are described below.

Figure 11. Fish Passage Structure in Upper Piney Creek.

The five proposed structures designated in Figure 14 as "Fish Passage" will be designed to control gully erosion and sediment movement in the smallest channels. The proposed design for the structures provides for several vertical feet of control while still allowing upstream and downstream fish movement. The West Tennessee River Basin Authority has already constructed one structure of this type in the system (not counted among the five here). Prior to installation of that structure, the existing channel was several feet below the root line of bank trees. The gully was moving laterally undercutting drainages to the channel. Since installation, the channel upstream has regained several feet of sediment through a reach of several hundred feet. The restored slope mirrors that of the calculated stable slope. See Appendix C.

The three proposed rock chutes are planned for larger tributaries to Piney Creek where erosion and channel incising have been identified. They will stabilize eroded banks, control sediment movement, and elevate the existing channel elevation to historical elevations. The design is based on the channel width and length of erosion at the proposed locations. Vertical control is based on the calculated stable slope. The structures will protect the Piney Creek watershed from head cutting up the tributaries, and provide permanent sediment control of eroding and incising channels.

Figure 12. Rock Chute structure on a similar stream in West Tennessee.

Six low drop grade control structures are proposed for the main stem of Piney Creek. The USACE Vicksburg District has researched, designed, and installed low drop grade control structures throughout their District boundaries. These structures are necessary to establish equilibrium slope in Piney Creek above the remeandered section to ensure Piney Creek is stable and the longer, meandering channel does not become plugged with sediment.

Name	River Mileage	Proposed Low Elevation	Proposed High Elevation	Structure Height (feet)	Cumulative Grade Control (feet)
Hatchie River	0	339.75	339.75		
Low Drop - 1	1.56	345.35	347.35	2.00	2.00
Low Drop - 2	2.38	350.36	352.36	2.00	4.00
Low Drop - 3	4.1	359.15	361.65	2.50	6.50
Low Drop - 4	5.31	366.94	370.44	3.50	10.00
Low Drop - 5	7.32	380.51	384.01	3.50	13.50
Low Drop - 6	8.9	392.78	396.28	3.50	17.00

