Big Sunflower River Watershed (Quiver River), Mississippi Draft Feasibility Report with Integrated Environmental Assessment

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Executive Summary

The Quiver River lies the Yazoo Basin in the Delta region of northwestern Mississippi. The Tallahatchie and Yalobusha Rivers join to form the Yazoo River and the Big Sunflower River enters downstream of this confluence. The Quiver River is a tributary of the Big Sunflower River.

The Quiver River is typical of streams in the Lower Mississippi River Alluvial Valley. Agriculture, irrigation, and flood risk management projects have degraded aquatic habitat. Past channelization and reduced instream flows in the Quiver River limit the amount of physical habitat present and cause decreased dissolved oxygen levels and higher water temperatures. Most streams within the Yazoo Basin have limited riparian vegetation, high nutrient concentrations, limited in-stream cover, low dissolved oxygen, high water temperatures, high turbidity, reduced habitat complexity, and low aquatic species richness and diversity. There are opportunities to restore a more historic flow regime, reestablish BLH riparian corridors, reduce sedimentation, lower nutrient concentrations, lower summer and fall water temperatures, and increase dissolved oxygen.

The Tentatively Selected Plan would build a pumping station on the Tallahatchie River approximately 2 miles north of Sharkey, MS. The station would have the capacity to pump 400 cfs from the Tallahatchie River. A 1,500 foot long channel would be excavated (63,000 cubic yards) to connect the pump station to Cassidy Bayou. Water would flow from Cassidy Bayou into Swan Lake. Water would flow from Swan Lake to Black Bayou, then to Sandy Bayou and then Parks Bayou, and finally into the Quiver River approximately 2.5 miles northeast of Brooks, MS.

The pumping station would be operated to ensure 100 cfs is maintained in the Quiver River. Water transfers to meet the project flow are most likely in September and October, but some may also be needed in August and November. Irrigation season generally extends from May to August and water can be withdrawn from the system as long as the 100 cfs project flow is maintained. Operation of the pump is not likely from December through April when the extra water is not needed for irrigation or ecological flows.

The Tentatively Selected Plan will address the three principal stressors on aquatic communities in the Quiver River and the transfer channels (Cassidy, Black, Sandy and Parks Bayous and Swan Lake). It will ensure a more natural stream flow and will improve water quality during late summer and autumn.

The Tentatively Selected Plan would supply enough water to irrigate approximately 36,855 acres split equally among rice, soybeans, and corn. All of these acres are currently irrigated with groundwater. It is anticipated that groundwater would no longer be used to irrigate these acres.

The estimated cost to construct the Tentatively Selected Plan is $20,236,141 and the annual operation cost is estimated to be $93,000.

The project would not have any significant adverse impacts on threatened or endangered species, water quality, air quality, historic resources, or the human environment.

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I. INTRODUCTION

The Quiver River lies the Yazoo Basin in the Delta region of northwestern Mississippi. The Tallahatchie and Yalobusha Rivers join to form the Yazoo River and the Big Sunflower River enters downstream of this confluence. The Quiver River is a tributary of the Big Sunflower River.

Historically, the Quiver River was a low gradient, meandering river with riparian corridors, instream cover and enough year-round flow to provide habitat for a variety of mussel and fish species. Water withdrawals, primarily for irrigation, now limit stream flow in the late summer and early fall and have degraded aquatic habitat quality and quantity. Loss of instream cover and riparian vegetation also impact habitat quality. Twenty-four mussel species are found in the river now, but over 40 native species exist in the Yazoo Basin and may have at one time been present in the Quiver River. Likewise for fish species, 43 species now occur in the Quiver River, but more than 80 may have been present in the past.

Loss of riparian vegetation, especially bottomland hardwoods, has degraded the aquatic habitat. Between 1950 and 1976, approximately one-third of the lower Mississippi alluvial valley's bottomland hardwood (BLH) forests were cleared for agriculture. By the 1980's less than 20% of the original forested wetlands remained (Klimas 1988, Stanturf et al. 2000, Gardiner et al. 2005, King et al. 2006). These bottomland swamps also provided water storage that supported stream flow in the Quiver River during the fall. Groundwater provided base flow in some of the Quiver tributaries (Speer et al. 1964). Water withdrawals for irrigation deplete water in the Quiver River and the alluvial aquifer. Depletion of the alluvial aquifer degrades habitat quality. A lack of reliable, affordable water for irrigation threatens the agricultural economy in the area.

Study Area

The headwaters of the Quiver River lie in west-central Tallahatchie County. It meanders more than 60 miles south through Tallahatchie and Leflore Counties before its confluence with the Big Sunflower River just north of U.S. Highway 82 in Sunflower County.

The Quiver River (Figure 1) is part of the Yazoo River Basin in the Mississippi Delta. Sardis, Arkabutla, Grenada, and Enid Lakes are all located in the Yazoo Basin and provide flood risk reduction. The Tallahatchie River flows from the hills of eastern and central Mississippi into the Delta region. As indicated in the Study Area map (Figure 2), downstream of Sardis Lake, the Tallahatchie flows through Panola, Quitman, and Tallahatchie Counties. North of Greenwood, MS, the Tallahatchie River converges with the Yalobusha River to form the Yazoo River. The Yazoo River downstream of the project area is authorized for a depth of 9 feet for navigation from the mouth of the river in Vicksburg, MS to Greenwood, MS. Clearing and snagging maintains the navigation channel to Yazoo City, MS.

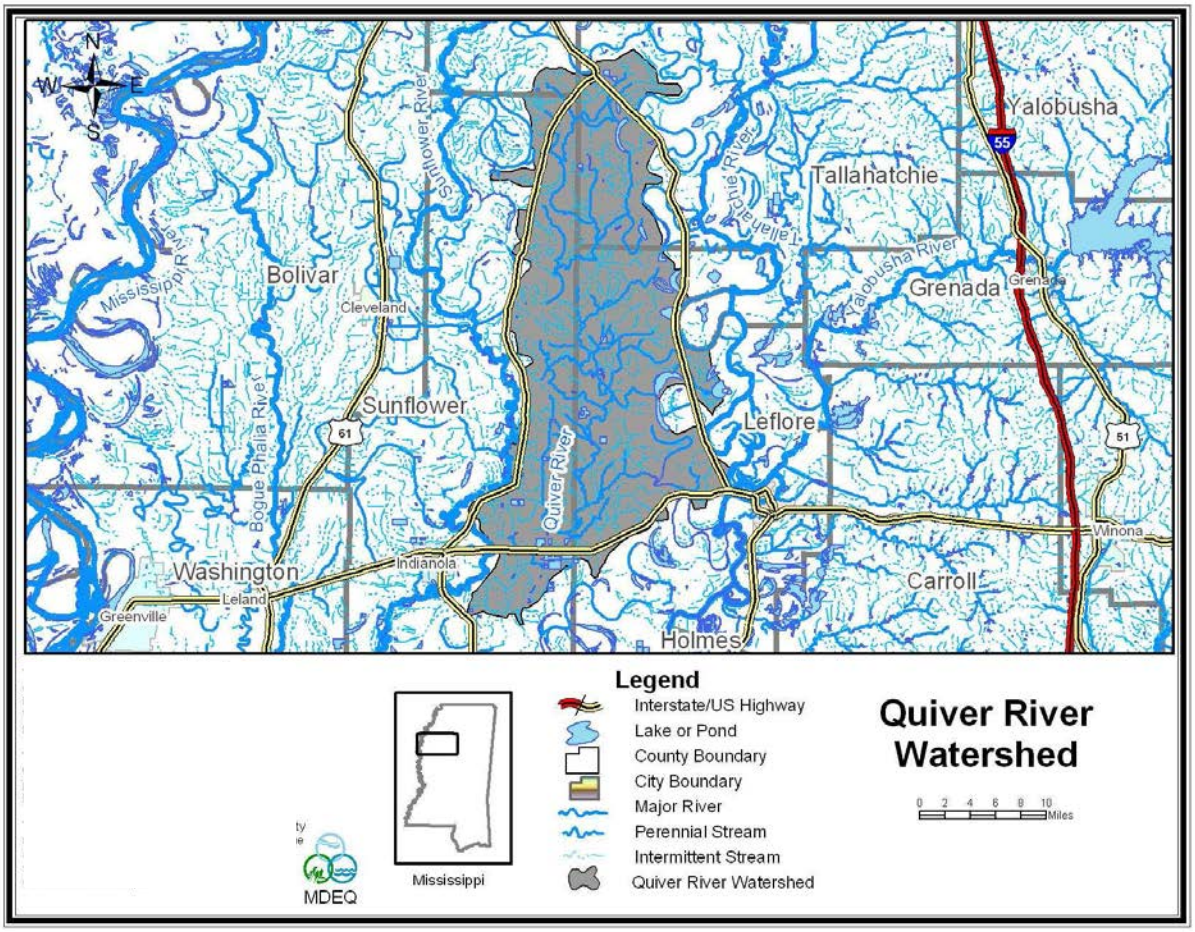

Figure 1. Map of the Quiver River Watershed

Study Scope

The study investigates potential aquatic habitat restoration of the Quiver River and considers compatible opportunities to provide agricultural water supply.

Authority

This study is being conducted in response to a Senate Resolution adopted 29 June 1973 by the Committee on Public Works of the US Senate. It reads as follows:
"*Resolved by the Committee on Public Works of the United States Senate, That the Chief of Engineers. U.S. Army, is hereby requested to review the report on the Mississippi River and Tributaries Project contained in House Document No. 308, 88th Congress, 2nd Session, and other reports with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time with reference to providing a plan for the development, utilization and conservation of water related land resources of the Yazoo Basin, including the backwater areas of the Mississippi and Yazoo Rivers. Such study should include appropriate considerations of the needs for flood protection, wise use of flood plain lands, bank stabilization, navigation facilities, regional water supply and waste water management facilities systems, general recreation facilities, enhancement and control of water quality, enhancement and conservation of fish and wildlife and other measures for the protection and enhancement of the environment.*"

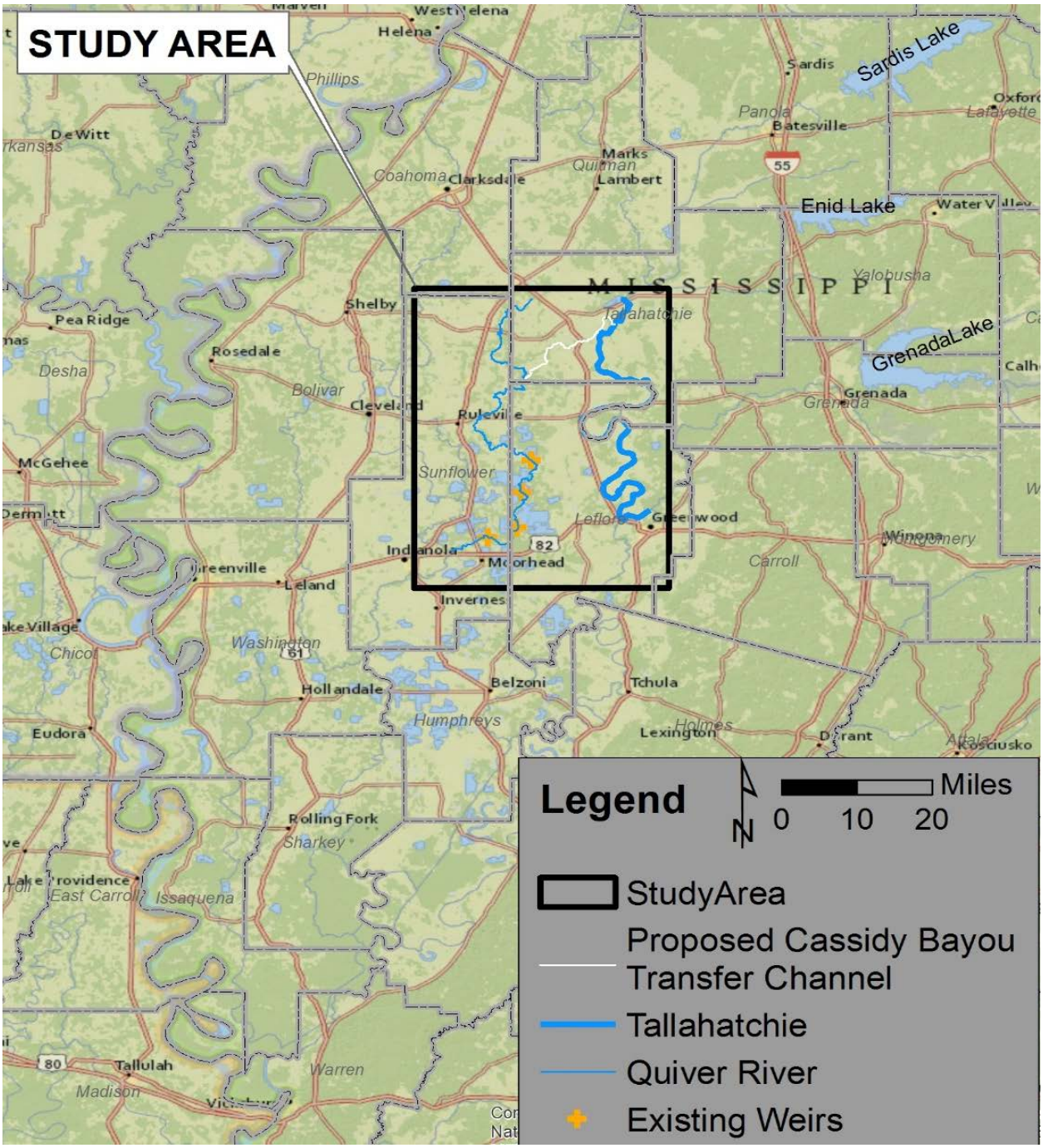

Figure 2. Map of the Study Area with features described later in the report.

Prior Reports, Projects, and Ongoing Programs

1928 – Flood Control Act of 1928 authorized four flood control reservoirs in the hill country of western Mississippi as part of the Yazoo Headwater Project. The four reservoirs are: Arkabutla (completed 1943), Sardis (1940), Grenada (1954), and Enid (1952). These lakes all drain to the Tallahatchie River. Releases from these flood control reservoirs provide year round flow to the Tallahatchie River. In addition to flood risk management, these reservoirs are used for recreation. Lake Enid is authorized to provide water supply.

1955 – Big Sunflower, Little Sunflower, Hushpuckena, and Quiver Rivers, and their Tributaries, and Deer Creek, Steele Bayou, and Bogue Phalia, Mississippi, General Design Memorandum No. 1. This report proposed a system of channel improvements along the area's rivers and tributaries.

1959 – Annex M to the Mississippi River and Tributaries, Comprehensive Review Report, Big Sunflower River Basin. This report recommended that the scope of the existing authorized project for the Big Sunflower Basin be increased to provide greater channel capacity on Steele Bayou and its tributaries.

1962 – Big Sunflower, Little Sunflower, Hushpuckena, and Quiver Rivers, and their tributaries and Deer Creek, Steele Bayou, and Bogue Phalia, Mississippi, Supplement A (GDM No. 1). This report recommended modifications to project streams as proposed in GDM No. 1.

1963 - Supplement B (to GDM No.1), prompted by local interest, this report modified GDM No.1 to add channel improvement to a reach of the Quiver River.

1967 – Channel Improvement Project, Quiver River above Parchman, Yazoo River Basin, Mississippi. Comprised 5.18 miles of clearing and snagging to a width of 110 feet, one channel cutoff, 118 feet in length with a bottom width of 25 feet and side slopes of 1 on 3; and enlargement of 0.74 mile of channel by excavation of 3 feet of material from the bottom and one side of the channel.

1995 - Flood Control, Mississippi River and Tributaries, Big Sunflower River Maintenance Project, Yazoo Basin, Mississippi - sediment removal and vegetation control measures on all or parts of the Big Sunflower River, Big Sunflower Bend way, Little Sunflower River, Bogue Phalia, Bogue Phalia Cutoff, Holly Bluff Cutoff, and Dowling Bayou south of Highway 82 to their confluence with the Yazoo River to reduce headwater flooding impacts.

Ongoing – Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through the MRBI, NRCS and partners work with producers and landowners to implement voluntary conservation practices that improve water quality, restore wetlands, enhance wildlife habitat and sustain agricultural profitability in the Mississippi River basin. Both the Big Sunflower and the Upper Yazoo basins are identified as Focus Area Watersheds. In this program, NRCS offers agricultural producers in priority watersheds the opportunity for voluntary technical and financial assistance.

Ongoing – Delta Task Force and the Yazoo-Mississippi Delta Joint Water Management District. Mississippi Governor's Executive Order No. 1341 – The Governor of the State of Mississippi established the Governor's Delta Sustainable Water Resources Task Force on 26 August 2014 to address the unsustainable decline of groundwater levels in the Mississippi River Alluvial Aquifer, the principal water supply for agriculture in the Mississippi Delta. This task force is led by the Executive Director

of the Mississippi Department of Environmental Quality (MDEQ) and includes representatives from the Delta Council, Delta F.A.R.M., Mississippi Farm Bureau, the Mississippi Soil and Water Conservation Commission, the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture, the Vicksburg District of the U.S. Army Corps of Engineers (USACE), and the Yazoo-Mississippi Delta Joint Water Management District (YMD). The Task Force is charged to work together to promote conservation measures, irrigation management practices and plans for the implementation of new Delta surface water and groundwater supplies; to advise MDEQ on policies related to Delta water resources; and to prepare and promote the implementation of strategies and plans developed though the Task Force to ensure the future sustainability of water resources in the Delta.

The 2014 Mississippi Ground Water Quality Assessment states:

> ***"Developing and Implementing Conjunctive Water Management Strategies***
> *The future of the Mississippi Delta's economic and environmental viability depends on abundant, accessible water of sufficient quality. Water needs in the region are broad and include personal consumption, irrigation, aquaculture, fisheries and aquatic habitat, wetland function, wildlife, and waste water assimilation. Over 17,000 permitted irrigation wells screened in the shallow Mississippi River Valley Alluvial Aquifer (MRVA) are used for irrigation and aquaculture and pump approximately 1.5 billion gallons of groundwater each day. However, this pumpage demand has exceeded the recharge to the MRVA resulting in continuing overbalances of groundwater withdrawals versus aquifer recharge, and notable water-level declines in the aquifer. Because of increased yields and profitability that irrigation provides over dry land farming, the level of water withdrawal permit applications continues to increase which further complicates this issue. Fortunately, these challenges are in a region that experiences historically around 53-55 inches of rainfall each year, is adjacent to the 1-1.5 MM cubic feet/second flow of the Mississippi River, and is downstream from four adjacent major flood control reservoirs. So, although the challenges are significant, opportunities exist for the development of conjunctive water management options and alternative surface water supplies. Conjunctive water management is the foundation for sustainable Delta water resources. In its simplest context, conjunctive water management is managing the coordinated use of surface and groundwater to satisfy desired water needs such that the total benefits exceed the sum of the benefits that would result from independent management of each water resource."*

II. PROBLEMS AND OPPORTUNITIES

The Quiver River is typical of streams in the Lower Mississippi River Alluvial Valley. Agriculture, irrigation, and flood risk management projects have degraded aquatic habitat. Past channelization and reduced instream flows in the Quiver River limit the amount of physical habitat present and cause decreased dissolved oxygen levels and higher water temperatures. Most streams within the Yazoo Basin have limited riparian vegetation, high nutrient concentrations, limited in-stream cover, low dissolved oxygen, high water temperatures, high turbidity, reduced habitat complexity, and low aquatic species richness and diversity. There are opportunities to restore a more historic flow regime, reestablish BLH riparian corridors, reduce sedimentation, lower nutrient concentrations, lower summer and fall water temperatures, and increase dissolved oxygen.

Figure 3. Quiver River in early fall showing low flow

PROBLEMS

Aquatic Habitat

Flows in the Quiver River, during the late summer and early fall, are lower than historic levels. Parts of the Quiver River are nearly dry in October and the fish and mussel habitat is poor. Bottomland hardwood forests and their associated water storage capacity have been lost. Low water levels in the

alluvial aquifer reduce the amount of water available to provide base flow to the small tributaries of the Quiver River. Loss of hydrologic connectivity (i.e. flowing water) within the system reduces the sustainability of fish and mussel populations. This interrupts dynamic biologic processes and the structure and function of the aquatic ecosystem and surrounding floodplain. Sedimentation from surrounding land use and lack of stable substrate for aquatic species contributes to the Quiver River ecosystem degradation. Three tributaries to the Quiver (Wild Bill, Bear, and Pecan Bayous) are Mississippi listed Section 303(d) Impaired Water Bodies due to organic enrichments (nutrients) and low dissolved oxygen (MDEQ 2008a, MDEQ 2008b, MDEQ 2008c). The specific problems include:

- Death of mussels from periodic streambed drying.
- Tolerant fish and mussel species dominate aquatic habitats
- Poor habitat reduces potential for protected aquatic species to recolonize the Quiver River
- Reduced littoral habitat and cover for young fish survival and rearing
- Groundwater depletion limits the aquifer's contribution to stream flow
- Low dissolved oxygen and increased water temperatures
- Reduced connectivity to tributaries in the larger watershed
- Lack of shade increases water temperatures in Quiver River
- Reduced input from vegetation limits food availability in the Quiver River
- Reduced habitat complexity and aquatic ecosystem structure
- BLH forest fragmentation
- Reduced migratory waterfowl feeding and refuge habitat in the Mississippi Flyway

Regional Water Supply

The Quiver River drains the region of the Mississippi Delta that has experienced the most groundwater depletion over the last few decades. Water use from the alluvial aquifer exceeds natural recharge by an estimated 300,000 acre feet per year. Groundwater users must drill deeper and spend more money to pump water from increasingly greater depths. Well maintenance costs are increasing because water from deeper wells has a higher mineral content and increases screen fouling.

OPPORTUNITIES

Aquatic Habitat

Restoring the natural flow regime in the Quiver River would directly benefit fish and mussels, and may allow some species to recolonize the area. Forested buffers would benefit the aquatic environment and a variety of mammals, birds, amphibians, and reptiles. There are specific opportunities to:

- Increase flow and wetted perimeter
- Increase littoral habitat for young fish rearing and survival
- Provide flow to sustain freshwater mussels
- Increase aquatic species richness and diversity

- Reconnect the Quiver River to its tributaries, the Big Sunflower River and the Lower Mississippi River System for riverine fish species
- Restore year round flow in the Quiver River
- Improve aquatic refugia habitat
- Improve spawning habitat
- Increase forested riparian zone.
- Increased bank stability
- Increase input from surrounding vegetation and food availability
- Improve aquatic structural complexity
- Reconnect isolated BLH tracts
- Increase biodiversity of aquatic and terrestrial resources
- Reconnect isolated BLH tracts for neo-tropical migratory birds
- Implement features noted in the North American Waterfowl Management Plan with the joint venture agencies
- Reduce nitrate concentrations
- Decrease water temperature
- Increase dissolved oxygen

Regional Water Supply

Mississippi produces 72% of the nation's farm raised catfish. Leflore and Sunflower Counties account for 22% of Mississippi's aquaculture acreage. There are opportunities to:

- Provide a supplemental, resilient, and reliable agricultural water source
- Reduce dependency on the alluvial aquifer
- Reduce irrigation costs
- Decrease well and pump maintenance needs

PLANNING GOALS AND OBJECTIVES

Goal

To restore the degraded aquatic and riparian ecological processes in the Quiver River, Cassidy, Black, Parks and Sandy Bayous, and Swan Lake; provide a more reliable water source for agriculture and aquaculture; and improve the reliability of the alluvial aquifer to be a long-term source for regional water supply.

Objectives

1. Restore fish and mussel habitat in the Quiver River.
   Required data: Output of Delta Minnow Model
2. Increase average wetted perimeter in the Quiver River connector channels
   Required data: Wetted perimeter in connector channels – Parks, Sandy, and Black Bayous.
3. Restore bottomland hardwood habitat in the floodplain.
   Required data: Acres of Bottomland hardwood restored.

4. Improve the economic efficiency of water supply for agriculture.
   Required data: The net average annual benefits.

Planning Constraints

1. Do not impact authorized navigation in adjacent streams.
2. Do not reduce benefits from existing flood risk management or other projects.

Public Scoping

A public scoping meeting for this study was conducted on 24 October 2012. Attendees included state and federal agency staff and landowners. Concerns raised included: navigation on the Yazoo River, soil erosion, streambank stability, irrigation, water quality, turbidity, nutrients, buffer strips, and ecotourism. A copy of the comments received are included in Appendix A.

III. EXISTING AND FUTURE CONDITIONS

EXISTING CONDITIONS [Affected Environment]

Physical

The study area is located in the Delta region of the Yazoo River Basin in northwestern Mississippi. The Delta is the flat, lowland area in the alluvial valley of the Mississippi River bordered by the loess bluffs to the east and the Mississippi River to the west. This is a highly productive agricultural region known for its cotton, corn, soybeans, rice, and catfish. Streams in this region are slow moving, and experience substantial variation in river stage. The area also contains an extensive system of oxbow lakes. Nearly all of the streams have been altered for flood control. These alterations were initiated in the early 1900's and work continues today. Channel modifications include clearing, cleanout, enlargement, straightening, and weir construction.

Cultivated crops cover over 70% of the land. Catfish farms are common. The riparian areas along the Quiver River, Tallahatchie River, and associated ditches and tributaries are generally less than 100 feet wide. There are some larger tracts of woody wetlands around oxbow lakes, abandoned channels, and in the NRCS's Wetlands Reserve Program.

Long, hot summers, comparatively short, mild winters, and abundant rainfall characterize the region's climate. The average annual temperature is approximately 63 degrees Fahrenheit with average monthly temperatures ranging from 82° in July and August to 41° in January. The average annual precipitation is approximately 55 inches with monthly averages ranging from approximately 3 inches in August to 6 inches in May. Precipitation as snowfall generally occurs about once a year, and is usually light. The frost-free growing season is approximately 7 months.

The project area is located within the Mississippi Alluvial Valley. Glacial melt waters carried large amounts of water, silt, sand, and gravel from the country's interior down to the Gulf Coast. The alluvial valley ranges in width from 30 to 90 miles. Holocene meander belts of the Mississippi River traverse the project area from north to south. Abandoned channels, point bar deposits, and some backswamp deposits are the major landforms within the immediate vicinity of the project area (Saucier 1994). Elevations in the project area range between 100 and 130 feet above sea level. The dominant soils in the project area are Alligator and Dundee soils with slopes of less than 3 percent (SSURGO 2014).

The Quiver River originates in west-central Tallahatchie County and meanders more than 60 miles through Tallahatchie and Leflore Counties before its confluence with the Big Sunflower River near Indianola in Sunflower County. The Quiver River is a slow-flowing stream and river stages vary approximately 15 feet annually. The river is turbid during flood flows, and dissolved oxygen is low when the river becomes stagnant in late summer and early fall. Four low-water weirs are located in the southern portions of the project area within the channel of the Quiver River. The weirs were built in the early 1960s to retain a minimum level of water in the stream during low water periods in late summer and early fall. Figure 3 (page 6) showed the Quiver River during low flow. Figure 4 shows the Quiver River during early spring and Figure 5 is the annual hydrograph for the Quiver River. Appendix B provides more detail on the hydrologic and hydraulic conditions.

Figure 4. Quiver River during spring high flow

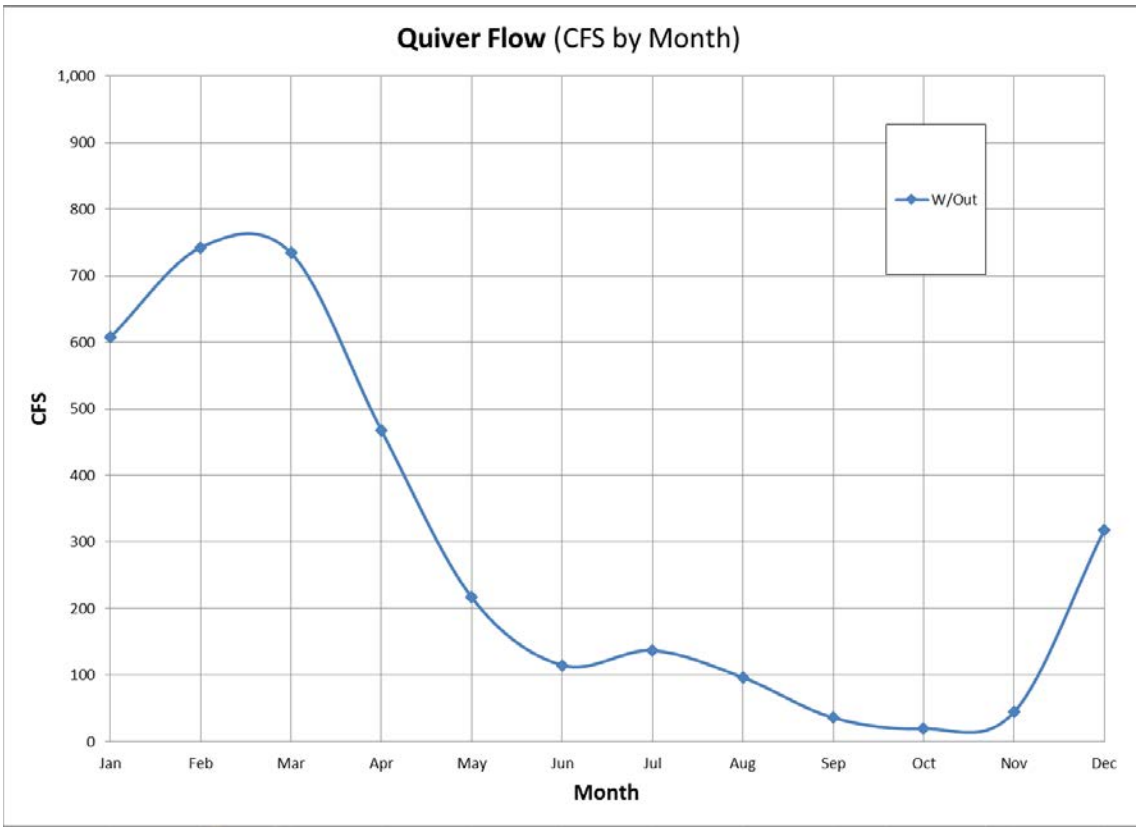

Figure 5. Quiver River Hydrograph (without project)

The Tallahatchie River originates in western Tippah County and flows west and then south for approximately 230 miles into Leflore County. North of Greenwood, Mississippi, the Tallahatchie River converges with the Yalobusha River to form the Yazoo River. In its course, the Tallahatchie River flows from the hills of eastern and central Mississippi into the Delta region of the state. Three USACE flood control reservoirs, Arkabutla, Sardis, and Enid, drain to the Tallahatchie River. Water levels on the Tallahatchie can fluctuate more than 20 feet annually with high stages typically occurring in late winter and early spring and low stages in late summer and early autumn. Discharge in the Tallahatchie River rarely drops below 1,000 cfs. The reservoirs regulate some of the flow in the Tallahatchie River. Outflows from the reservoirs are limited during the normal flood season (December to May) and regulated during the beginning of the low water season (June to September) in order to empty the flood control storage. This emptying of the flood control storage maintains flows during the typical low water season. The reservoir releases reduce summer water temperatures and lower turbidity. Figure 6 shows the Tallahatchie River annual hydrograph.

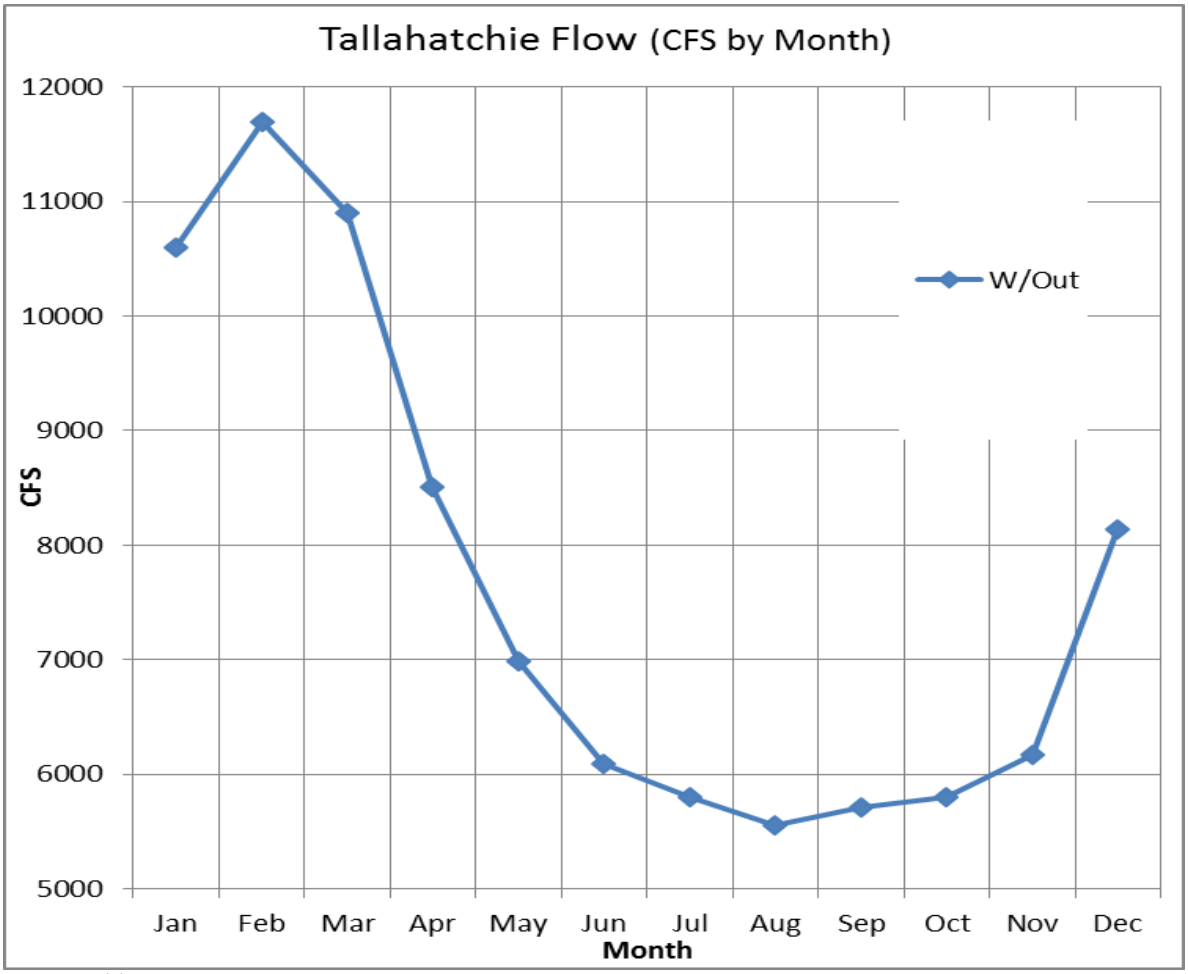

Figure 6. Tallahatchie River Hydrograph (without project)

The delta is the flat, lowland area of the Mississippi River alluvial valley. There is little vertical relief between the watersheds. The streams, ditches, and rivers in the region are connected, when the Tallahatchie River exceeds its banks and flow crosses into the Quiver River and other adjacent

watersheds. Fish and mussels from the Tallahatchie have access into the Quiver River, but the habitat in the Quiver does not support the same aquatic communities as that in the Tallahatchie.

Aquatic Resources and Fisheries

Past hydrologic modifications have reduced aquatic habitat quality, species diversity, and water quality throughout the project area. Littoral zones of the project area streams typically have soft, unconsolidated substrates, and instream cover is sparsely distributed. Emergent vegetation, primarily alligator weed, provides the only substantial instream cover but coverage is usually less than 10% of littoral area. There are sections of the Quiver River which have no surface flow for short, intermittent periods throughout the year. In Sandy and Parks Bayou there is almost no flow in the summer and no wetted stream perimeter to maintain macroinvertebrates and vegetation. Black Bayou is a large ditch with little habitat value. Three principal stressors on aquatic communities in the Quiver River are apparent: increased sedimentation (from ditch erosion and instream accretion of soft, unconsolidated soil particles), reduced stream flow and consequent poor water quality during late summer and autumn, and loss of a forested riparian corridor.

The Quiver River flows into the Big Sunflower which is a tributary of the Yazoo River. There are no significant barriers to fish movement in the system so all of the aquatic species occurring anywhere within the Yazoo or any of its tributaries have access to the Quiver River. At high water, the headwaters of the Yazoo Basin streams are also connected which further facilitates fish movement within the Basin. There are 83 species of fish in the Yazoo River and they all have access to the Quiver, but only 43 species are found there (Appendix C). Minnows and sunfishes dominate the fisheries in the Quiver River and tolerant fish species are most common. They are adapted to low dissolved oxygen and high pulses of suspended solids; they do not require clean, firm substrates for spawning; and they have the ability to live in shallow, slack water pools for extended periods.

The Delta Stream Minnow Model was used to quantify the quality of the fish habitat in the Quiver River. This model was developed at the Engineer Research and Development Center to evaluate habitat quality in low gradient, warmwater streams in the Mississippi River Alluvial Plain Level III ecoregion. Research has shown that the percentage of native minnows is well correlated to changes in velocity and is a good indicator of the habitat conditions. Most minnows are positively rheophilic and will respond to changes in water velocity. These minnows are also the host species for several mussel species. The relationship of habitat suitability to velocity is shown in the following equation:

$$HSI = Velocity_{ft/s} (0.37) + 0.22$$

This model was applied to the October median flows in the Quiver River. October has the lowest median flows and the poorest habitat conditions in the Quiver (see Figure 5). The October median flows range from approximately 4 to 14 cfs in the Quiver River. The model found an average HSI of 0.27 in the Quiver River in October. The total surface acres at October median flow is 374.95. The total Habitat Units available are 94.27. [The model was calculated across 114 cross sections in the Quiver River which varied in the acres. The average HSI shown here is the average of the HSI values, but each value represents a slightly different acreage. Appendix C contains the complete model results.]