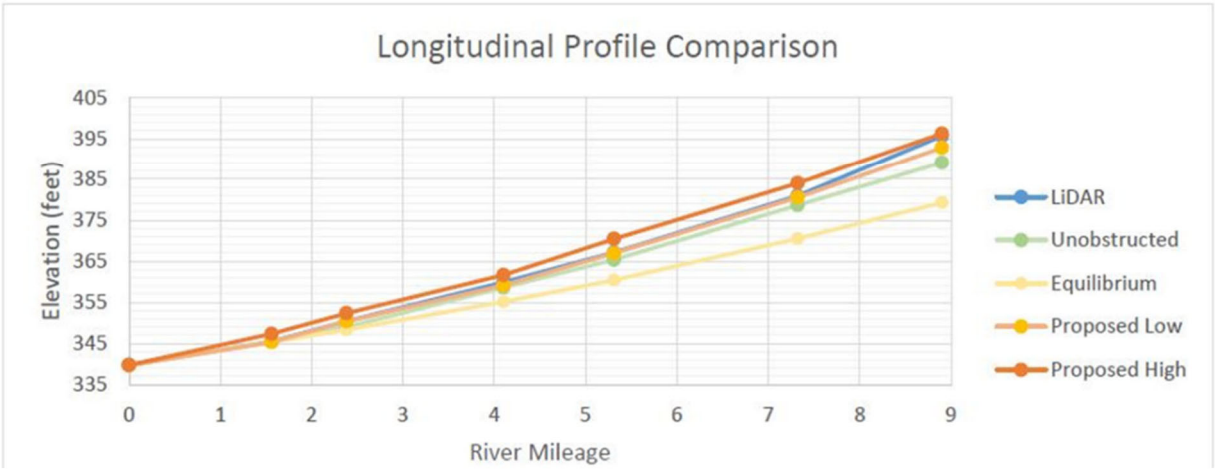

Figure 13. Determination of Size and Location of Grade Control Weirs

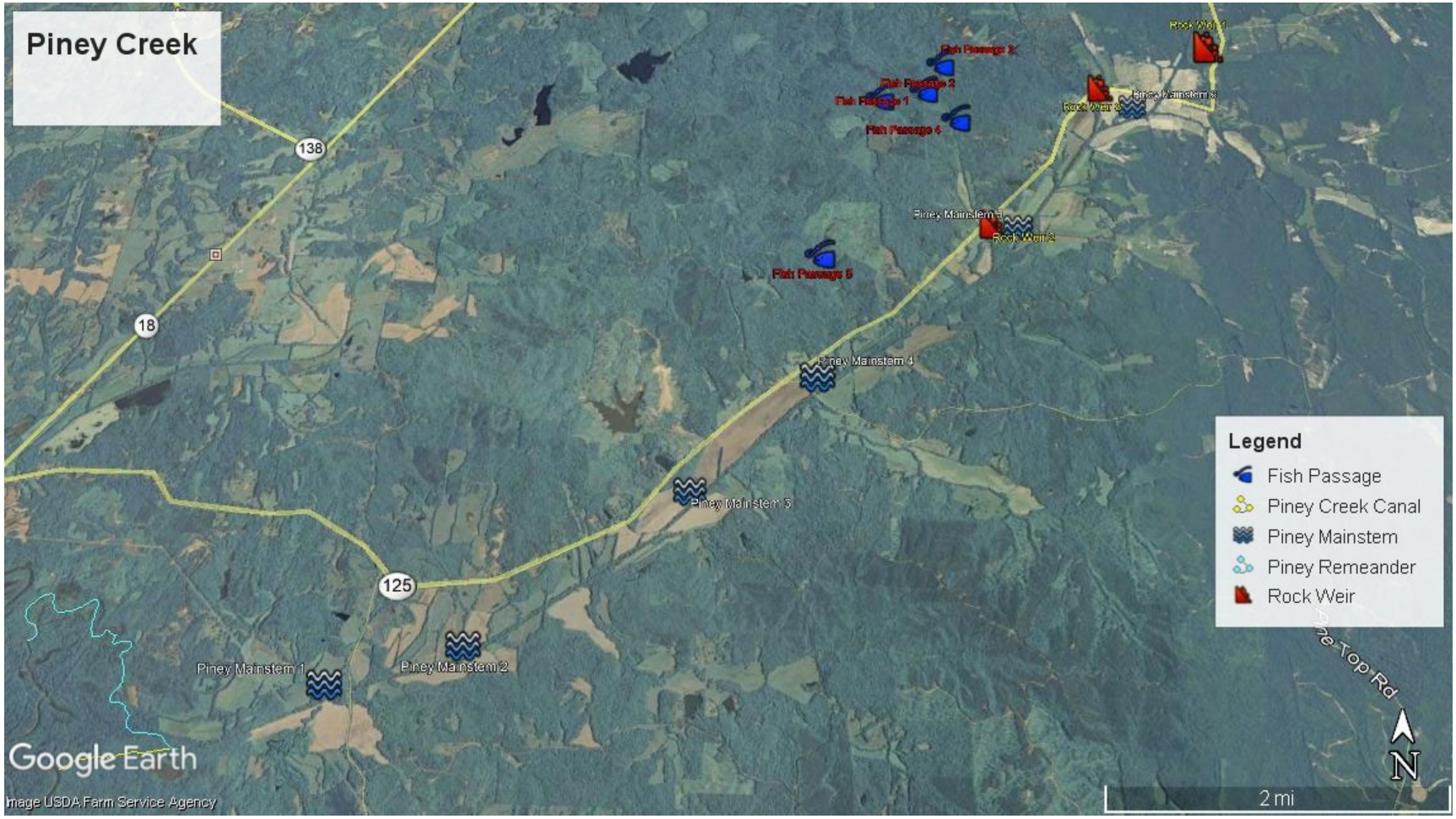

Figure 14 Tentatively Selected Plan

National Significance of the Project

Piney Creek is a major tributary of the Hatchie River and is the largest single source of sediment. Restoration of Piney Creek will enhance the channel and floodplain of the Hatchie River. Channelization was a common practice throughout the Lower Mississippi River Valley and the Hatchie River is the only undammed, unchannelized tributary of the Lower Mississippi. Channelization is a leading cause of loss of biodiversity in aquatic systems. This project would improve the hydrologic function and geomorphic character of Piney Creek and contribute to preservation and restoration of biodiversity in the watershed. Bottomland hardwoods are a nationally significant habitat type, and over 80% of the historic bottomland hardwood forest has been lost in the Mississippi River Alluvial Valley. This project would enhance the bottomland hardwood forest on Piney Creek, especially those within the Hatchie River Wild and Scenic River Corridor. The federally listed long-eared (*Myotis septentrionalis*) and Indiana (*M. sodalis*) bats may occur in the project area. Improved forest conditions will enhance summer roosting and foraging habitat for these species. The ecosystem provides habitat for more than 100 species of fish including 11 species of catfish; 50 species of mammals; 35 species of mussels; 250 species of birds including migrating birds; along with many reptiles, amphibians and invertebrates.