The most common mussel species are also tolerant of poor habitat. The threeridge (*Amblema plicata*), and bankclimber (*Plectomerus dombeyanus*) mussels comprise 85% of the population in the Quiver (Miller and Payne 1997a, Miller and Payne 1997b, Miller and Payne 2004). During the summer and autumn, the Quiver River has shallow water with little or no surface flow. Low flow stresses mussels (Figure 7).

Although tolerant mussels dominate in the area, there are low densities of more sensitive species. The state endangered pyramid pigtoe (*Pleurobema rubrum*) is present within the Quiver, and the federally endangered sheepnose (*Plethobasus cyphyus*) and federally threatened rabbitsfoot (*Quadrula cylindrica cylindrica*) are present within the Sunflower River near the confluence with the Quiver River. Overall, there are 44 species of freshwater mussels in the Yazoo Basin with 28 species identified from the Quiver River (Appendix C). Miller and Payne (1997a, 2004) noted a lack of juvenile mussels in the study area and few small mussel shells indicating that recent recruitment is low or sporadic.

Figure 7. Quiver River Mussels at Low Water

Terrestrial and Wildlife Resources

The majority of the project area is agricultural and has little value for wildlife with the exception of flooded fields in winter for waterfowl. There are forested riparian areas, some larger scattered bottomland hardwood and cypress tupelo forests associated with oxbows and abandoned stream channels, and private lands enrolled in the NRCS Wetland Reserve Program (WRP). Approximately 16 percent of the project area is forested (USDA 2014). Native species in the riparian and forested areas include raccoon, mink, bobcat, coyote, deer, wild turkey, muskrat, river otter, beaver, turtles, snakes, frogs, toads, hawks, vultures, Mississippi kite, herons, egrets, bald eagles, kingfishers, songbirds, and woodpeckers.

Wetlands

The majority of the forested lands are streamside wetlands (USDA 2014). Most of these wetlands are bottomland hardwoods, e.g., willow oak, Nutall oak, overcup oak, bitter pecan, red maple, sweetgum, green ash. Riverine backwater flooding supports bald cypress and water tupelo swamps

in stream-connected depressions (Klimas et al. 2011). There are also restored wetlands in various stages of succession scattered throughout the project area.

Threatened and Endangered Species

Federally listed species within the study area include pondberry (*Lindera melissifolia*), sheepnose mussel (*Plethobasus cyphyus*), and rabbitsfoot mussel (*Quadrula cylindrica cylindrica*). Pondberry is a low growing, deciduous shrub approximately 1.5 to 6.5 feet in height that grows in clumps in shaded areas of mature bottomland hardwood forests. There are two known colonies of pondberry within Sunflower County located in small wooded patches along an agricultural drainage ditch outside of the project area (USFWS 2014). The endangered sheepnose mussel and threatened rabbitsfoot mussel are known to occur in the Big Sunflower River upstream of the Quiver River confluence. The sheepnose mussel is primarily found in larger rivers in shallow shoal habitats with moderate to swift currents over coarse sand and gravel. The rabbitsfoot mussel is typically found in medium-sized streams and some larger rivers in shallow areas along the bank and adjacent runs and shoals where water velocity is reduced. Within the Big Sunflower River, both species were found in gravelly shoals (Miller and Payne 2004). Both of these mussel species are tachytictic, or summer breeders (Parmalee and Bogan 1998). Potential fish hosts for these mussel species include rheophilic shiners, chubs, and minnows (Fobian 2007, Guenther et al. 2009, Wolf et al. 2012).

Socio-economic Resources

The study area lies in Leflore, Sunflower, and Tallahatchie Counties, Mississippi. These counties are all rural. Within the project area, more than 70 percent of the land is in agriculture.

The population of Leflore County in 2013 was estimated at 31,607 with an estimated 2.2 percent decrease from 2010. The median household income of Leflore County was $24,480 from 2009 to 2013. The largest employers by industry in Leflore County in 2013 were manufacturing (22%), retail trade (17%), and healthcare (12%). No other industry accounted for greater than 10 percent of the annual average employment.

The population of Sunflower County in 2013 was estimated at 27,997 with an estimated 4.9 percent decrease from 2010. The median household income was $26,619 from 2009 to 2013. The largest employers by industry in 2013 were transportation and warehousing (19%), retail trade (17%), healthcare (15%), and agriculture forestry, fishing, and hunting (12%). No other industry accounted for greater than 10 percent of the annual average employment.

The population of Tallahatchie County in 2013 was estimated at 15,081 with an estimated 1.9 percent decrease from 2010. The median household income was $29,853 from 2009 to 2013. The largest employers by industry in 2013 were retail trade (30%), agriculture forestry, fishing, and hunting (19%), and transportation and warehousing (12%). No other industry accounted for greater than 10 percent of the annual average employment. Appendix D includes more information on the socio-economic conditions in the area.

Water Quality

The study area has had hydrologic modifications such as clearing, snagging, channel enlargements, drainage ditches/alterations, weirs, diversions, and water withdrawals/irrigation. Low water, excessive sedimentation, and the accumulation of historically used organo-chlorine pesticides such as DDT are also common in the project area streams. In 2001, a fish consumption advisory was issued for all lakes, rivers, bayous, and sloughs in the Delta region of Mississippi due to DDT and toxaphene contamination, and although a few waterbodies have been removed from the advisory since that time none are located in the project area (MDEQ 2014a). This advisory recommends people limit their consumption of carp, gar, buffalo and large catfish (over 22 inches) to no more than two meals per month. The Tallahatchie River, Quiver River, and proposed transfer channel alignment are not identified on the 2014 303(d) list of impaired waters for the state of Mississippi; however, two Quiver River tributaries - Pecan Bayou and Turkey Bayou - in the vicinity of the project area are listed for organic enrichment/low dissolved oxygen (MDEQ 2014b). The Quiver River was listed on the 2006 303(d) list for sediment, organic enrichment/low dissolved oxygen, nutrients (primarily from nonpoint sources), and total nitrogen and total phosphorous. Total Maximum Daily Loads (TMDL) were developed in 2008 for all of these (MDEQ 2008a, 2008b, 2008c). Concentrations of nitrogen and phosphorus typically peak in the spring when agricultural fertilizers are applied and runoff occurs from bare, tilled soil (Shields et al. 2008).

Water Supply

The Quiver River has experienced the most severe groundwater level declines in the Delta over the past several decades as agricultural irrigation has increased to improve agricultural productivity. Water use from the Mississippi River Alluvial Aquifer (alluvial aquifer) exceeds natural recharge by an estimated 300,000 acre feet per year. Catfish farming is a significant industry in the region and relies on groundwater; the mineral content of surface water makes it less desirable for intensive fish farming. Row crop farmers also withdraw surface water from rivers and streams, including the Quiver. Agricultural surface water withdrawals from the Quiver and Big Sunflower Rivers reduce flow and compromise aquatic habitat.

Tailwater recovery and on-farm surface water impoundments are capturing some of the runoff from agricultural fields and reusing it for irrigation. These conservation practices do reduce the need to use groundwater and surface water for irrigation, but they also limit the amount of water that returns to the streams. The MRBI encourages use of such conservation practices. These conservation measures alone are not be sufficient to supply the water needed for agriculture and aquifer levels continue to decline in the region. Aquifer depletion and surface water withdrawals both degrade fish habitat.

FUTURE WITHOUT PROJECT CONDITIONS

Water use (groundwater and surface water) for irrigation purposes is expected to continue. The water level in the alluvial aquifer will continue to decline. Energy costs to pump groundwater will increase. The flow in the Quiver River will likely decrease. If the water supply declines too much, or the cost of pumping from the aquifer increases, there may be a change to crops that require less water. These crops would not be as valuable and agricultural benefits would decline. This could have impacts to both the regional and national economies.

Climate change may increase the frequency and duration of extreme weather events, such as floods or droughts. More frequent droughts would likely exacerbate the water supply, stream flow and groundwater issues.

Groundwater withdrawals will continue to exceed recharge capacity. It is possible that the cost of pumping water for irrigation would eventually make it economically unviable, but surface water withdrawals would not stop and the aquifer would not likely recover within the next 50 years.

There will be no foreseeable change in high water conditions in the study area. During high water, the Tallahatchie River will continue to exceed its banks and flow into the Quiver River and other adjacent streams.

Aquatic Resources and Fisheries

Aquatic habitat will continue to degrade as water withdrawals continue. Vegetation in the channel may increase as flows decline. Declining flow volume will decrease velocity and the habitat units available will decrease. Calculating habitat units for the Future Without Project (FWOP) would require making assumptions about the locations and amounts of future water withdrawals. For the purposes of the analysis of impacts, this calculation will not be done and the future without project habitat units will be assumed to be the same as the existing condition – 94.27 habitat units. Mussel populations will decline and more species will likely be lost from the Quiver. Declining flows will stress mussels more than fish because fish can move to other areas as water levels fall.

Terrestrial and Wildlife Resources

The majority of the project area is agricultural. If irrigation water becomes less available, less productive farm land may be converted to drier crops, pasture or may be allowed to lie fallow. More land may be enrolled in USDA conservation programs. The habitat for some species of wildlife could improve slightly if less land is farmed. Winter flooding for waterfowl hunting is likely to continue unchanged.

Wetlands

The only remaining wetlands known to occur in the area are the riparian forests. These are likely to remain. The lower flows in the late summer and fall may shift the species mix in some areas, but the spring high flows will provide the hydrology to sustain them.

Threatened and Endangered Species

Mussel habitat quality will continue to degrade and there will be less habitat available for rabbitsfoot and sheepnose. Pondberry would not likely establish within the project area.

Socio-economic Resources

The population would continue to decrease. There will be fewer jobs in the agricultural sector. Mechanization and farming practices changes are driving this trend throughout the region.

Water Quality

Nutrient levels peak in the spring and these are not likely to change. Lower flows in the late summer and fall will drive dissolved oxygen levels down. These flows will likely have no effect on sedimentation or scouring within the channel. Changes in agricultural practices could shift the use of fertilizers, but the change would not have a significant effect on water quality.

Water Supply

Water supply (groundwater and surface water) needs for irrigation are expected to continue. The water level in the alluvial aquifer will continue to decline and the energy costs to pump groundwater will increase. The amount of surface water available in the Quiver River will likely decrease. If the water supply declines too much, there may be a change to crops that require less water, more pasture, and/or more fallow lands. The drier crops would be less valuable. This could have negative impacts to both the regional and national economies. Catfish production would also decrease causing a significant economic impact in the region.

IV. FORMULATE ALTERNATIVE PLANS

The planning objectives must be directly related to the problems and opportunities identified for the study and will be used for the formulation and evaluation of plans. Historical data defined specific characteristics of the Quiver River and targets for habitat restoration. The strategy of the plan formulation is to address the low flow in the Quiver River, especially during the most impacted period of the year that is the fall fish young-of-year rearing period.

Modeling of the flow using the Tennant Methodology (discussed below) establishes the targeted flow to achieve and sustain ecological benefits. Measures are considered that will achieve some or all of these objectives in some quantifiable manner, and these are combined into alternative plans. The ability and costs of these plans to achieve the objectives are analyzed and use for screening and comparison purposes.

Management Measures

Measure 1. End alluvial aquifer use.

Measure 2. Transfer water from adjacent surface water source.

Measure 3. Modify Existing Weirs. This measure would modify the four existing weirs to allow for fish passage and increased water transfer down the channel during low flow periods.

Measure 4**.** Reconnection of historic oxbows and channels.

Measure 5. New Bayou Weirs. Placement of weirs at the downstream end of bayous to retain water within the bayous year round.

Measure 6. Riparian Forests. Establish riparian forests on stream banks.

Screening of Measures

Measure 1: This measure was screened and will not be carried forward into alternative formulation. It would cause increased use of Quiver River surface flow which would impact aquatic habitat. Catfish farming relies on groundwater. Complete elimination of aquifer use is not consistent with the state's statutory requirement for conjunctive use of surface water and groundwater and therefore is not a practical option.

Measure 2: This measure is retained for further analyses.

Measure 3: The measure was screened out and will not be carried forward into alternative formulation. The existing weirs are sheet metal and stone with a concrete cap. Modification of the weirs would require complete removal. It would also affect the function of the existing weirs and violate the second constraint.

Measures 4 and 5: Theses measures were screened out and will not be carried forward into alternative formulation. Survey data showed the Quiver River was too incised for these measures to provide benefits. Water would not enter into these oxbows and bayous from the Quiver River

without significantly altering them or the Quiver River. Increased water retention in these areas could also induce flooding.
Measure 6: This measure is retained for further analyses. It provides increases to water quality and aquatic fauna refugia habitat. It has relatively low implementation costs.

Formulation Strategy

Measures 2 and 6 were carried forward for alternative formulation.

Measure 2 had to be refined to determine transfer routes and possible quantities. The only adjacent surface water source that would provide a reliable summer and fall capacity is the Tallahatchie River. A series of connector channels would transfer water from the Tallahatchie River to the Quiver River - Cassidy Bayou, Swan Lake, Black Bayou, Parks Bayou, and Sandy Bayou. A newly constructed transfer ditch could be built, but using the existing channels will provide more benefits and be more cost efficient. Figure 8 shows the approximate route of water transfer from the Tallahatchie to the Quiver River.

Several factors impact the quantity of water that can be transferred from the Tallahatchie to the Quiver. First, water withdrawals cannot impact navigation in the Yazoo River. Second, water withdrawals cannot degrade habitat in the Tallahatchie. And third, water input into the Quiver River cannot induce flooding. Preliminary hydraulic analysis shows the Quiver River has the capacity to add 400 cfs during the irrigation season. This was set as the upper limit for the analysis. Habitat analysis using the Revised Tennant Method and the Tennessee Method indicate the historic low flow in the Quiver River was 60 – 100 cfs. The project flow for alternative formulation was set at 100 cfs. More detail is provided in the Appendix B.

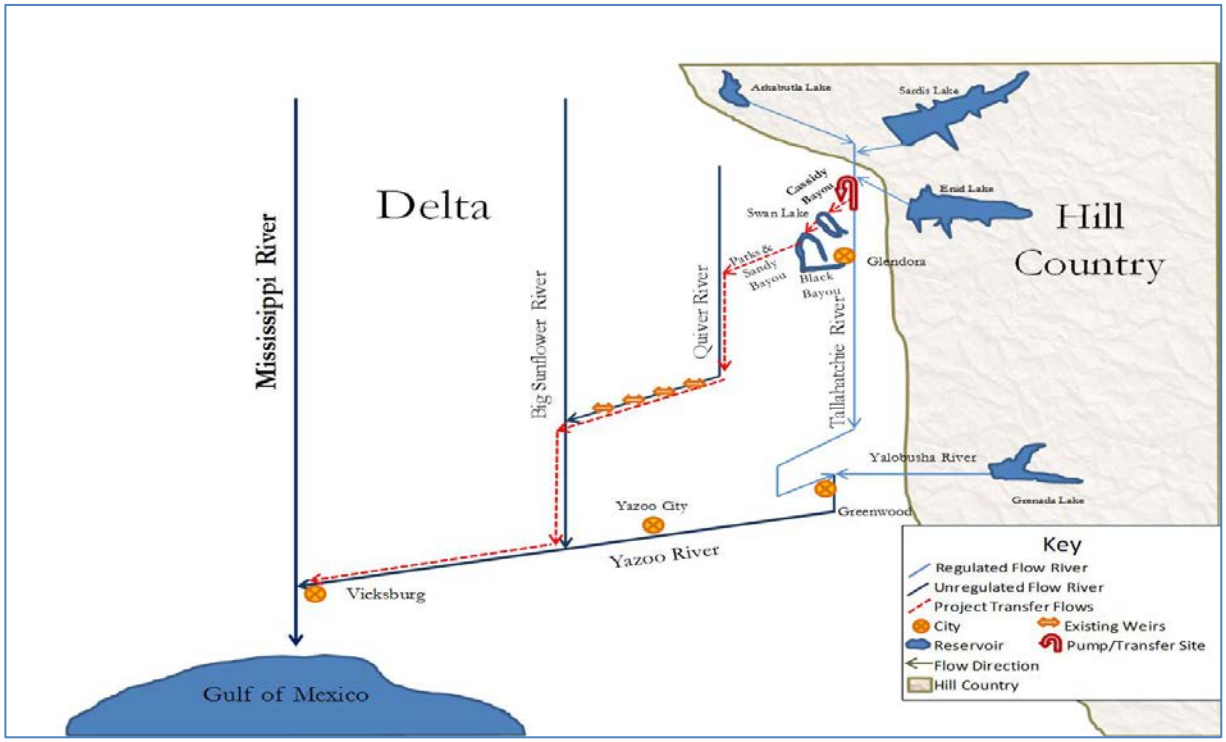

Figure 8. Transfer Conveyance from Tallahatchie River to the Quiver River (not to scale).

Initial Array of Alternative Plans

Alternative 1 is the No Action Alternative. Under this alternative, USACE would take no action to restore the ecosystem in the Quiver River or provide any additional water for agriculture. Other agencies would continue to manage resources in and around the Quiver River. USDA would continue to enroll willing landowners in conservation programs and MDEQ would continue to manage water quality and TMDLs.

Alternative 2 would transfer 100 cfs of water from the Tallahatchie River to the Quiver River. It would also plant trees on approximately 100 acres. At the request of Yazoo Management District, MDEQ provided assurances that the 100 cfs project flow would remain in the stream.

Alternative 3 would transfer 200 cfs of water from the Tallahatchie River to the Quiver River. It would also plant trees on approximately 100 acres. At the request of Yazoo Management District, MDEQ provided assurances that the 100 cfs project flow would remain in the stream.

Alternative 4 would transfer 300 cfs of water from the Tallahatchie River to the Quiver River. It would also plant trees on approximately 100 acres. At the request of Yazoo Management District, MDEQ provided assurances that the 100 cfs project flow would remain in the stream.

Alternative 5 would transfer 400 cfs of water from the Tallahatchie River to the Quiver River. It would also plant trees on approximately 100 acres. At the request of Yazoo Management District, MDEQ provided assurances that the 100 cfs project flow would remain in the stream.

Final Array of Alternative Plans

Alternatives 2 – 5 all include the same project flow of 100 cfs and would have similar benefits for the environment, although the larger alternatives would increase wetted perimeter in the transfer channels. The larger alternatives would have benefits for water supply and aquifer protection so all of the alternatives from the initial array were retained.

Alternative 1 – No Action: Under this alternative, USACE would take no action to restore the ecosystem in the Quiver River or provide any additional water for agriculture. A variety of non-structural actions from other agencies will continue.

USDA agencies would work with landowners to implement projects that would benefit habitat in the area and provide some aquifer protection.

The Farm Service Agency (FSA) manages the Farmable Wetlands Program. The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. By restoring farmable wetlands, FWP improves groundwater quality, helps trap and break down pollutants, prevents soil erosion, reduces downstream flood damage, and provides habitat for water birds and other wildlife.

FSA administers the Conservation Reserve Program (CRP). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

The Natural Resources Conservation Service (NRCS) administers the Agricultural Conservation Easement Program (ACEP). Agricultural Land Easements prevent conversion of productive working lands to non-agricultural uses and protect the long-term viability of the nation's food supply. Agricultural land easements provide additional public benefits, including environmental quality, historic preservation, wildlife habitat and protection of open space. Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, filter sediments and chemicals to improve water quality, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

NRCS also manages the Healthy Forests Reserve Program (HFRP). Land enrolled in HFRP easements must restore, enhance or measurably increase the recovery of threatened or endangered species, improve biological diversity or increase carbon storage.

Alternative 2 – 100 cfs: This alternative would build a pumping station on the Tallahatchie River approximately 2 miles north of Sharkey, MS. The station would have the capacity to pump 100 cfs from the Tallahatchie River. A 1,500 foot long channel would be excavated (63,000 cubic yards) to connect the pump station to Cassidy Bayou. Water would flow from Cassidy Bayou into Swan Lake. Water would flow from Swan Lake to Black Bayou, then to Sandy Bayou and then Parks Bayou, and finally into the Quiver River approximately 2.5 miles northeast of Brooks, MS. This alternative will require new weirs in Cassidy and Black Bayou so that water can reach the required water surface elevation without flowing back into the Tallahatchie. At Black Bayou 2.4 acres will be cleared to construct the weir and 1.3 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 100 cfs to pass. This will include up to 13,905 ft and 45,000 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared for construction and along the streambanks in areas where conservation easements are acquired; a maximum of 100 acres of tree planting is anticipated.

The pumping station would be operated to ensure 100 cfs is maintained in the Quiver River. Water transfers to meet the project flow are most likely in September and October, but some may also be needed in August and November. During October, nearly all of the 100 cfs will be needed to maintain the project flow. Irrigation season generally extends from May to August and water can be withdrawn from the system as long as the 100 cfs project flow is maintained. Operation of the pump is not likely from December through April when the extra water is not needed for irrigation or ecological flows. It is assumed the pump cannot be regulated to deliver less than 100 cfs.

All of the programs described for Alternative 1 would be available.

The estimated cost of this alternative is $11,634,653 (in 2016 dollars).

Alternative 3 – 200 cfs: This alternative is essentially the same as Alternative 2, however the pump station would have two 100 cfs pumps so that it can deliver 200 cfs for irrigation and ecological purposes, but only 100 cfs when needed to maintain the project flow.

At Black Bayou 2.4 acres will be cleared to construct the weir and 1.5 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 200 cfs to pass. This will include up to 22,700 ft and 114,100 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared for construction and along the streambanks in areas where conservation easements are acquired; a maximum of 100 acres of tree planting is anticipated.

All of the programs described for Alternative 1 would be available.

The estimated cost of this alternative is $15,829,056 (in 2016 dollars).

Alternative 4 – 300 cfs: This alternative is essentially the same as Alternative 2, however the pump station would have one 100 cfs pump, and one 200 cfs pump so that it can deliver 300 cfs for irrigation and ecological purposes, but only 100 cfs when needed to maintain the project flow.

At Black Bayou 2.5 acres will be cleared to construct the weir and 1.7 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 300 cfs to pass. This will include up to 38,600 ft and 191,700 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared for construction and along the streambanks in areas where conservation easements are acquired; a maximum of 100 acres of tree planting is anticipated.

All of the programs described for Alternative 1 would be available.

The estimated cost of this alternative is $17,577,719 (in 2016 dollars).

Alternative 5 – 400 cfs: This alternative is essentially the same as Alternative 2, however the pump station would have two 100 cfs pumps and one 200 cfs pump so that it can deliver 400 cfs for irrigation and ecological purposes, but only 100 cfs when needed to maintain the project flow.

At Black Bayou 2.6 acres will be cleared to construct the weir and 1.8 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 400 cfs to pass. This will include up to 41,700 ft and 249,200 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared for construction and along the streambanks in areas where conservation easements are acquired; a maximum of 100 acres of tree planting is anticipated.

All of the programs described for Alternative 1 would be available.

The estimated cost of this alternative is $20,236,141 (in 2016 dollars).

V. EVALUATE ALTERNATIVES

Alternative 1 – No Action. The impacts of this alternative were described in the Future Without Project Conditions Section.

Alternative 2 – 100 cfs.

Aquatic Resources and Fisheries

This alternative will address the three principal stressors on aquatic communities in the Quiver River and the transfer channels (Cassidy, Black, Sandy and Parks Bayous and Swan Lake). It will ensure a more natural stream flow and will improve water quality during late summer and autumn. The 100 acres of bottomland hardwood reforestation and the USDA programs restore habitat on the streambank, shade the streams, increase allocthonous input, and improve overall habitat conditions. The USDA programs also have the potential to reduce sedimentation.

The Delta Stream Minnow Model was applied to the October median flows in the Quiver River. The October median flows for this alternative range from approximately 104 to 114 cfs in the Quiver River. This flow would closely approximate the historic October flow in the Quiver River. The model found an average HSI of 0.41 in the Quiver River in October. The total surface acreage at October median flow is 467.05. The total Habitat Units available are 180.83 for a net increase of 86.56 over Alternative 1. As the habitat improves, some of the fish and mussel species in the Yazoo River are likely to move into the Quiver.

All of the fish and mussel species in the Tallahatchie River already have access to the Quiver River through the Yazoo and Big Sunflower Rivers and during headwater flooding. No new species will be introduced into the Quiver River. As the habitat in the Quiver River improves, more species are likely to colonize this area from elsewhere in the Basin. The required weirs on Black and Cassidy Bayous would not create barriers to fish passage or otherwise impact habitat.

Terrestrial and Wildlife Resources

Winter flooding for waterfowl will be the same. Improved fish and mussel populations will benefit a variety of animals that eat fish and mussels such as great blue herons, mink, and raccoon. Construction noise and activity will disturb wildlife and drive them from the area temporarily. Animals will return to the area post-construction. Some trees will be cleared to facilitate construction, but the areas will be replanted.

Wetlands

The weir sites on Black and Cassidy Bayous lie on the edge of the water. Construction will be managed to avoid impacts to these waterbodies. No other wetlands are known to occur in the areas proposed for construction. If wetlands are discovered, they will be avoided. Some of the transfer channels like Parks and Sandy Bayous were historic wetlands but are now dry most of the year. Restoring flow through these may restore some wetland functions. Wetted perimeter in Parks and Sandy Bayous would increase 10 - 50%. This alternative would replant approximately 100 acres of

high quality bottomland hardwoods along streambanks. These trees would benefit songbirds, squirrels and other species.

Threatened and Endangered Species

Mussel habitat quality will improve as indicated above and there will be more habitat available for rabbitsfoot and sheepnose mussel. Pondberry is not likely to recolonize the area. Coordination with U.S. Fish and Wildlife Service will confirm the determinations regarding impacts to listed species.

Socio-economic Resources

There will likely be a continued population decrease. Supplying some water for irrigation will improve productivity on farms, but would not significantly affect employment, because other factors are driving the decreases.

Water Quality

Water quality in the Tallahatchie and Quiver Rivers are similar so there would be no direct impact on water quality. Increased flows in the late summer and fall will raise dissolved oxygen levels and benefit fish and mussels. Although this alternative will increase flows from May to November, the flows will still be less than the spring high flows and will not increase sedimentation or scouring within the channel. There will be some short term disturbance in the connector channels during construction, but the channels will be dry at that time. Excavated material will be spread on adjacent agricultural fields.

Water Supply

This alternative would supply enough water to irrigate approximately 9,214 acres split equally among rice, soybeans, and corn. All of these acres are currently irrigated with groundwater. It is anticipated that groundwater would no longer be used to irrigate these acres.

Alternative 3 – 200 cfs.

Aquatic Resources and Fisheries

The effects of this alternative will be similar to that for Alternative 2. Although more water will be diverted into the system for irrigation, these higher diversions will occur during early to mid-summer, and not during the low flow season. The total Habitat Units available are 180.83, net increase of 86.56, same as Alternative 2 because the October flows are the same for both alternatives. As the habitat improves, some of the fish and mussel species in the Yazoo River are likely to move into the Quiver.

Terrestrial and Wildlife Resources

Winter flooding for waterfowl will be the same. Improved fish and mussel populations will benefit a variety of animals that eat fish and mussels such as great blue herons, mink, and raccoon. Construction noise and activity will disturb wildlife and drive them from the area temporarily.

Animals will return to the area post-construction. Some trees will be cleared to facilitate construction, but the areas will be replanted.

Wetlands

Similar impacts to Alternative 2. Wetted perimeter in Parks and Sandy Bayous would increase 20 - 100%. This alternative would replant approximately 100 acres of high quality bottomland hardwoods along streambanks. These trees would benefit songbirds, squirrels and other species.

Threatened and Endangered Species

Mussel habitat quality will improve as indicated above and there will be more habitat available for rabbitsfoot and sheepnose mussel. Pondberry is not likely to recolonize the area. Coordination with U.S. Fish and Wildlife Service will confirm the determinations regarding impacts to listed species.

Socio-economic Resources

There will likely be a continued population decrease. Supplying 200 cfs for irrigation will improve productivity on farms more than supplying 100 cfs, but it would not significantly affect employment.

Water Quality

The effects on water quality for this alternative will be similar to those described for Alternative 2.

Water Supply

This alternative would supply enough water to irrigate approximately 18,427 acres split equally among rice, soybeans, and corn. All of these acres are currently irrigated with groundwater. It is anticipated that groundwater would no longer be used to irrigate these acres

Alternative 4 – 300 cfs.

Aquatic Resources and Fisheries

The effects of this alternative will be similar to that for Alternative 2. Although more water will be diverted into the system for irrigation, these higher diversions will occur during early to mid-summer, and not during the low flow season. The total Habitat Units available are 180.83, net increase of 86.56, same as Alternative 2 because the October flows are the same for both alternatives. As the habitat improves, some of the fish and mussel species in the Yazoo River are likely to move into the Quiver.

Terrestrial and Wildlife Resources

Winter flooding for waterfowl will be the same. Improved fish and mussel populations will benefit a variety of animals that eat fish and mussels such as great blue herons, mink, and raccoon. Construction noise and activity will disturb wildlife and drive them from the area temporarily.

Animals will return to the area post-construction. Some trees will be cleared to facilitate construction, but the areas will be replanted.

Wetlands

Similar impacts to Alternative 2. Wetted perimeter in Parks and Sandy Bayous would increase 30 - 150%. This alternative would replant approximately 100 acres of high quality bottomland hardwoods along streambanks. These trees would benefit songbirds, squirrels and other species.

Threatened and Endangered Species

Mussel habitat quality will improve as indicated above and there will be more habitat available for rabbitsfoot and sheepnose mussel. Pondberry is not likely to recolonize the area without intervention. Coordination with U.S. Fish and Wildlife Service will confirm the determinations regarding impacts to listed species.

Socio-economic Resources

There will likely be a continued population decrease. Supplying 300 cfs for irrigation will improve productivity on farms more than supplying 100-200 cfs, but it would not significantly affect employment.

Water Quality

The effects on water quality for this alternative will be similar to those described for Alternative 2.

Water Supply

This alternative would supply enough water to irrigate approximately 27,641 acres split equally among rice, soybeans, and corn. All of these acres are currently irrigated with groundwater. It is anticipated that groundwater would no longer be used to irrigate these acres

Alternative 5 – 400 cfs.

Aquatic Resources and Fisheries

The effects of this alternative will be similar to that for Alternative 2. Although more water will be diverted into the system for irrigation, these higher diversions will occur during early to mid-summer, and not during the low flow season. The total Habitat Units available are 180.83, net increase of 86.56, same as Alternative 2 because the October flows are the same for both alternatives. As the habitat improves, some of the fish and mussel species in the Yazoo River are likely to move into the Quiver.

Terrestrial and Wildlife Resources

Winter flooding for waterfowl will be the same. Improved fish and mussel populations will benefit a variety of animals that eat fish and mussels such as great blue herons, mink, and raccoon.

Construction noise and activity will disturb wildlife and drive them from the area temporarily. Animals will return to the area post-construction. Some trees will be cleared to facilitate construction, but the areas will be replanted.

Wetlands

Similar impacts to Alternative 2. Wetted perimeter in Parks and Sandy Bayous would increase 40 - 200%. This alternative would replant approximately 100 acres of high quality bottomland hardwoods along streambanks. These trees would benefit songbirds, squirrels and other species.

Threatened and Endangered Species

Mussel habitat quality will improve as indicated above and there will be more habitat available for rabbitsfoot and sheepnose mussel. Pondberry is not likely to recolonize the area. Coordination with U.S. Fish and Wildlife Service will confirm the determinations regarding impacts to listed species.

Socio-economic Resources

There will likely be a continued population decrease. Supplying 400 cfs for irrigation will provide the biggest improvement in productivity, but it would not significantly affect employment.

Water Quality

The effects on water quality for this alternative will be similar to those described for Alternative 2.

Water Supply

This alternative would supply enough water to irrigate approximately 36,855 acres split equally among rice, soybeans, and corn. All of these acres are currently irrigated with groundwater. It is anticipated that groundwater would no longer be used to irrigate these acres

VII. COMPARE ALTERNATIVE PLANS

Several different sets of criteria were used to compare the alternative plans. The first two are from the 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The last table compares other pertinent information for the alternatives.

Table 1. Summary of Alternatives relative to the Planning Objectives

Alternatives	Costs	AAHU increase Objective 1	Wetted Perimeter Increase Objective 2	Bottomland Hardwood Acres Objective 3	NED Excess Annual Benefits Objective 4
1 – No Action	$0	0	0	0	0
2 – 100 cfs	$11,634,653	86.56	10 – 50 %	100	$151,000
3 – 200 cfs	$15,829,056	86.56	20 – 100%	100	$137,000
4 – 300 cfs	$17,577,719	86.56	30 – 150%	100	$225,000
5 – 400 cfs	$20,236,141	86.56	40 – 200%	100	$275,000

Table 2. Qualitative Assessment of the Four Principles and Guideline Criteria (for both the federal ecosystem mission and local water supply)

Alternatives	Completeness	Effectiveness	Efficiency	Acceptability
1 – No Action	This alternative provides no benefits.	This alternative will not alleviate any problems or achieve any opportunities	Although this alternative has no cost, habitat conditions will decline. It is not efficient.	There are no obstacles to implementing this plan, but it provides no solution to the identified problems.
2 – 100 cfs	This alternative is complete. All benefits can be achieved without further actions.	All four action alternatives would effectively solve the habitat problems. This alternative would provide some benefits for water supply, but would not solve the problem as much as other plans.	This plan is the most efficient for NER benefits.	This alternative is implementable. It will provide resolution for the ecosystem problems and will alleviate some of the identified water supply problems.
3 – 200 cfs	This alternative is complete. All benefits can be achieved without further actions.	All four action alternatives would effectively solve the habitat problems. This alternative is the third most effective in resolving water supply problems.	This plan is the second most efficient for NER benefits.	This alternative is implementable. It will provide the same amount of resolution for the ecosystem problems and will provide more resolution of the identified water supply problems than Alternative 1 or 2.
4 – 300 cfs	This alternative is complete. All benefits can be achieved without further actions.	All four action alternatives would effectively solve the habitat problems. This alternative is the second most effective in resolving water supply problems.	This plan is the third most efficient for NER benefits.	This alternative is implementable. It will provide the same amount of resolution for the ecosystem problems and will provide more resolution of the identified water supply problems than Alternative 1, 2 or 3.
5 – 400 cfs	This alternative is complete. All benefits can be achieved without further actions.	All four action alternatives would effectively solve the habitat problems. This alternative would provide the most resolution for the water supply problem.	This alternative is the least efficient for NER benefits among the four action alternatives.	This alternative is implementable. It will provide the same amount of resolution for the ecosystem problems and will provide the most resolution of the identified water supply problems.

Table 3. System of Accounts Alternative Comparison

Alternatives	NED	EQ	RED	OSE
1 – No Action	This alternative provides no benefits.	This alternative will not alleviate any problems or achieve any opportunities	No impact.	No impact
2 – 100 cfs	The net excess average annual benefits of this alternative are $151,000.	This alternative will provide EQ benefits.	This alternative would have the least RED benefits during construction because it is the smallest of the action alternatives. Some RED benefits may derive for the operation, maintenance and monitoring of the pump station, and they would be similar for all alternatives.	All of the construction is in rural areas. There are no anticipated effects on noise, air quality, community cohesion or any other factor significant to OSE.
3 – 200 cfs	The net excess average annual benefits of this alternative are $137,000.	Same benefits as Alt 2.	This alternative would have the second least RED benefits. Slightly more operation, maintenance and monitoring RED benefits.	All of the construction is in rural areas. There are no anticipated effects on noise, air quality, community cohesion or any other factor significant to OSE.
4 – 300 cfs	The net excess average annual benefits of this alternative are $225,000.	Same benefits as Alt 2.	This alternative would have the second most RED benefits during construction. Slightly more operation, maintenance and monitoring RED benefits.	All of the construction is in rural areas. There are no anticipated effects on noise, air quality, community cohesion or any other factor significant to OSE.
5 – 400 cfs	The net excess average annual benefits of this alternative are $275,000.	Same benefits as Alt 2.	This alternative would have the most RED benefits. Slightly more operation, maintenance and monitoring RED benefits.	All of the construction is in rural areas. There are no anticipated effects on noise, air quality, community cohesion or any other factor significant to OSE.

VIII. TENTATIVELY SELECTED PLAN

PLAN SELECTION

The National Ecosystem Restoration (NER) Plan is Alternative 2. It is the most efficient plan and delivers the most ecosystem benefits for the cost.

The non-Federal Sponsor prefers Alternative 5 and is prepared to pay the difference between the NER plan and Alternative 5. Therefore, the Tentatively Selected Plan (TSP) is the locally preferred plan (LPP) - Alternative 5, which is a multipurpose Ecosystem Restoration and Water Supply plan. The TSP maximizes water supply benefits compared to costs. Provides the same level of ecosystem benefits as the NER plan, and is consistent with the Federal objectives. This alternative allows the non-Federal sponsor to provide a reliable water source for irrigation and reduce aquifer depletion.

The Assistant Secretary of the Army for Civil Works approved a waiver to allow the LPP on 23 June 2016. That approval stated in part:

> The LPP includes all the measures of the NER plan, but would include an enlarged diversion structure from the Tallahatchie River and a modification to the Sandy Bayou and Parks Bayou to allow for the capability to provide up to 400 cfs of water for agricultural water supply purposes. The additional withdrawals for agriculture irrigation would typically occur from May through August of any given year. The priority for the withdrawal of the 100 cfs flow of water is to support the ecosystem restoration. Additional withdrawals for agricultural purposes would not impair the proposed restored flows for the Quiver River nor the existing flows of the Tallahatchie. By allowing the withdrawals of surface flows for agricultural purposes, there would be fewer withdrawals from the aquifer, thereby supporting a continued stabilization of the aquifer and potential capacity for increased recharge.