Implementation Plan

Real Estate

Piney Creek flows through pasture land and forests. The grade control will be constructed within the banks of the Creek. The waterbottoms are privately owned and real estate interests will need to be acquired. Real estate will be acquired from fewer than 20 landowners for the weirs and channel. The fee estate will be acquired for the project features and a temporary work area easement will be acquired for construction and access areas. The plan identifies construction areas, staging areas or access over private lands, and estimates the cost. The non-Federal Sponsor, West Tennessee River Basin Authority, has responsibility to acquire all lands, easements and rights of ways necessary for the project. Appendix E contains a full description of real estate issues in the Real Estate Plan.

Design

The pilot channel alignment is based on LiDAR and aerial photography. The exact location will be ground-truthed and will account for micro-topography and forest conditions. Excavated material will be used on the inside bends of the new channel to help direct the meanders. The larger weirs follow the designs from the Vicksburg District USACE Process for the Design of Low Drop Grade Control Structures (08816 MVK). The need for each of the structures will be reexamined during the Plans and Specifications phase. The rock chutes are also a standard design. The West Tennessee River Basin Authority has pioneered the design of the small "fish passage" structures and the design will follow their standard. Appendix C contains details of the design parameters for each.

Construction Method

An amphibious trackhoe will be used to dig a meandering pilot channel. Material will be placed on the inside bends. The weirs will be built using track hoes from one side of the stream. More detail regarding access and construction methods will be developed during the preparation of plans and specifications for the project.

Funding And Construction Schedule

A detailed funding and construction schedule cannot be developed until Congress appropriates money for the CAP 206 program and USACE allocates the money to this project. Below is a generic schedule which will be further refined after detailed plans and specifications are developed.

- Receive funding.
- Negotiate the Project Partnership Agreement – Duration 100 days.
- Prepare for surveying and initiate field work – Duration 45 days.
- Develop plans and specifications – Duration 200 days.
- Perform Biddability/Constructability/Environmental/Sustainability Review (BCOES) – Duration 30 days.
- Contracting prepares for advertisement – Duration 30 days.
- Contract advertised - Duration 30 days.
- Process award – Duration 15 days.
- Preconstruction submittals – Duration 30 days.
- Construction begins when conditions allow.
- Construction will take 2 years to complete.

The smaller, upstreamgrade control structures can be built in any order. It is preferable to complete these prior to beginning the low drop structures in Middle Piney Creek. All of the grade control should be completed before the meander restoration.

Operations, Maintenance, Repair, Rehabilitation, And Replacement

The project has no operational features and is likely to require only minor maintenance for the first few years. The fish passage weirs, rock chutes and low drop structures will be inspected annually. The fish passage weirs may require some debris removal.

Monitoring and Adaptive Management

Previous research on meandering channels, sediment control and grade control structures has indicated effectiveness in improving biodiversity and ecological conditions. Monitoring will be conducted to ensure stability, and to assess the ecological response to the project. A more specific monitoring plan will be developed concurrent with plans and specifications and will be revised again upon completion of construction. Similar projects on Barnes Fork Creek and Stokes Creek are being monitored now and lessons learned from those monitoring plans will be taken into account. The Monitoring Plan will include the criteria and methods described here and specific criteria related to monitoring the condition of the meandering channel. The Hatchie River and Piney Creek have been the subject of university research projects for years and these projects are expected to continue and will provide information that is beyond the scope of typical USACE monitoring.

The specific target of the project is to reestablish a stable, meandering channel in Piney Creek that effectively manages its own bedload. This will improve conditions for fish and will also improve the surrounding bottomland hardwood forest. The performance measures for Piney Creek were

established based on monitoring of other projects in the area to determine meaningful and attainable levels of improvement. Because the meander section will be "new" habitat, there are no exact baseline conditions to establish a baseline.

Channel: Cross sections on the new channel will be established immediately upon construction completion. The cross sections will be surveyed annually to monitor the channel adjustment from pilot channel to full channel. There are no specific performance criteria for this, but if the surveys show the channel is not adjusting as expected, adaptive management may be necessary. Further targeted excavation or hardening of inside bends may be necessary.

Fish: The new channel will be surveyed for fish upon construction completion. At least 70% of the species that were found in Middle and Upper Piney Creek are expected to immediately inhabit the new channel. Reaches will be established for quantitative fish sampling in Piney Creek, two in the new channel and two in Middle Piney Creek. The reaches will be sampled annually for five years. The Lower Piney section will be considered successful if the number of species reaches the number that have previously been found in Piney Creek and the number of fish increases at least 10% each year for 5 years.

Mussels: No baseline data for mussels in Piney Creek are available. The Middle Section will be surveyed for mussels prior to, or concurrent with, the construction of the meandering channel. The new channel will be surveyed for mussels in Year 3, 4 and 5 post construction. The presence of at least 5 species of mussels will be considered successful, however absence of mussels will not necessarily indicate failure. It will take some time for enough mussels to populate the new habitat to detect their presence.

Tree planting: Survival of planted trees must reach 80% or they will be replanted.

Riparian Conditions: The streambanks will be surveyed to determine percent shoreline cover and canopy closure. Shoreline cover of 70% and canopy closure of 60% will be considered successful. If monitoring results are inconclusive or indicate corrective action is needed to achieve project success criteria, monitoring will continue for another four years or until the District Engineer determines the criteria for ecosystem restoration are met. If the criteria for success are not met within 10 years, monitoring will continue at 100% non-federal cost.

If monitoring indicates the project goals are not being met, adaptive management features could include vegetative plantings in the riparian or littoral zones. Modification of the weirs (e.g. notches, lowering, raising) would be considered as an adaptive management feature, but only if the changes are not required as a result of a design or construction deficiency. The tree planting cost estimated in the first cost of the project includes contingency to fully replant. Other adaptive management features could be considered if monitoring indicates an issue. Adaptive management costs were estimated at $15,000 total. See Complete Plan in Appendix A.

Cost-Sharing Requirements

The feasibility study was funded for $100,000 full federal expense and cost shared 50/50 for all costs in excess of that. Construction cost-sharing will be 65/35%. In accordance with the terms of the PPA, the non-Federal sponsor must provide all lands, easements, and rights-of-way, (LERs) required for the project. OMRR&R is a 100% non-Federal responsibility. See Tables 6 - 11 below.

Table 7. Construction Cost (First Cost) for the Tentatively Selected Plan (2021 dollars)

Accounts	Description	Contingency	Total
01 Real Estate	Lands and Damages	30%	$419,000
02 Relocations	Utility Relocations	25%	$125,000
09 Channels and Canals	Pilot channel	25%	$1,635,707
16 Bank Stabilization	Weirs	25%	$9,298,000
30 PED	E&D for Bank Stabilization	25%	$1,696,000
31 Construction Management	S&A for Bank Stabilization	25%	$1,395,000
Total First Cost of Construction			**$14,568,707**

Table 8. Other Cost (2021 dollars)

Description	Total
Feasibility Study	$194,000
Annual OMRR&R Cost	$2,000

Table 9. Cost Apportionment for the Tentatively Selected Plan (2021 dollars)

Item	Cost Share	Federal Cost	Non-Federal Cost	Total
Feasibility Study (first $100k)	100/0	$100,000		$100,000
Feasibility (shared)	50/50	$47,000	$47,000	$94,000
Construction	65/35	$9,469,660	$5,099,047	$14,568,707
Total		$9,616,660	$5,146,047	$14,762,707
Annual OMRR&R	0/100		$2,000	$2,000

Table 10. Sponsor Responsibility for the Tentatively Selected Plan (2021 dollars)

Item	Cost
LERRDS	$419,000
Feasibility Study – Work in Kind	$47,000
Monitoring – Work in Kind	$15,000
Construction – Work In Kind	$4,680,047
Cash	NA
Annual OMRR&R	$2,000

Federal Responsibilities for the Selected Plan

The Federal government (USACE) will be responsible for PED and construction of the project in accordance with the applicable provisions of Public Law 99-662 (WRDA of 1986), as amended. The Government (USACE), subject to Congressional authorization, the availability of funds, and the execution of a binding agreement with the NFS in accordance with Section 221 of the Flood Control Act of 1970, as amended, and using those funds provided by the NFS, shall expeditiously construct the Project, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

Non-Federal Responsibilities for the Selected Plan

Provide 35 percent of total ecosystem restoration costs as further specified below:

Provide the non-Federal share of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for ecosystem restoration features of the project;

Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to ecosystem restoration;

Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the ecosystem restoration features of the project;

Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total ecosystem restoration costs;

Do not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the project;

Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d- 5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 - 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the ecosystem restoration features, hinder operation and maintenance of the project, or interfere with the project's proper function.