ECOSYSTEM SIGNIFICANCE

Streams are important as spawning and nursery habitats, seasonal feeding areas, refuges from predators and competitors, shelter from extreme weather, and travel corridors. The Mississippi Department of Environmental Quality considers the ecosystem of the Quiver River to be significant and has committed to regulate the extraction of surface water out of the Quiver River for the purpose of ecosystem restoration. Institutional, technical, and public importance factors as described in ER 1105-2-100 are:

Institutional Importance

The TSP would improve conditions for these listed species:
Endangered Species Act
- Sheepnose mussel (*Plethobasus cyphyus*) [endangered]
- Rabbitsfoot mussel (*Quadrula cylindrica*) [threatened]

Mississippi State Heritage Program
- Pyramid pigtoe mussel (*Pleurobema rubrum*)
- Mucket mussel (*Actinonias ligamentina*)
- Spike mussel (*Elliptio dillata*

Technical Importance

Greater than 80% of bottomland hardwood forest wetlands in the Mississippi Alluvial Valley have been lost to deforestation which is positively correlated with regional losses of biodiversity and degradation of downstream water quality. These loss percentages are thought to be similar to the losses within the Quiver River.

The needs within the watershed for conservation practices and partnerships that improve water quality, restore riparian forests, enhance wildlife habitat, while sustaining agriculture productivity is becoming an increasingly high priority. The Quiver River is located within the Big Sunflower River Watershed, which NRCS specifically identified as a focus area of the Mississippi River Basin Healthy Watersheds Initiative (MRBI)(Figure 9). The Natural Resources Conservation Service (NRCS) works through the MRBI to work with producers to conserve America's natural resources while ensuring economic viability of cropland. The MRBI is part of a commitment of $100 million over four years to address critical water quality concerns in priority watersheds while boosting rural economies.
http://www.nrcs.usda.gov/Internet/FSE_MEDIA/nrcseprd336528.jpg.

The study area is located entirely within the Mississippi River Basin which is one of eight critical conservation areas (CCAs) designated by the Secretary of Agriculture as priority regions across the country. Identified resource concern priorities are water quality degradation, inefficient use of irrigation water, and inadequate habitat for fish and wildlife. The Regional Conservation Partnership Program is being implemented by NRCS to focus conservation efforts within this high priority CCA.

Yazoo-Mississippi Delta Joint Water Management District (YMD) Groundwater reports 1990 – present

YMD and USGS studies show a 21.5 ft decline in the water surface of the aquifer since 1990. This is a strong indicator of the increasing scarcity of the groundwater resource.

The decline of the aquifer decreases the base flow in some tributaries of the Quiver River. The decreased flow limits fish habitat and decreases biodiversity and in-stream connectivity.

The diversity of the Quiver River is far below that of other streams in the larger watershed that benefit from water releases upstream. The Tallahatchie River adjacent to the Quiver River receives additional flow from the USACE owned and operated Sardis Reservoir, which is one of four USACE reservoirs in Mississippi.

Perennial streams and smaller rivers, which provide a significant portion of the flow to higher order rivers like the Yazoo and Mississippi Rivers, have been reduced to intermittent streams in the Mississippi River delta. These former perennial streams and rivers provided the nursery areas and important habitat for many terrestrial, avian, and aquatic species.

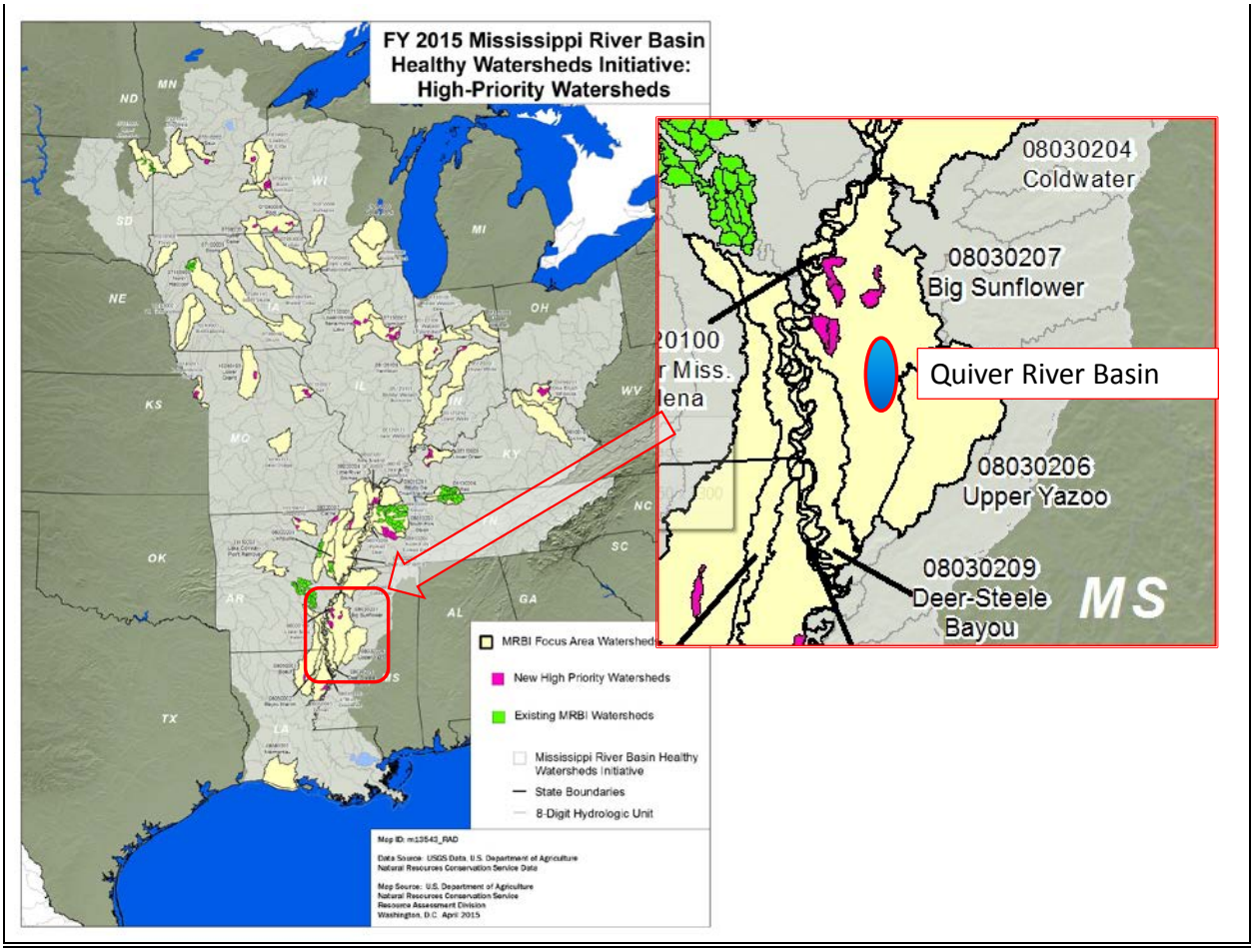

Figure 9. NRCS Mississippi River Basin Initiative Focal Areas - Big Sunflower

Public Importance

The American Fisheries Society vulnerable species list in the Yazoo River Basin (larger encompassing watershed) include the American eel, paddle fish and blue sucker. These rheophilic species (prefers to live in fast moving water) likely used the Quiver River during portions of their life cycle when it experienced perennial flows, and this potential would return if flow in the Quiver River was restored. Restoring the presence of rheophilic species in the Quiver would result in increased aquatic species richness and diversity and aid to increased biodiversity in the larger system. The interagency Neo-tropical Migratory Bird Conservation Program, known as Partners in Flight (PIF), have identified bottomland hardwood forests throughout the southeast as a habitat of regional concern from the impacts of its loss and high fragmentation to breeding birds. The Department of Defense participates in this effort (http://www.dodpif.org) with representatives from all branches of the Services. The Corps of Engineer's representative is from the Engineering Research and Development Center in Vicksburg, Mississippi. The key components to DoD PIF's work are its partnerships at local, state, regional, national, and international levels, as well as its leadership in implementing ecosystem-based bird conservation planning, installation, and regional Integrated Management Plans (INRMPs), the DoD Coordinated Bird Monitoring Plan, North

American Bird Conservation Initiative (NABCI) projects, management of DoD's Important Bird Areas Program, and the Bird/Animal Aircraft Strike Hazard (BASH) Program.

Implementation Plan

Real Estate

Real estate interests will be acquired for access, the pump station, new disposal sites, channel weir locations, construction areas, and planting areas. All property is agricultural land.
The following will be acquired in the Cassidy Bayou area (5 owners):
Perpetual Road Easement for access to site (5.77 acres)
Perpetual Channel Easement (includes Channel, Weir & Disposal Areas) (54.25 acres)
Fee excluding minerals (Proposed Pump Site) (11.73 acres)

The following will be acquired in the Black Bayou area (2 owners):
Perpetual Road Easement for access to site (4.02 acres)
Perpetual Channel Improvement Easement (includes Area for Weir) (22.70 acres)
Quiver River excavation will be on private water bottoms and a channel easement will be acquired, as well as a temporary work area easement for the disposal of the excavated materials. The location of these excavation and disposal areas has not been identified yet. The project will reforest riparian stream banks with native bottom land hardwood species within 25 feet of both bank tops at several locations within Tallahatchie and Leflore Counties. Possible areas of reforestation are Cassidy Bayou, Fish Lake Outlet, Black Bayou, Sandy Bayou, Parks Bayou, Quiver River and Big Sunflower River. Actual locations have not been identified at this time. The District proposes the acquisition of a Bank Protection and Reforestation Easement. This subject will be addressed further in final REP.

Construction Method

The construction of the channel cross overs is based on a dragline excavating from the top bank and casting the material into a spoil bank running parallel to the channel. The material in the spoil bank is to be spread and shaped by dozers. The construction of the weirs consist of stone with a sheet pile cut-off. It is assumed that the water would be diverted around or through the site so that the construct can be in the dry. The sheet piling is to be driven by pile driving equipment (crane, pile hammer, and etc.). A hydraulic excavator and front-end loader is to place the stone for each weir.

In general the pumping station consist of a concrete substructure supported on H-piles, a metal building superstructure housing electric pumps, misc. equipment and materials associated with pumps, and a riprap channel protection. It is assumed that a dewatering system (well points) is required. Dozers and an hydraulic excavator would be used to clear and grub the site. The hydraulic excavator with the assistance of a dozer is to excavate the channel and the site for the structure. The H-piles are to be driven by pile driving equipment (crane, pile hammer, and etc.). A crane is to be used to place the concrete, construct the metal building, and to install the pumps. A hydraulic excavator, dozer, front-end loader, rollers are used to place fill/backfill for the structure. The hydraulic excavator and front-end loader would place the riprap and filter stone for the riprap channel protection.

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 provides construction authority and appropriations for the project. Below is a generic schedule which will be further refined after detailed plans and specifications are developed.

- Receive Congressional Authority and Appropriation
- Negotiate the Project Partnership Agreement – Duration 100 days
- Prepare for Surveying and initiate field work – Duration 45 days
- Develop Plans and Specs – Duration 255 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 3 years to complete

Operations, Maintenance, Repair, Rehabilitation, and Replacement

The project flow of 100 cfs will be measured at the downstream most weir in the Quiver River. If the flow is below 100 cfs, the pumps must be engaged to reach 100 cfs and/or water withdrawals in the system must stop.

Cost-Sharing Requirements

For the TSP, the cost of the NER (100 cfs) plan will be cost shared at a 65% Federal and 35% non-Federal sponsor. Per ER 1105-2-100, Chapter 3.b.3, the non-Federal sponsor must pay all cost allocated to water supply purposes. Therefore, any cost above the 100 cfs pump (NER) will be 100% funded by the non-Federal sponsor. Detailed cost information can be found in Appendix E.

Table 4. Cost Apportionment for the NER and LPP Plans in 2016 dollars

Item	NER Plan – Alternative 2*	LPP – Alternative 5 (TSP)
Lands and Damages	$502,750	$502,750
Channels and Canals	$3,642,662	$5,495,491
Pumping Plant	$4,812,223	$9,513.076
PED	$2,028,044	$3,579,411
Construction Management	$648,974	$1,145,412
Interest During Construction	$517,000	$895,000
Total	**$12,151,653**	**$21,131,140**

*The Federal Cost Share limit is 65% of the NER Plan.

Table 5. Cost Apportionment for the LPP in 2016 dollars

Item	Federal Cost	Non-Federal Cost	Total
Construction (not including interest during construction)	$7,562,524*	$12,673,617	$20,236,141
Feasibility Study	$675,000	$675,000	$1,350,000
Monitoring and Adaptive Management	$97,500	$52,500	$150,000
Total	$8,335,024	$13,401,117	$21,736,141
Annual OMRR&R		$93,000	$93,000

*This is 65% of $11,634,653 – the NER construction cost without interest during construction.

Table 6. Sponsor Responsibility for the LPP in 2016 dollars

Item	Cost
LERRDS	$502,750
Feasibility Study	$675,000
Monitoring and Adaptive Management	$52,500
Cash	$12,170,867
Annual OMRR&R	$93,000

Monitoring and Adaptive Management

The project is designed to benefit fish and mussels. Baseline fish and mussels surveys will be done prior to beginning pump operation. Mussel surveys will be done in years 0, 3, and 5 and fish monitoring in years 0, 2 and 4. The Year 0 monitoring will include habitat and substrate surveys to establish the monitoring locations. After year 5, the results will be examined to determine if mussels have recolonized in the Quiver River and if the appropriate fish hosts are present. Monitoring will cease if results for both are positive. If either fish or mussels do not respond, adaptive management may be necessary. If fish species do not show a positive response, the system will be examined for potential barriers or other limiting factors. If fish respond but mussels do not, mussels could be relocated from within the Quiver/Big Sunflower system. Monitoring will continue after adaptive management actions.

The Year 0 mussel and fish surveys are estimated at $18,000, and the subsequent surveys will be $12,000 each. The initial fish survey will be $15,000 and subsequent surveys will be $10,000 each. The total cost of monitoring will be between $77,000 and $120,000. Relocating mussels would cost around $20,000. A total of $150,000 is estimated for monitoring and adaptive management.

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 the costs for the NER plan and 100% of the costs for the difference between the NER plan and the LPP:

> 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

Several uncertainties will be addressed during the development of feasibility level designs for the project.

1. Channel capacity of Quiver River and transfer channels will be verified during feasibility level design. The existing surveys date to 1980 and there is potential for changed conditions that may require modification to the NER plan and/or the LPP.

2. The height and status of existing weirs in the system will be verified during feasibility level design and could require some adjustments in the anticipated channel work in the connector channels.

3. The locations of bottomland hardwood reforestation are not known. All of the alternatives propose 100 acres, but is dependent on willing land owners. The habitat value will be higher if the replanting connects or creates larger contiguous blocks of forest

Environmental Disclosures

Environmental Operating Principles

Operating Principal #3 – Create mutually supporting economic and environmentally sustainable solutions. Quiver River is a severely degraded ecosystem that due to low flow or no flow conditions nearly every year provides poor aquatic habitat. A relatively simple project to lift water and let it gravity flow into the watershed from an adjacent river with year round flow (due to reservoir management) can significantly increase aquatic habitat. Additionally, for some additional cost, reliable agricultural production and food security can be increased.

Operating Principal #5 – Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs. A relatively simple project provides surface water as a resource for a degraded system with only life cycle management needed for the pumping facilities. Since this is not a flood risk management project, and once the lift is initiated from the Tallahatchie the remaining flow is gravity based, there will be little to no long term channel maintenance expected. The risk of poor performance is minimal.

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.

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 search of EPA databases on superfund sites (CERCLIS), toxic release inventory (TRI), hazardous waste sites (RCRA), Brownfields facilities (ACRES), facilities regulated for toxic substances (TSCA), facilities regulated for radiation and radioactivity (RADInfo), and water discharge permits (PCS) revealed that no releases or spills occurred within the proposed work limits. A search of MDEQ databases for underground storage tanks also revealed no tanks within the proposed work limits. If any HTRW is encountered during construction activities, the proper handling and disposal of these materials would be coordinated with the Mississippi Department of Environmental Quality (MDEQ) and USEPA.

State and Federal Holdings

There are no state or federal holdings within the project area.

Cultural Resources

A search of the Mississippi Historic Resources Inventory Database (2011) for recorded archaeological sites and previous surveys within one (1) mile of the proposed project areas did not reveal any recorded sites within the footprint of any of the proposed project features. However, several archaeological sites have been recorded within the one mile search area. Twenty-three sites were identified within one mile of the Black Bayou Weir project area, including 22 National Register of Historic Places (NRHP) ineligible, and one NRHP unevaluated site. Twenty seven (27) archaeological sites were identified within one mile of the proposed Cassidy Bayou Weir and Pump

Station, including 23 NRHP ineligible sites, three NRHP eligible, and one NRHP listed Mississippian mound and associated artifact scatter. Along with the archaeological sites, the MDAH database indicated six cultural resource surveys have been performed within one mile of this proposed project area. Three (3) archaeological sites were identified within one mile of the proposed Cassidy Transfer Cut at area 1, including two NRHP unevaluated sites, and one site listed as NRHP eligible. Finally, 10 archaeological sites were identified within one mile of the proposed Cassidy Transfer Cut at area 2, including six NRHP ineligible sites and four NRHP eligible. The MDAH database also indicates one archaeological survey within one mile of the proposed project area.

Elements of this project are still in design stages, but the area of proposed effect (APE) will be contained within the boundaries of the currently defined Rights-of-Entry (ROE) areas, and in close proximity to the project locations. When firm design plans that include the final APEs are finalized these will be supplied to the State Historic Preservation Officer (SHPO) and the Tribal Historic Preservation Officers (THPO) with vested interests in the culture resources in these areas. Since the ROE areas, and in turn future APEs, have not been previously surveyed for cultural resources, pursuant to 36 CFR 800, approximately 100% of the APEs will be Phase I surveyed for cultural resources prior to construction. The results of these surveys will be presented to the SHPO and THPOs during consultation. Should cultural resources be encountered during surveys, the U.S. Army Corps of Engineers, following consultation with the SHPO and THPOs, will first seek to avoid sites. If avoidance is not possible, coordination will be initiated with the Advisory Council on Historic Preservation, SHPO, and THPOs to develop appropriate testing and mitigation procedures.

Recreation Resources

The state of Mississippi recently conducted surveys of residents and an associated report of recreational needs (MDWFP 2014). The top five recreational activities that Mississippi residents participate in include fishing on a bank or pier, fishing on a boat, camping, jogging/running/walking for exercise, and events/festivals. The top five activities that Mississippi residents stated they would like to participate in include hiking and trails, canoeing/kayaking/rafting/tubing, water parks/splash pool/sprayground, camping, and archery. The proposed project would take some water from the Tallahatchie River and move it to the Quiver River. This would slightly improve recreational fishing opportunities in the Quiver River, but is not likely to have any significant effect on fishing in the Tallahatchie.

Prime & Unique Farmlands

The majority (>70 percent) of the lands in the project area are in agriculture. Dominant crops include soybeans (~41 percent), corn (~12 percent), rice (~5 percent), and cotton (~4 percent) in the vicinity of the project area (USDA 2014). Aquaculture becomes more prevalent along the downstream reaches of the Quiver River accounting for approximately 1 percent of the project area. The majority of agricultural lands immediately adjacent to the Tallahatchie River, proposed transfer channel, and Quiver River are considered prime farmland with the exception of those adjacent lands of the Quiver River in Leflore County (SSURGO 2014).