Do not use project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project.

Risk and Uncertainty

Risk and uncertainty for the project are both low. The techniques and measures proposed for Piney Creek are standard practices that have been implemented throughout the region. The area is rural and there are no features near homes.

H&H Risks

The anthropogenic impacts and resulting problems within Piney Creek and Hatchie River have been well documented by multiple agencies. MVM and the WTRBA have collectively proposed a watershed-scale design as a best-case solution. As part of any design, some uncertainties exist. The goal of the proposed design is to choose the alternative with the least uncertainties and minimize risk of design failure. Grade control structures such as low drop structures, fish passages, and rock chutes have been utilized in various forms by USACE for decades. Risk related to grade control is not unique to this project and is relatively well known. Pilot channels are less common, and for that reason, will be qualitatively discussed with regards to risk and uncertainties.

Several unknowns or uncertainties exist for projects proposing hydraulic design implementation. The pilot channel design is no exception. Future land management practices, increased storm intensity, and feasibility-level assumptions are uncertainties that should be considered prior to advancing to the design phase. Land use changes such as upgradient forest clearing, poor roadway practice, or agricultural field development can increase sediment loading and flood flows. Fortunately, the watershed has a high percentage of protected land and limited roads. Furthermore, there is a low likelihood of development given the proximity to flooding and rural location. Another unknown for the project is future changes in typical storm duration and intensity. Current pilot channel dimensions are designed around existing sediment loading and flows, and drastic changes in either situation could impact pilot channel success. To minimize impacts, a climate change study was conducted and will be considered during the design phase. Another uncertainty for the project is the accuracy of the LiDAR. Experience shows that the sand thalweg reflects LiDAR well, but obstructed readings with canopy, deep pools, and/or wood debris are not reliable. To overcome LiDAR unknowns, a degree of conservatism was used in calculating quantities and costs. Survey data acquired during the design phase will replace LiDAR estimates and provide more precision for the existing conditions.

For the proposed solution, failure to meet design goals for the pilot channel includes sediment filling and blocking the movement of water and sediment from upstream. Design failure would not improve current existing conditions and impacts to Piney Creek would not be restored. The overall risk of failure does not include loss of life or significant damage beyond what exists at the site currently.

Figure 15. Beaver Creek

To minimize risk of design failure, MVM will rely heavily on NFS pilot channel experience. Within West Tennessee, several pilot-channel projects have been constructed and routinely monitored. Stokes Creek, Baxter Bottoms Creek Phase III, and Beaver Creek have shown successful results after implementing a pilot channel. Brief descriptions are summarized below with information and photographs provided by NFS.

Beaver Creek in Huntingdon, Carroll County, Tennessee includes approximately 3,000 ft of pilot channel completed in March 2017. The monitoring report from March 2021 shows a successful restoration with adequate water and sediment movement. No corrective actions were recommended although beaver activity was being monitored at the lower end of the project. A September 2020 photo is shown below.

The Stokes Creek Stream Restoration project located near Ruellen in Dyer County, Tennessee includes 10,125 feet of pilot channel. Construction was completed in October 2016 and routinely monitored since. Based on monitoring reports from March 2021, the restored channel is progressing as expected with no remedial actions. An aerial photograph from September 2020 is shown below.

Figure 16. Stokes Creek

The Baxter Bottoms Creek Phase 3 pilot channel located near Mason in Tipton County, Tennessee included the restoration of approximately 7,735 linear feet of channel added to previous phases. Construction was completed in 2016 and has been routinely monitored since. Based on monitoring reports from March 2021, the restored channel is progressing as expected with no remedial actions. A September 2020 photo is shown below.