The project will not convert any prime farmland to other uses.

Environmental Justice

The Department of Defense's Strategy on Environmental Justice of 1995, directs Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population.

In Leflore County, the civilian labor force unemployment rate was 10.6 percent from November 2013 to December 2014. The amount of the population living below the poverty level in 2013 was 41.1 percent. The population of Leflore County in 2013 consisted of: 72.6 percent Black or African American, 24.1 percent white persons not Hispanic, 2.5 percent persons of Hispanic or Latino origin, 0.7 percent Asian, 0.4 percent American Indian and Alaska Native, less than 0.1 percent was Native Hawaiian and Other Pacific Islander, and 0.7 percent persons reporting two or more races.

In Sunflower County, the civilian labor force unemployment rate was 12.3 percent from November 2013 to December 2014. The amount of the population living below the poverty level in 2013 was 45.0 percent. The population of Sunflower County in 2013 consisted of: 72.8 percent Black or African American, 25.2 percent white persons not Hispanic, 1.5 percent persons of Hispanic or Latino origin, 0.4 percent Asian, 0.3 percent American Indian and Alaska Native, less than 0.1 percent was Native Hawaiian and Other Pacific Islander, and 0.6 percent persons reporting two or more races.

In Tallahatchie County, the civilian labor force unemployment rate was 9.6 percent from November 2013 to December 2014. The amount of the population living below the poverty level in 2013 was 38.4 percent. The population of Sunflower County in 2013 consisted of: 56.5 percent Black or African American, 36.2 percent white persons not Hispanic, 6.0 percent persons of Hispanic or Latino origin, 0.9 percent Asian, 0.3 percent American Indian and Alaska Native, 0.1 percent was Native Hawaiian and Other Pacific Islander, and 1.0 percent persons reporting two or more races.

The minority populations of the counties encompassing the project area are greater than 50 percent and are meaningfully greater than the general population. No residential, commercial, or industrial areas exist within or adjacent to the proposed project area. Impacts associated with construction activities of the pump station, weirs, and associated channel work would be temporary and have no disproportionate effects to environmental justice communities. Additionally, the project would not result in any loss of flood risk reduction from existing flood risk management projects in the area.

Navigation

The Tallahatchie River receives discharges from three of the four flood control reservoirs in Mississippi. Due to these releases the summer and fall flow in the Tallahatchie River is an order of magnitude higher than it was prior to the construction of the reservoirs. All of the streams connected to the reservoirs are greatly enhanced by the operation of the reservoirs. The following hydrograph from a gage near Glendora, which is downstream of the proposed transfer point, shows that the withdrawals for ecosystem restoration and water supply is less than 10% of the Tallahatchie flow downstream of the transfer point and would not affect navigation downstream.

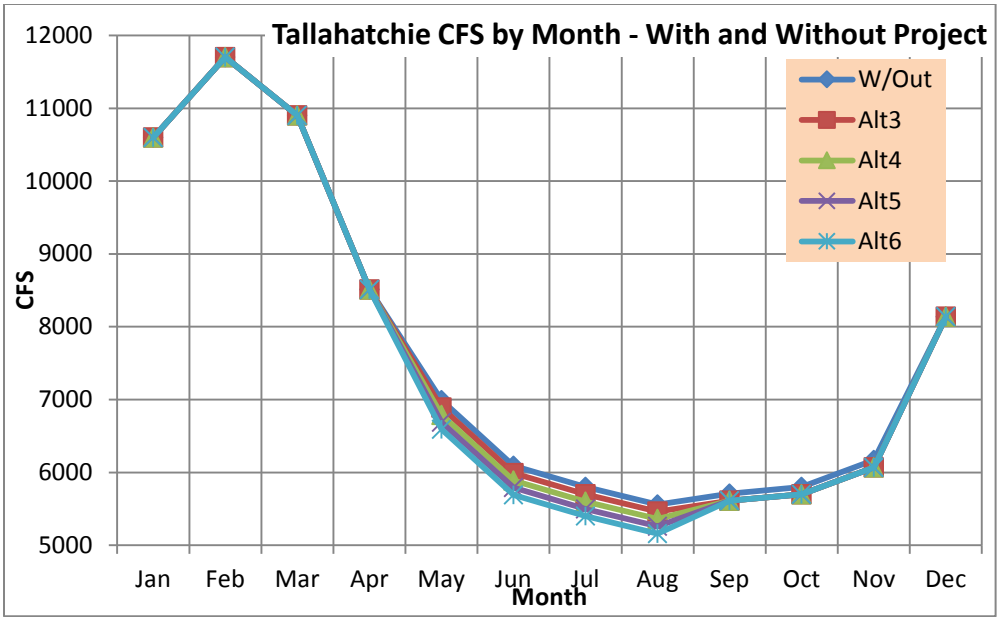

Figure 10. Tallahatchie stages by alternative (Alt 3= 100cfs, Alt 4 =200cfs, Alt 5=300cfs, Alt 6=400cfs)

Air Quality

Leflore, Sunflower, and Tallahatchie counties, Mississippi are all presently classified as "in attainment" with the state's air quality requirements. Project construction would require heavy equipment and there would be some mobile, temporary sources of emissions. These would not violate air quality standards. The planned pump station will be electric powered and will have no on-site emissions.

Noise

There will be an increase in noise during construction, but the construction areas are rural and near developed agricultural areas. The temporary increase in noise will not have significant impacts on the human environment and is not likely to disturb wildlife. The pumps are electric-powered and will be audible when operating, but only at close range.

Water Quality

A draft 404(b)1 Water Quality Analysis is included in Appendix F. At this time, the impacts to water quality are expected to be minor and short term. More detailed analysis will be done during the development of feasibility level designs and plans and specifications. The Vicksburg District will obtain Water Quality Certification from the State of Mississippi prior to construction. If the LPP would induce any unavoidable impacts, they would be mitigated in accordance with the Clean Water Act and state laws.

VIEWS OF THE NON-FEDERAL SPONSOR

The Non-Federal Sponsor supports the TSP, the Locally Preferred Plan, and provided a letter to the Vicksburg District on 21 September 2015 affirming their support. The letter also confirms their understanding that they will be responsible for all incremental costs over and above the costs associated with the 100 cfs National Ecosystem Restoration Plan, including any additional design, real estate, construction, operational, or maintenance costs.

CUMULATIVE EFFECTS

Quiver River lies within the Big Sunflower watershed. The Big Sunflower River is a tributary of the Yazoo River which flows into the Mississippi River. The Quiver River watershed is 515 square miles. Land use is predominately agriculture.

The section "Prior Reports, Existing Water Projects, and Ongoing Programs" of this report describes all of the specific past and present activities that may accumulate with the proposed project. The entire area has undergone significant alterations to maximize agricultural production and efficiency. Terrestrial wildlife habitat is limited, but conditions are stable. Aquatic habitat is degraded and is trending down in most of the region. Agricultural water supply and groundwater depletion are growing concerns throughout the Mississippi Delta and in the entire Mississippi Embayment region which includes Mississippi, Arkansas, Tennessee and other surrounding states.

The proposed Quiver River project would restore fish and mussels habitat and increase sustainability of those resources in the region. There are no other reasonably foreseeable projects in the area which would accumulative with this proposed project to either improve or further degrade habitat.

There are two large water supply projects under construction in Arkansas. These types of projects are likely to continue as groundwater depletion is reducing the economic efficiency of agriculture in the region and degrading stream habitat quality.

COORDINATION

The project delivery team had multiple meetings with representatives from the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, the Mississippi Department of Wildlife Fish and Parks, and Mississippi Department of Environmental Quality. These agencies raised issues regarding operations and maintenance of the system, ecosystem effects, impacts to the Tallahatchie, water quality, groundwater, and endangered species. These issues drove plan formulation, analysis and plan selection. As indicated elsewhere in the report, further analysis during the feasibility design phase and plans and specifications will be necessary to resolve all concerns.

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	2
Endangered Species Act of 1973, as amended	2
Farmland Protection Policy Act of 1984	1
Fish and Wildlife Coordination Act of 1958	2
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
Other Federal Policies	
Prime and Unique Farmlands	2
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.

IX. CONCLUSION

This office has assessed the environmental impacts of the proposed action and has determined that the tentatively selected plan is expected to benefit aquatic species and provide water supply benefits. It would have no significant negative impacts upon vegetation, fish, wildlife, cultural resources, or the human environment. Restoration of the Quiver River would benefit the natural environment and would help protect the agricultural economy in the area. A draft Finding of No Significant Impact is included in Appendix G.

Following public and technical review, more detailed construction plans will be developed and analyzed. All appropriate site specific surveys and coordination for water quality certification, cultural resources, HTRW, and federally listed species will be completed prior to construction.

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Appendix A

Public Scoping

Big Sunflower River Watershed (Quiver River), Mississippi
Feasibility Study

Public Scoping Meeting
24 October 2012

Landowner + Soil scientist

Comment Card

On which condition would you like to comment, please choose:

- [X] **Existing Conditions**
- [ ] **Future Conditions**
- [ ] **Opportunities**
- [ ] **Problems/Challenges**
- [ ] **Other**

Comments: It's muddy & parts of it's banks are eroding. As part of the Big Sunflower, it's problems contribute to Sunflower, Then Yazoo & MS Rivers & eventually the Gulf.

Would like to know More specifically about the River.

Name [redacted] **Affiliation** USDA-NRCS

Street [redacted] **Phone** [redacted]

City, St Zip [redacted] **Fax** _____

E-mail [redacted]

Landowner + Soil Scientist

Comment Card

On which condition would you like to comment, please choose:

- [ ] **Existing Conditions**
- [X] **Future Conditions**
- [ ] **Opportunities**
- [ ] **Problems/Challenges**
- [ ] **Other**

Comments: Changes - Would like to see buffer zones/filter strips along drainages & streambanks - Something to slow water and filter sediments. Would like to see less muddy surface water runoff going straight into our ditches & drainages which lead into these rivers. Will it be possible to irrigate out of it? What about ECO-TOURISM?

Name [redacted] **Affiliation** USDA-NRCS

Street [redacted] **Phone** [redacted]

City, St Zip [redacted] **Fax** _____

E-mail [redacted].gov

Landowner + soil scientist

Comment Card

On which condition would you like to comment, please choose:

- ☐ **Existing Conditions**
- ☐ **Future Conditions**
- ☑ **Opportunities**
- ☐ **Problems/Challenges**
- ☐ **Other**

Comments: If we could change landowners + farmers' mentality about plowing every spring + fall + installing buffers, we could decrease erosion + sedimentation. If we could GET THEM TO CARE.

Name [redacted] **Affiliation** USDA NRCS
Street [redacted] **Phone** [redacted]
City, St Zip [redacted] **Fax**
E-mail [redacted]

Comment Card

On which condition would you like to comment, please choose:

- ☐ **Existing Conditions**
- ☐ **Future Conditions**
- ☐ **Opportunities**
- ☐ **Problems/Challenges**
- ☐ **Other**

Comments: I would like to recieve information on the status of this project. Keep updated.

Name [redacted] **Affiliation** NRCS
Street **Phone**
City, St Zip **Fax**
E-mail [redacted]

Comment Card

On which condition would you like to comment, please choose:

- ☐ **Existing Conditions**
- ☐ **Future Conditions**
- ☐ **Opportunities**
- ☐ **Problems/Challenges**
- ☐ **Other**

Comments: _____

Name [redacted] **Affiliation** USDA - NRCS
Street [redacted] **Phone** [redacted]
City, St Zip [redacted] **Fax** [redacted]
E-mail [redacted]

Landowner & Soil scientist

Comment Card

On which condition would you like to comment, please choose:

- ☐ **Existing Conditions**
- ☐ **Future Conditions**
- ☐ **Opportunities**
- ☒ **Problems/Challenges**
- ☐ **Other**

Comments: Poor water quality - turbidity, sedimentation
Erosion - streambank stabilization
Low flow? Can you irrigate out of it?
What problems do USACE & YMD see?
What about pesticide/chemical & Nitrogen & Phosphorus concentrations?

Name [redacted] **Affiliation** USDA - NRCS
Street [redacted] **Phone** [redacted]
City, St Zip [redacted] **Fax** [redacted]
E-mail [redacted]

Comment Card

On which condition would you like to comment, please choose:

- [x] **Existing Conditions**
- [x] **Future Conditions**
- [x] **Opportunities**
- [ ] **Problems/Challenges**
- [ ] **Other**

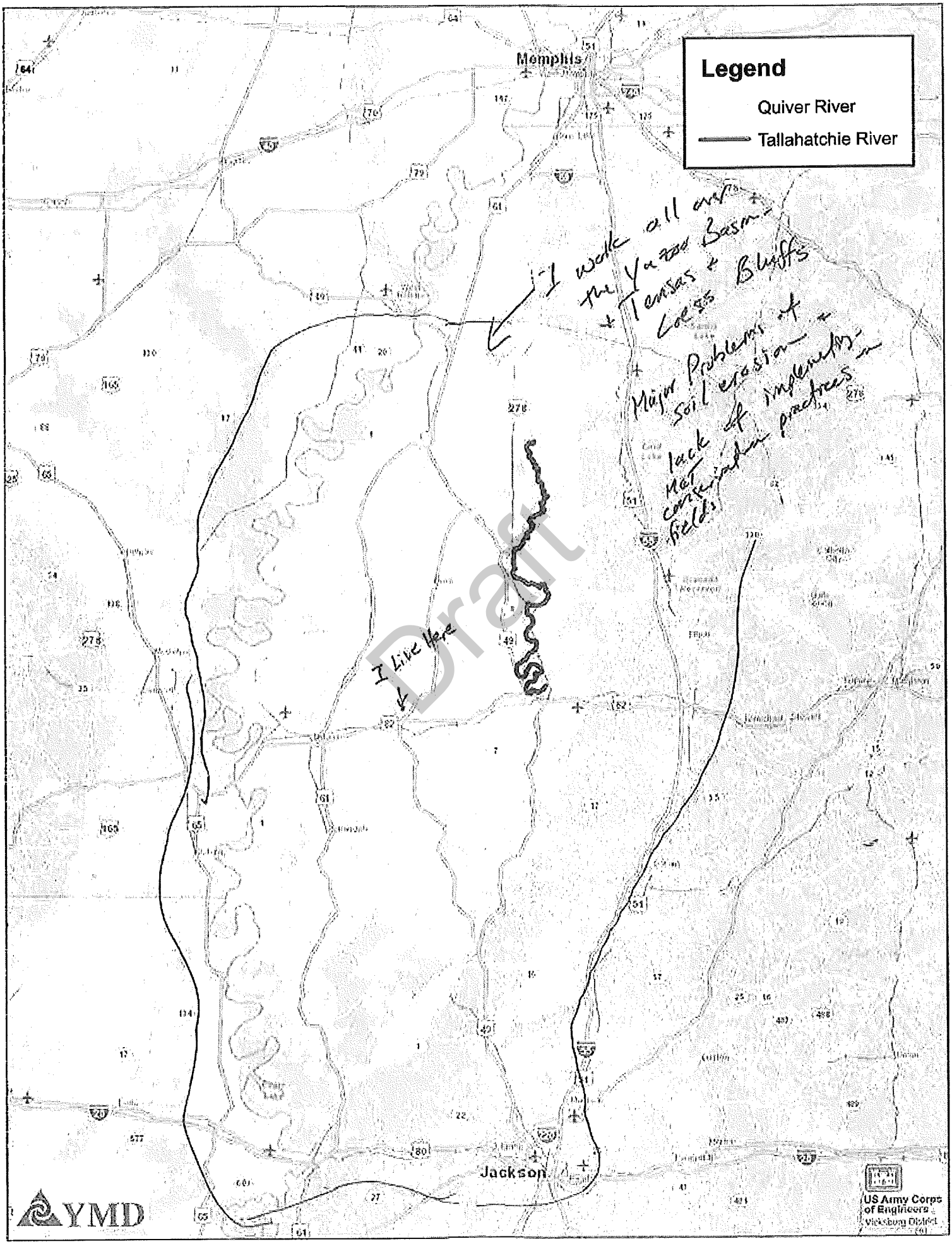
Comments: I plan to continue to use the Quivas for irrigation in the future. We need a good water flow to maintain habitat as well as irrigate.

Name [redacted] **Affiliation** [redacted]

Street [redacted] **Phone** [redacted]

City, St Zip [redacted] **Fax** _____

E-mail [redacted]


Legend
Quiver River
Tallahatchie River
Memphis
Jackson
I walk all over the Yazoo Basin + Tensas + Loess Bluffs
Major Problems of soil erosion + lack of implementation of conservation practices on fields
I Live Here
Draft
YMD
US Army Corps of Engineers
Vicksburg District

Yazoo County Port Commission
Post Office Box 172
Yazoo City, Mississippi 39194

L. Henry Cote, Sr.
Port Director

Telephone
(662) 746-1273

October 24, 2012

The Yazoo County Port Commission strongly opposes any attempt to divert water from the Yazoo River. As an active port operating on the Yazoo River the commission will take any and all steps necessary to prevent water from being diverted.

Sincerely,

L. Henry Cote, Sr.

Appendix B

Hydraulics & Hydrology

Table of Contents

I. General Description

The Quiver River is located in the central portion of the Mississippi Delta and is part of the Sunflower River Basin. The Quiver River flows through Tallahatchie, Sunflower, and Leflore counties. The river has a drainage area of 515 square miles and is 85 miles long. The land use for the Quiver River is predominantly agriculture with approximately 77 percent of the basin in agriculture production. The soils of the Quiver River are predominantly clay with a low hydraulic permeability. These characteristic make the Quiver River Basin ideal for the production of rice and catfish. These two commodities are highly depended upon water for successful cultivation and production. Due to the agricultural water demands in the basin, excessive groundwater withdrawals within the Quiver River Basin have lowered the groundwater levels in this region of the Mississippi Delta and due to the heavy clay soils that are found through most of the Quiver River Basin, recharge to the aquifer is virtually non-existent.

Based on the geology of the Quiver River Basin, it is believed that base flow for the Quiver River was not supported from the groundwater but from rainfall and flow from swampland. Much of the swamp land in the basin has since been cleared and placed into agriculture production. Much of the land has under gone improvements, such as land leveling and pads and pipes, to improve the efficiency and methods that can be used for irrigation of the agriculture products that are produced in the basin.

Presently, flow in the Quiver River is supported from rainfall and irrigation return flow during the growing season. During the low flow periods of September through November, flow below 1 cubic foot per second (cfs) is not uncommon. The only features that prevent the entire river from becoming dry are the four weirs that were placed in the Quiver River by the Corps during the construction of the cut-offs and channel clearing of the Quiver River in the early 1960's.

The Tallahatchie River is located to the east of the Quiver River and is formed at the confluence of the Coldwater River and Little Tallahatchie River. The Yocona River also flows into the Tallahatchie River. The Tallahatchie River flows to the south to the City of Greenwood. At Greenwood, the Tallahatchie and Yalobusha Rivers join and form the Yazoo River. The Tallahatchie River at Swan Lake is located 5.7 miles downstream of the proposed transfer location and has a drainage area of 5,130 square miles. The flow in the Tallahatchie River is influenced by the discharge from the three flood control reservoirs upstream, Arkabutla, Sardis, and Enid Lakes. A map showing the Yazoo Basin and the location of the reservoirs can be seen in Figure 1. Arkabutla Dam is located on the Coldwater River in DeSoto and Tate Counties. Arkabutla Dam has a drainage area of 1,000 square miles. Sardis Dam is located in Panola County on the Little Tallahatchie River and has a drainage area of 1,545 square miles. Enid Dam is located on the Yocona River in Yalobusha County and has a drainage area of 560 square miles. These reservoirs are authorized for flood control as part of the Yazoo Headwaters Project. These

reservoirs are operated under a seasonal guide curve which calls for the filling of the lakes in the late winter and spring by retaining the runoff from spring storm events. Excess water is released as downstream control points allow. The lakes are held at the summer pool level from May through August. Beginning in August, the seasonal guide curves begin to fall back to conservation pool.

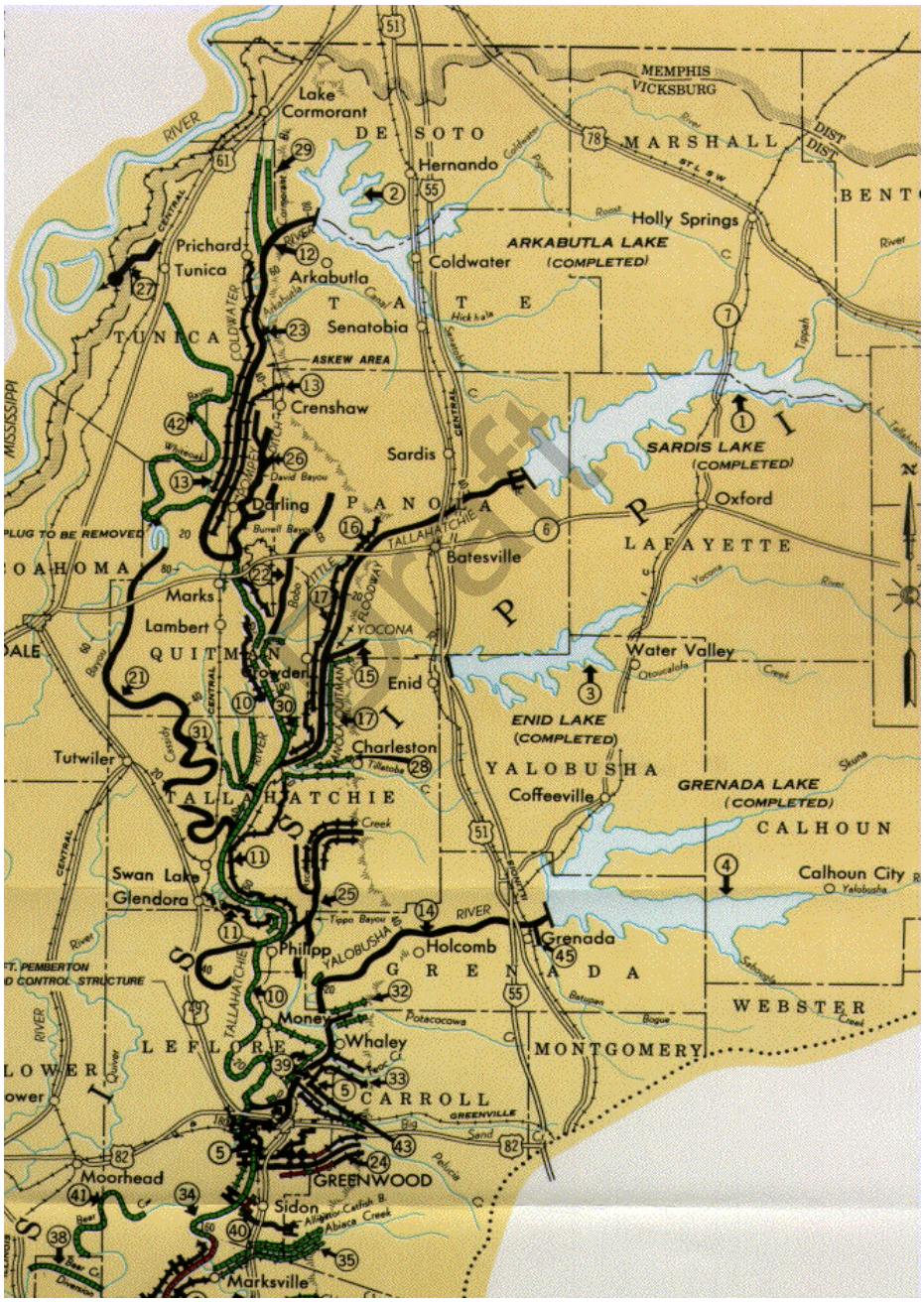


Figure 1: Yazoo Basin Reservoirs

The Yazoo Basin Reservoirs have, in-essence, altered the flow regime of the Tallahatchie River. Historically, the Tallahatchie River would have the much higher flows during the winter and spring than the summer and fall as the basin receives higher rainfall amounts during the winter and spring. However, the reservoirs retain the excess runoff from the winter and spring rains in the reservoirs. The excess runoff that is captured by the reservoirs is released during the summer and fall months; therefore increasing the flow on the Tallahatchie River during months that it historically would be experiencing low flow. This altered flow regime makes the Tallahatchie River an excellent source to transfer flow to the Quiver River which has minimal to no flow during the late summer and fall months.

The transfer of water from the Tallahatchie River to the Quiver River is a natural occurrence in the Yazoo River Basin. During periods in which the Tallahatchie River experiences high stages, water will flow through Parks and Sandy Bayous into the Quiver River. This transfer occurs when the Tallahatchie River at Swan Lake is at stages greater than 21.9 ft. This is approximately a 3-4 year event. Since 1989 when the current regulation plan for the Yazoo Basin Lakes has been in effect, this elevation has been exceeded 2,190 days.

II. General Plan Overview

a. Original Plan:

The original plan for the Quiver River transfer called for a pumping station and closure structure to be built at the mouth of Black Bayou and pump water from the Tallahatchie River into Black Bayou. Channel cleanout and enlargement in Sandy and Parks Bayou would allow the water to flow from Black Bayou into Sandy Bayou, then into Parks Bayou and thence into the Quiver River. A map showing the original project features can be seen in Figure 2.

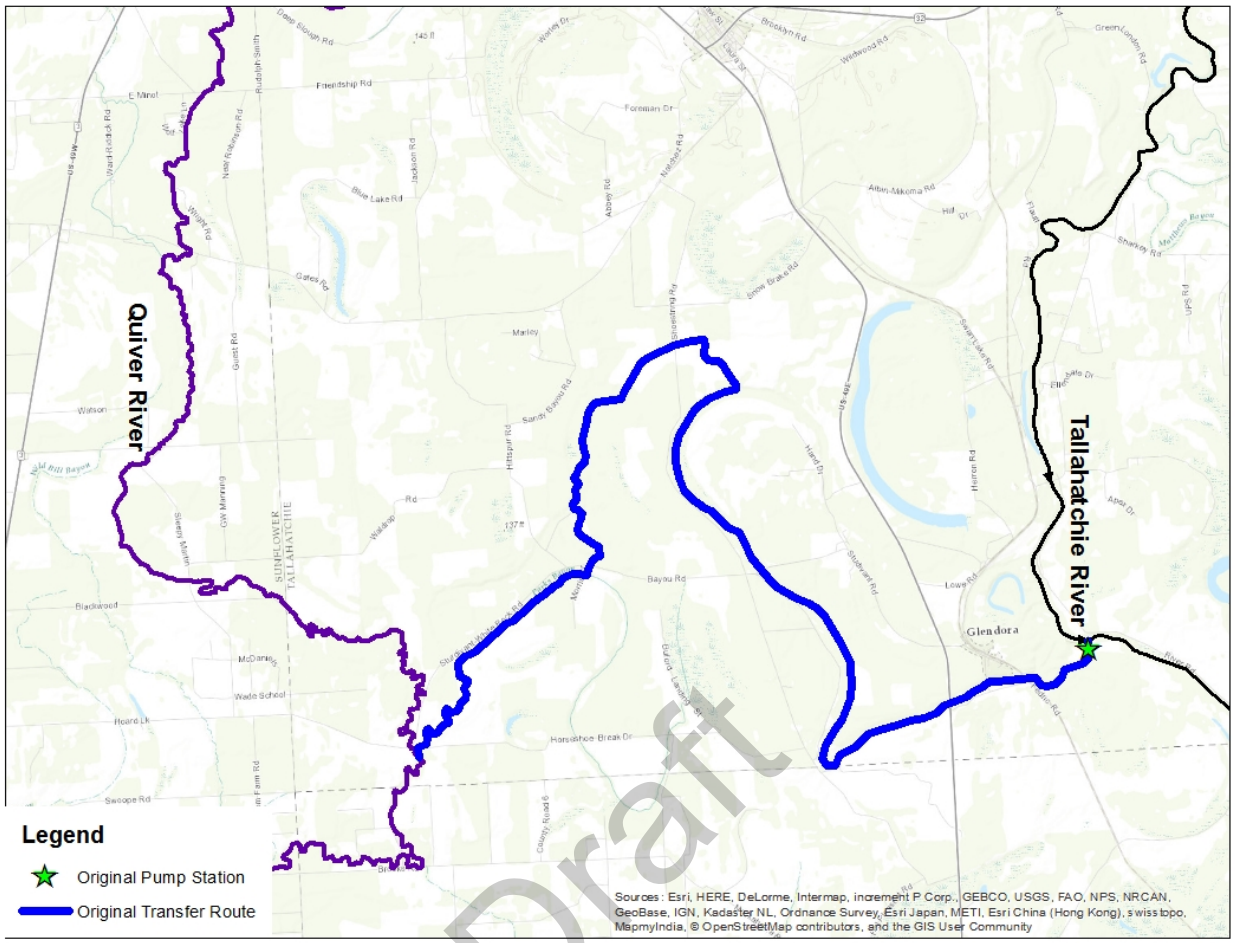


Figure 2: Original Transfer Route

b. Current Plan:

The current plan for the Quiver River Transfer calls for the construction of a new channel through a high ridge between Cassidy Bayou and the Tallahatchie River. A pumping plant and gravity structure would be constructed near the Tallahatchie River to control the transfer of water from the Tallahatchie River into Cassidy Bayou. The construction of two weirs, one weir on Cassidy Bayou between the mouth of Cassidy Bayou and the new transfer channel and the other at the mouth of Black Bayou, would be constructed to prevent the water that is being transferred from flowing back into the Tallahatchie River. Channel work in Parks and Sandy Bayous would still be required. A map showing the location of project features can be seen in Figure 3.

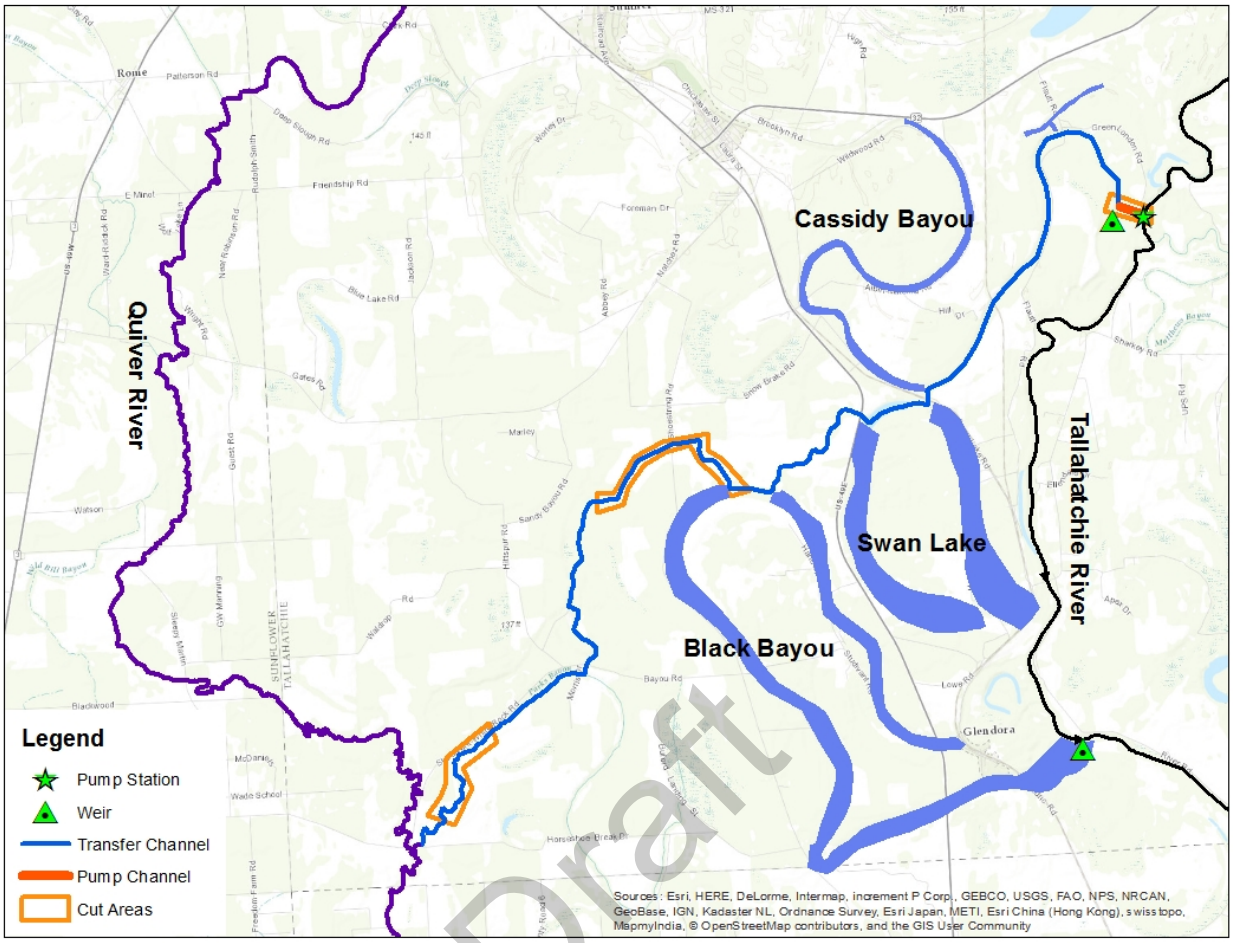


Figure 3: Proposed Quiver River Transfer

III. Determining Project Flow

a. Quiver River

To determine the best project flow for the Quiver River, several different methods for determining environmental and low flows currently used by other states including the 7Q10, Tennant Method (Montana), and Tennessee Method for ungaged streams were applied to the Quiver River and other streams in the Mississippi Delta.

Stage data for the Quiver River at Doddsville has been collected and published by the Vicksburg District from 1938-Present. During this period, periodic discharge measurements were taken at this gaging location. Using the gage and discharge data that is available for the Quiver River at Doddsville, a rating curve was developed with the use of Microsoft Excel and Statistical Analysis Software (SAS) to develop a rating curve for the Quiver River at Doddsville. Fitting the discharge curve to the observed data

was difficult so multiple curves were developed depending upon the stage. SAS was used to calculate the discharge based upon the stage data and the appropriate rating curve for that particular stage. Data was also split between the construction of the cut-offs and weirs on the Quiver River in the early 1960's.

i. Different Methods

The 7Q10 method for determining the minimum flow is the most popular method for determining low flow in a stream and is the state standard for determining loadings for National Pollutant Discharge Elimination (NPDES) permits in Mississippi (MDEQ). The 7Q10 is the minimum flow that can be expect for seven days on a 10 year return period. The United States Geological Service (USGS) published a report in 1964 titled "Low-Flow Characteristics of Streams in the Mississippi Abayment in Mississippi and Alabama." This publication reported the 7Q10 for the Quiver River at Doddsville as 0.7 cfs. The 7Q10 for the Quiver River was calculated using stage and discharge data that has been collected by the U.S. Army Corps of Engineers at this station since 1938 using a plug-in for the Hydraulic Engineering Center (HEC) DSS-VUE 2.0.1 software that was developed by North Carolina Department of Water Resources (NCDWR). The 7Q10 that was calculated by the NCDWR plug-in for HEC DSS-VUE for the Quiver River at Doddsville was 15 cfs. Although the 7Q10 method is good for determining the minimum flow for planning point source discharges into a stream, the method does not provide an adequate flow for supporting fisheries and aquatic habitat.

The Tennant Method or the Montana Method (Tennant, 1976) is the second most popular method for determining project flow. The Tennant Method was developed by Bob Tennant as a way to determine flow that is needed to support trout fisheries in western states. The Tennant Method uses percentage of the average annual flow to determine the minimum flow needed to support quality fisheries. The following list is how the Tennant Method characterizes various percentages of the average annual flow:

10% Average Annual Flow – Poor or Minimum Flow

30% Average Annual Flow - minimum for good fishery

60% or Greater Average Annual Flow – Optimum Flow

The Tennant Method was applied to the Quiver River at Doddsville using the stream characterizations set forth in the method. The Tennant Method produced a flow of 155 cfs as 30 percent of the average annual flow for the Quiver River at Doddsville. After reviewing the minimum flow needed for a good fishery (30 percent of average annual flow), it was determined that the

calculated flow was much greater than what would reasonably be seen in a Mississippi Delta stream during the late summer and fall even under natural conditions prior to alteration.

The Tennant Method was then applied to the Sunflower River at Sunflower, MS. The Sunflower River at Sunflower also has a long period of record that dates from the 1936 to present. The calculated flow using the Tennant Method for 30 percent of the average annual flow was 338 cubic feet per second, which is much greater than the historical minimum flow that was observed in the 1930's through early 1950's, prior to the diminishment of base flow due to groundwater withdrawals (USGS). The average historical minimum flow for this same period was calculated to be 180 cfs.

Review of the stage and discharge data for the Quiver River and other Delta streams show significant differences to the streams that were used in the development of the Tennant Method. Streams in the Mississippi Delta typically experience multiple peaks in a single year due to significant precipitation events that occur throughout the year. In comparison, western streams typically have a single peak per year which is the result of the spring snow melt. This variation of flow in the Delta streams and Quiver River result in the average flow being much greater than the median flow. This skew between the average flow and median flow calculates an project flow for Mississippi Delta streams which is much greater than what realistically can be achieved or what was historically observed.

After determining that the Tennant method created a project flow that was much greater than what could be realistically achieved on the Quiver River and determining that the calculated flow was much greater than what historically was observed in the Quiver River, the Tennessee Method for ungagged streams was applied to the Quiver River. The Tennessee Method for ungagged streams uses a simple calculation of 0.2 x Drainage Area (square miles) to determine the project flow in cfs. The Tennessee Method for ungagged streams appeared to be a better method than the Tennant Method as Tennessee has similar rainfall patterns as Mississippi. Each state receives rainfall throughout the year which produces a multiple peak hydrograph for the streams. The values that were obtained using this method for the Quiver River at Doddsville were determined to be more realistic and reasonable for an environmental restoration project on the Quiver River.