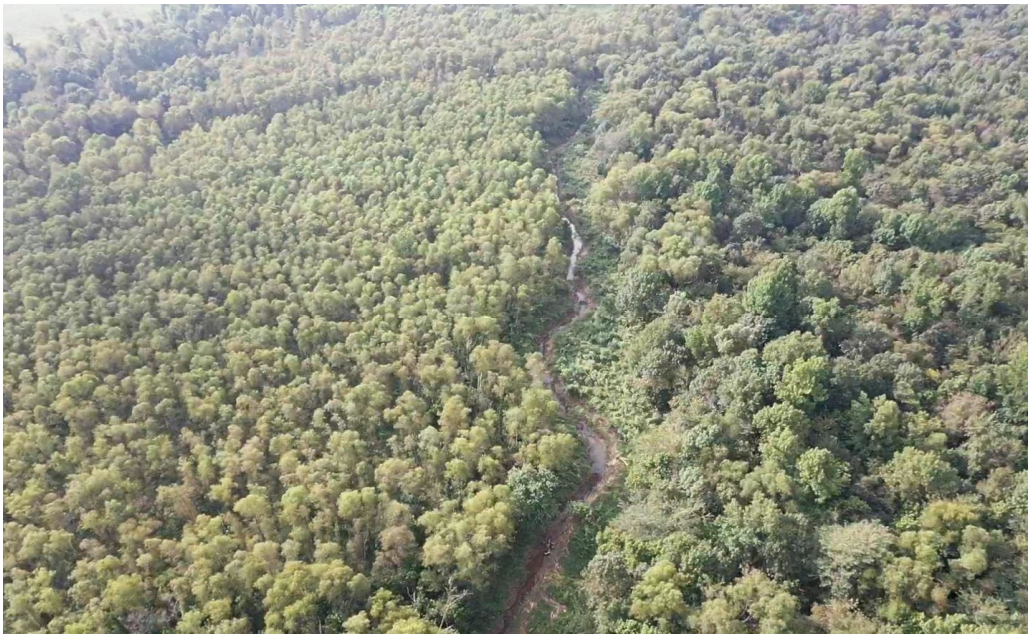

Figure 17. Baxter Bottoms

Other Risks

The Lower Piney Creek area is subject to backwater from the Hatchie River. High water makes the area difficult to access with equipment and could delay construction start. The pilot channel will be fully excavated in one construction season once the water levels are appropriate. The water levels will have less impact on the weirs in the upper and middle portions of Piney Creek.

Bat surveys may be required for the area prior to construction; USACE will coordinate with USFWS when the Design and Implementation phase is underway. The plan assumes construction will occur in the winter to avoid disturbing bats. Cultural resource surveys and coordination would be completed to examine the exact alignment of the channel meander. This area is mostly wetland and the probability of discovering a significant site that cannot be avoided is low. The Tennessee Department of Environment and Conservation (TDEC) will have to issue an Aquatic Resources Alteration Permit, however TDEC requires plans and specifications to 65-95% complete stage to begin review of a permit application. TDEC has approved similar projects in the region.

None of these issues create significant risk for project design, performance, outcomes, costs or schedules.

Climate Change

In 2016, USACE issued Engineering and Construction Bulletin No. 2016-25 (USACE, 2016) (hereafter, ECB 2016-25), which mandated that climate change be considered for all federally funded projects in planning stages. This guidance was updated with ECB 2018-14 (USACE, 2018). A qualitative analysis of historical climate trends, as well as assessment of future projections was provisioned by ECB 2018-14. Even if climate change does not appear to be an impact for a particular region of interest, the formal analyses outlined in the guidance result in better-informed planning and engineering decisions.

Based on a literature review of relevant climate data, there is a clear consensus that temperatures will rise over the next century. There is some consensus that there will be mild increases in the severity and frequency of storms in the region. However, there is no consensus on future changes in hydrology. Observed data from near the study area temperatures have been gradually rising since the 1970s after a cooling period in the earlier part of the century. Annual precipitation seems to be highly variable since the 1940s. Peak annual streamflow also seems to be highly variable for the available period of record at a nearby gage (1997-2017).

Based on the results of this assessment, including considerations of observed precipitation and streamflow in the basin, there is not strong evidence suggesting increasing peak annual streamflow will occur in for the future within the region. Furthermore, there is only some consensus the region might see a mild increase in the frequency and severity of precipitation events. This evidence, by itself does not indicate high confidence in an increase in peak flows in the Piney Creek basin.

Based on the lack of clear evidence showing an increase in streamflow, the effects of climate change can be considered within the standard uncertainty bounds associated with the hydrologic/hydraulic analysis being conducted as part of this study.

Environmental Disclosures

Floodplain Management

Executive Order 11988, Floodplain Management (signed 24 May 1977), requires Federal agencies to recognize the significant values of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. The Executive Order has an objective of the avoidance, to the extent possible, of long and short-term adverse impacts associated with the occupancy and modification of the base floodplain and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practical alternative. Under this Order, the Corps of Engineers is required to provide leadership and take action to:

a. Avoid development in the base floodplain unless it is the only practical alternative;
b. Reduce the hazard and risk associated with floods;
c. Minimize the impact of floods on human safety, health, and welfare; and
d. Restore and preserve the natural and beneficial values of the base floodplain.

The Tentatively Selected Plan will not cause development in the floodplain or increase flood hazards or impacts.

Hazardous, Toxic, And Radioactive Waste (HTRW)

The local sponsor shall be responsible for ensuring that the development and execution of Federal, state, and/or locally required HTRW response actions are accomplished at 100 percent non-project cost, and no cost sharing credit will be given for the cost of response actions. If an HTRW problem is discovered during the PED phase, all work on that portion of the project shall be delayed until the local sponsor, EPA, state and local authorities, as appropriate, are consulted and the extent of the problem is defined. Measures to avoid the HTRW site can then be considered, if necessary, or possible required design changes can be accomplished after the problem and response have been determined (ER 1165-2-132)

In the case of HTRW identification, changes to the project schedule, cost estimate and NEPA documentation must be considered. Should the discovered HTRW site result in significant impacts for the recommended project, preparation of a reformulation document and/or a post-authorization change report may be required. The local sponsor will be responsible for planning and accomplishing any HTRW response measures, and will not receive credit for the costs incurred. This does not limit any rights the sponsor may have to recover such costs from PRP or responsible third parties or to work through state agencies to compel cleanup by PRP or responsible third parties prior to sponsor's acquisition of land.

A record search has been conducted of the EPA's EnviroMapper Web Page (https://www.epa.gov/enviro/myenviromapper). The EPA search engine was checked for any superfund sites, toxic releases, or hazardous waste sites within the vicinity of the proposed project. There have been multiple site visits to Piney Creek between 2017 and 2020. The records search and site surveys did not identify the presence of any hazardous or suspected hazardous wastes in the project area. As a result of these assessments, it was concluded that the probability of encountering HTRW is low. If HTRW is encountered during construction activities, the proper handling and disposal of these materials would be coordinated with the Tennessee Department of Environment and Conservation (TDEC) and USEPA.

Environmental Justice

Hardeman County has approximately 25,000 residents. Bolivar is the largest town in the County and has approximately 5,000 residents. The population is declining slowly. According to 2014 U.S. Census Bureau estimates, 55% of the residents are White and 42% are African-American. The main project area is approximately 2.5 miles from Bolivar.

The area is rural and construction sites are not located near residences. There will be some increase in large truck traffic during construction, but it will be temporary and will not disproportionately impact any communities.

State and Federal Holdings

There are no State or Federal holdings within the project area. There are Federal Wildlife Refuges and State Parks near and within the Piney Creek watershed. The project will improve overall conditions in the area, but have no direct impacts on State or Federal holdings.

Wetlands

Lower Piney creek is part of the large bottomland hardwood forest associated with the Hatchie River. This project will reestablish a meandering channel to replace a ditch that was dug to facilitate draining the wetland. The ditch has caused a valley plug that is killing hardwoods and degrading the quality of the forest. The project will not change the amount of wetlands, but will improve quality.

Endangered Species

The U.S. Fish and Wildlife Service has stated the area lies within the potential range for Indiana (*Myotis sodalis*) and northern long-eared bats (*M. septentrionalis*). Bat surveys were suspended for Summer 2020 due to coronavirus concerns; surveys may be required prior to construction. USACE will continue to coordinate with USFWS to ensure the project does not impact listed bats. Long-term, the project will improve sustainability of the bottomland hardwood habitat important for bats. The project assumes only minimal tree clearing and it would occur only from October 15-March 31 to avoid the possibility of direct take. Any maternity colonies or roost trees identified in subsequent surveys would be avoided. Prior to the suspension of surveys for Summer 2020, bat surveys were valid for 2 years; policy may change when surveying is reinstated. Coordination with USFWS will occur as part of the review of this report and will continue through construction as needed. No other species are known to have potential to occur in this area.

Cultural Resources

Correspondence with the State Historic Preservation Officer (SHPO) indicates there are three sites and three surveys within a mile of the study area, but no known sites or surveys within the immediate study area. The non-federal sponsor has contracted an archaeological firm to complete a literature review and Phase I archaeological survey of the study area. If there are no significant cultural resources within the Piney Creek Ecosystem Restoration Study Area of Potential Effect, the proposed undertaking will not have an adverse impact on cultural resources and a no affect determination will be issued and USACE will seek concurrence with the TNSHPO and THPOs. Section 106 consultation should be concluded prior to the final report.

The Tentatively Selected Plan would be unlikely to have any impact on known cultural resources. The study area has not been previously studied although areas within one mile of the study area have been surveyed. Three known sites are within one mile of the project area so there is a moderate chance of archaeological resources being present. The non-federal sponsor has contracted an archaeological firm to conduct a literature review and Phase I archaeological survey of the study area. We do not anticipate finding any significant cultural resources and will seek a no effect determination in consultation with the TN SHPO and THPOs based on the final results of the survey. Section 106 concurrence should be concluded prior to the final report.

Prime & Unique Farmlands

There are no Prime or Unique Farmlands in the Project Area.

Air Quality

Air quality in Hardeman County is considered to be 'in attainment' by the TDEC Division of Air Pollution Control. With implementation of the Tentatively Selected Plan, the project-related equipment would produce small amounts of engine exhaust during construction activities. The temporary, minor impacts to air quality would be localized to the project area and would not affect area residents. The project area would still be in attainment for all air quality standards. The project would not impact Tennessee's State Implementation Plan.

Water Quality

Piney Creek is on the state 303(d) list for impaired waters. It is listed for habitat alteration and sedimentation. This project would restore habitat and reduce sedimentation. A 404(b)(1) evaluation is provided in Appendix A. An Aquatic Resources Alteration Permit from the Tennessee Department of Environment and Conservation will be required. USACE will obtain these permits during the development of Plans and Specifications. TDEC has approved similar projects on Barnes Fork Creek in Henry County and Stokes Creek in Dyer County.

Noise

The area is rural and none of the construction sites are near residences so the temporary noise increase during project construction would not be an issue.

Mitigation

USACE policy in ER 1105-2-100 states, "Ecosystem restoration projects should be designed to avoid the need for fish and wildlife mitigation." This project was designed accordingly. Much of the area is stressed or dead and dying timber and BLH species are not able to naturally regenerate. Trees will be planted along the restored channel in areas where they have been lost. Tree clearing would be avoided and minimized to the greatest extent practicable. Some individual trees may be removed to allow for construction. These areas will be replanted after construction with a mix of bottomland hardwood species. Monitoring of replanted areas will occur as described in the monitoring plan. The project will have a net gain of BLH in both quantity and quality.

Coordination

To be completed after agency and public review.

Views of the Non-Federal Sponsor

The West Tennessee River Basin Authority is the study sponsor and supports the Tentatively Selected Plan.

Relationship of Plan to Environmental Laws and Regulations
The relationships of the recommended plan to the requirements of environmental laws, executive orders, and other policies are presented below:

Federal Policies and Acts	Compliance Status
Archeological Resources Protection Act of 1979	2
Bald Eagle Act	1
Clean Air Act Amendments of 1977	1
Clean Water Act of 1977, as amended	1
Endangered Species Act of 1973, as amended	2
Farmland Protection Policy Act of 1984	2
Fish and Wildlife Coordination Act of 1958	1
Flood Control Act of 1946, as amended	1
Food Security Act of 1985	1
National Environmental Policy Act of 1969	2
National Historic Preservation Act of 1966, as amended	2
River and Harbor and Flood Control Act of 1970	1
Water Resources Development Act of 1986	1
Water Resources Planning Act of 1965	1
Executive Orders	
Floodplain Management (E.O. 11988)	1
Protection, Enhancement of the Cultural Environment (E.O. 11593)	1
Protection of Wetlands (E.O. 11990)	1
Environmental Justice (E.O. 12898)	1
Other Federal Policies	
Prime and Unique Farmlands	1
Water Resources Council, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies	1

1/ Full compliance with the policy and related regulations has been accomplished.
2/ Partial compliance with the policy and related regulations has been accomplished. Coordination is ongoing.

Conclusion

This office has assessed the environmental impacts of the Tentatively Selected Plan and has determined that the plan is expected to benefit aquatic species. It would have no significant negative impacts upon vegetation, fish, wildlife, cultural resources, or the human environment.

During the development of plans and specifications for the project, any changes will be coordinated to ensure compliance for endangered species, water quality certification, cultural resources, and HTRW. Additional surveys for listed bats are required prior to tree clearing to identify any roost or maternity trees.

Recommendation

To be completed after public and agency reviews.

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