The method was also applied to the Sunflower River at Sunflower to determine if a reasonable number was also obtained. Using the Tennessee Method for the Sunflower River at Sunflower calculated 153 cfs for the project flow which is

near the historical minimum flow for this stream. This method also allows for the ratioing of flow to drainage area such that an project flow could be calculated for at various locations along a stream. A table showing the calculated flows for each method can be seen in Table 1.

River Station	7Q10 Method	Tennant Method	0.2 X Drainage Area (square mi.)
Quiver River at Doddsville	15	155	58.4
Sunflower River at Sunflower	46	338	153
Tallahatchie River at Swan Lake	672	2,332	1,026

Table 1: Comparison of Various Project flow Methods

b. Tallahatchie River

i. 7Q10

To determine the available flow in the Tallahatchie River for transfer to the Quiver River, the same methodologies that were applied to the Quiver River were applied to the Tallahatchie River. The Tallahatchie River at Swan Lake has stage and discharge records from 1956-2008. This station is a key station in the Yazoo Basin as this station is used as a control point for regulating discharge from Arkabulta, Sardis and Enid reservoirs.

The 7Q10 was first calculated using HEC-DSSVUE and was determined to be 672 cfs. Next, the Tennant Method was applied to the Tallahatchie River at Swan Lake. The Tennant Method calculated a flow of 2,332 cfs. Since the Tallahatchie River's natural flow patterns have been completely altered by the upstream reservoirs, this number that is calculated using the Tennant Method is much higher than what would historically been observed prior to the construction of the upstream flood control reservoirs. The upstream reservoirs have in essence inflated the average annual flow as the lakes capture upstream runoff and distribute the flow to the river throughout the year. Also, it was the opinion of the engineers that the standards that were applied to the Quiver River should be the same standards that were applied to the Tallahatchie River to determine the available flow that can be transferred without impacting the fisheries or aquatic habitat in the Tallahatchie River.

Using the Tennessee Method for Ungaged Streams of 0.2 x drainage area (5,130 square miles) calculated an project flow of 1,026 cfs which is greater than the computed 7Q10. A table showing the calculated project flow values for the Tallahatchie River can be seen in Table 1.

To determine the available flow that can be transferred from the Tallahatchie River on a reliable basis, a monthly duration analysis was conducted for the Tallahatchie River at Swan Lake using HEC-DSSVue. The 95 percent exceedance flows for each month were used to calculate the available flow by month that could be obtained from the Tallahatchie River for transfer to the Quiver River. The calculated project flow for the Tallahatchie River was subtracted from the 95 percent monthly exceedance values to determine if enough flow was available in the Tallahatchie River to support project flow in the Quiver River more than 95 percent of the time. Based on this analysis, enough flow is present in the Tallahatchie River to support the calculated project flow in the Quiver River of 100 cfs. A table showing the available flow can be seen in Table 2.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
95% Exc.	1628	2108	2319	2175	1360	1467	1464	1235	1403	2059	1160	1296
Project flow for Tallahatchie River at Swan Lake	1,026											
Available Flow	602	1082	1293	1149	334	441	438	209	377	1033	134	270

Table 2: Available Flow in Tallahatchie River Based on 95% Exceedance

c. Flow Available for LPP

To determine the flow that is available in the Tallahatchie River for the LPP, engineers reviewed the available flow in the Tallahatchie River at the 95 percent exceedance while maintaining the project flow that was calculated for the Tallahatchie River. In reviewing the available flow in the Tallahatchie River during the irrigation season of May through August at the 95 percent exceedance, the available flow for transfer for irrigation is between 214 cfs and 441 cfs. The same analysis was performed for the 90 percent exceedance. The flow that is available to be transferred from the Tallahatchie River using the 90 percent exceedance values can be seen in Table 3. In analyzing the results, the available flow for transfer from the Tallahatchie River during the irrigation season (May-August) from the Tallahatchie River ranges between 590 cfs and 814 cfs.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90% Exc.	2060	2645	3420	2748	1616	1800	1725	1840	2266	3240	1560	1886
Project flow for Tallahatchie River at Swan Lake	1,026											
Available Flow	1034	1619	2394	1722	590	774	699	814	1240	2214	534	860

Table 3: Available Flow in Tallahatchie River Based on 90% Exceedance

Therefore, the maximum LPP flow of 300 cfs is available between 90 and 95 percent of the time and project flow is available greater than 95 percent of the time.

In analyzing the impacts that the Quiver River Transfer might have downstream on navigation, the theoretical stage reduction that the project might have on downstream stations was analyzed. In studying the stage and discharge relationships for stations downstream, it was determined that the, theoretical reduction in stage that might occur from the proposed project would be no greater than 0.5 feet at Yazoo City. This reduction in stage should not impact the downstream navigation, as navigation is currently limited on the Yazoo and very few tows travel the waterway as the Vicksburg District does not receive any appropriations to maintain navigation on the Yazoo River. Also, the Yazoo River is not navigable above Redwood when the Mississippi River at Vicksburg is below 13.0 feet on the gage. In analyzing the gage data for the Mississippi River at Vicksburg, on average the Mississippi River at Vicksburg is below 13 feet on the gage by the middle of August. Therefore, in the drier months, September through November, when the 100 cfs NER flow would be transferred into the Quiver River, the Yazoo River would not be navigable past Redwood unless the Mississippi River is above average.

In determining the potential impacts to fisheries or the potential to disconnect oxbows or side channels on the Tallahatchie River, a review of aerial imagery in Google Earth from the transfer site to Greenwood was performed. It was observed that only two oxbows or cutoffs remain in connection with the Tallahatchie River without some flood control structure or dredge disposal between the Tallahatchie River and oxbow or side channel. These two locations are shown in Figure 4. These locations were observed in the aerial imagery for high events and low events to determine the connectivity.

The first location is the downstream end of Philip Cutoff and the second location is Money Bayou. In reviewing the imagery that is in Google Earth, these locations also appear to be in connection with the Tallahatchie River during both high and low water events. Therefore, the project should not isolate oxbows or cutoffs that are currently connected to the Tallahatchie River on a regular occurrence.

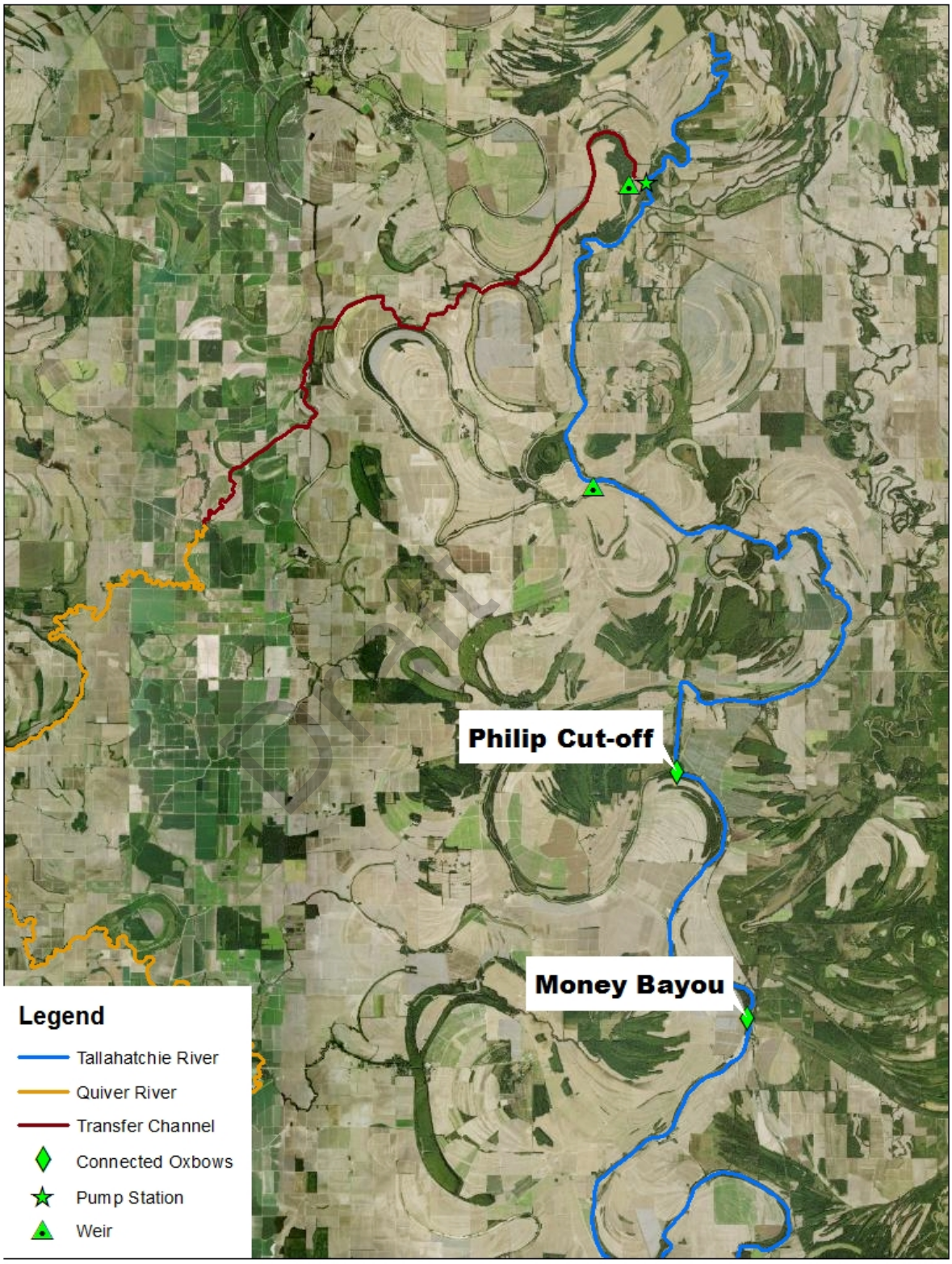


Figure 4: Unobstructed Tallahatchie River Oxbow Connections

IV. Hydraulic Modeling

a. Original Model

During the Reconnaissance Phase of the project, a HEC-RAS model was developed to determine an estimate of the material that would need to be removed from Parks and Sandy Bayous to allow the transfer of water from the Tallahatchie River to the Quiver River. The model was developed using surveyed cross-sections that were taken approximately every 2000 feet. This original model was developed with the pumping plant at the mouth of Black Bayou.

During the early phases of the Feasibility Study, the original HEC-RAS model that was developed for the Reconnaissance Phase of the project was used to determine the amount of material that would need to be removed from Parks and Sandy Bayous as part of the channel clean-out and enlargement that would be required for the project. The Quiver River was also incorporated into the original model using Lidar data, 1980 surveys of Quiver River permanent ranges and construction profiles from the construction of the cut-off and weirs on the Quiver River during the 1960's. Various flow alternatives including the selected NER Plan and Locally Preferred Plan were routed through the model. Data obtained through the model was used to calculate the environmental benefits and the amount of material that would need to be removed from Parks and Sandy Bayou. Table 4 shows the length and amount of material that will need to be removed as part of the channel clean-out and enlargement that will need to be performed on Parks and Sandy Bayous.

Plan	Length of Channel Improvement (ft.)	Amount of Material to be Removed (cu. Yds.)
NER	13,865	45,000
LPP	45,000	306,000

Table 4: Length of Channel Improvements and Amount of Material to be Removed in Parks and Sandy Bayous

To determine the environmental benefits of the project, the median monthly flows on the Quiver River were calculated using the stage and discharge data for the Quiver River at Doddsville and Sunflower. Using the median monthly flows at Doddsville and Sunflower, a monthly flow ratio was created by dividing the median monthly flow by the drainage area. This monthly flow ratio was then applied downstream of inflow points and at gaging stations to determine the median monthly flow at various locations on the Quiver River. The existing median monthly flows were then run through the HEC-RAS model to calculate the existing median monthly water surface elevation, wetted perimeter, and depth of flow over the four weirs on the Quiver River. Next, the existing monthly median flows plus the NER flow were run through the model, followed by the existing median monthly flows plus the LPP flow. The results were then exported to Excel for comparison. The results of the HEC-RAS models were mapped using HEC-RAS RASMapper and FESM.

b. Redevelopment

During the Feasibility study, engineers determined that moving the location of the transfer point on the Tallahatchie River could potentially allow the transfer of the water through the use of gravity flow nearly fifty percent of the time instead of having to pump one hundred percent of the time. A map showing the location of the new transfer location can be seen in Figure 3. This transfer location would require the construction of the new channel from the Tallahatchie River to Cassidy Bayou. The water that was being transferred from the Tallahatchie River would flow into Cassidy Bayou, then into Swan Lake, Fish lake Outlet, Black Bayou, Sandy Bayou, Parks Bayou and then into the Quiver River.

A HEC-RAS model was developed for the new transfer channel, Cassidy Bayou, Swan Lake, and Black Bayou using LiDAR data and survey information from the Local Sponsor. This HEC-RAS model was used to determine the amount of material that would need to be removed from the high ridge between the Tallahatchie River and Cassidy Bayou and determine the water surface elevation that would result in Cassidy Bayou to set the weir elevation for the weir in Cassidy Bayou that would be needed to prevent the water that is being transferred from flowing back into the Tallahatchie River.

Since the cuts required in Sandy and Parks Bayous were based upon environmental and locally preferred project flows, the water surface elevation that was calculated in the original HEC-RAS model for Black Bayou was used as the downstream boundary condition for the new plan.

To determine the elevation at which water could be gravity flowed through the proposed transfer channel, the Tallahatchie River was extracted from the Yazoo Basin Corps Water Management Model (CWMS) and connected to the HEC-RAS model for the proposed transfer channel to Black Bayou. A lateral structure was used to model the gravity structure between the Tallahatchie River and the proposed transfer channel. Various flows were modeled along the Tallahatchie River to determine the water surface elevations that were needed at the lateral structure to allow the gravity flow of 100 cfs, 200 cfs, 300 cfs, 400 cfs and 500 cfs. The water surface elevations that were calculated by the model to allow gravity transfer can be seen in Table 5.

Flow (cfs)	Needed Elevation (ft.)
100	132.5
200	133.3
300	134.0
400	134.5
500	134.9

Table 5: Elevation Needed at Transfer to Various Flow Rates

To determine the duration that water could potentially be gravity flowed through the proposed transfer channel, a monthly duration analysis for the Tallahatchie River at Locopolis and Swan Lake was conducted in HEC-DSSVue. The elevation difference between two stations was divided by the river miles between the stations to determine the river slope per mile between the two stations. The average slope for each month was calculated and used as the slope for that month. The average slope for that month was multiplied by the river miles between the transfer location and Locopolis to give the difference in water surface elevation between the locations. The monthly duration values that were calculated in HEC-DSSVue for Locopolis were subtracted by the slope for that month to determine the duration at the proposed transfer location.

Using the calculated duration for the proposed transfer location and the water surface elevations that are needed for the gravity transfer, it was determined that the project flow could be gravity flowed through the gated structure at the transfer location 60 percent of the time during the critical months of August through November. Also, the locally preferred plan could be gravity flow 50 percent of the time during May and June, 40 percent of time during July and 30 percent of the time during August. A table showing these values can be seen in Table 6.

To prevent water that is being passed through the transfer from flowing back into the Tallahatchie River, two weirs will need to be constructed. The first weir would be between the transfer channel and the mouth of Cassidy Bayou at an elevation of 134.5 feet and the second weir would be at the mouth of Black Bayou at an elevation of 132.0 feet. The elevations of the weirs were set based upon the results of the HEC-RAS models. A map showing the location of the two weirs can be found in Figure 3.

Tallahatchie River @ Cassidy Transfer Channel											
Labels		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	O
Units	Percent Exceedance	FEET									
Type											
1	0.1	149.63	146.35	147.45	146.39	146.33	145.41	144.39	141.63	143.95	
2	0.2	145.77	146.20	147.02	146.39	146.31	145.41	144.20	141.55	143.84	
3	0.5	145.45	145.76	145.76	145.70	146.03	145.11	143.69	141.38	143.40	
4	1	145.31	145.34	145.28	145.10	145.93	144.72	143.21	141.21	141.51	
5	2	145.10	144.94	145.04	144.69	145.73	143.81	141.18	140.78	141.07	
6	5	144.41	144.73	144.71	144.10	144.03	142.65	140.31	140.08	139.61	
7	10	144.11	144.48	144.35	143.59	142.98	140.11	138.91	138.98	138.51	
8	15	143.81	144.10	143.88	142.89	142.03	138.71	137.71	137.59	136.94	
9	20	143.53	143.70	143.48	141.81	140.80	137.85	136.91	136.85	136.41	
10	30	142.71	142.90	142.48	140.14	138.73	136.11	135.61	135.68	135.28	
11	40	141.21	141.50	141.08	138.29	136.93	135.41	134.61	134.39	134.11	
12	50	139.29	140.10	139.18	136.55	134.94	134.48	133.81	133.68	133.51	
13	60	137.61	137.84	137.03	134.39	132.94	132.71	132.29	132.78	132.71	
14	70	134.55	135.50	134.98	132.26	130.38	131.41	130.81	131.58	131.72	
15	80	131.36	131.43	132.67	130.14	128.33	129.21	129.11	129.08	130.21	
16	85	129.06	129.76	130.84	129.28	127.71	128.31	128.24	127.78	129.31	
17	90	128.21	128.78	129.38	128.51	127.15	127.39	127.65	127.11	128.38	
18	95	126.71	126.89	128.18	127.79	126.47	126.63	127.01	126.30	127.09	
19	98	126.04	125.82	127.48	127.09	124.80	126.21	125.99	125.25	125.81	
20	99	125.40	125.52	126.98	126.08	124.63	125.81	125.59	123.62	125.41	
21	99.5	123.51	124.20	125.98	125.78	124.31	125.20	125.36	122.78	124.71	
22	99.8	122.04	11.21	11.29	125.23	123.96	124.77	125.08	122.68	124.31	
23	99.9	85.19	11.21	11.29	125.15	123.84	78.51	124.81	122.68	123.62	
		Flow Wanted		100	200	300	400	500			
		Water Surface Needed		132.49	133.34	133.96	134.48	134.93			

Table 6: Monthly Duration Analysis for Tallahatchie River at Transfer Location

V. Results

a. Flow

To analyze the difference in flow that would be observed on the Quiver River with the proposed project, the median monthly flows that were calculated for the Quiver River at Doddsville, Sunflower and the mouth and plotted in Microsoft Excel. The flows that would occur on the Quiver River with the NER Plan and the LPP were also plotted in Excel. The results shown below do not account for irrigation withdrawls that would occur if the project is constructed. The actual hydrograph for the NER + 300 cfs would vary with the number and location of surface water irrigation permits that are allowed along the Quiver River by the Mississippi Department of Environmental Quality and the Yazoo-Mississippi Delta Water Management District as they are responsible for the permitting and operation of the project, respectively.

In comparing the data for the Quiver River at Doddsville, the NER plan of 100 cfs would increase the median flow for October from 7 cfs to 107 cfs. A graph comparing the existing median monthly flows to the NER Plan and LPP for the Quiver River at Doddsville can be seen in Figure 5. For the Quiver River at Sunflower, the NER plan would increase the median monthly flow for October from approximately 10 cfs to 110 cfs, as shown in Figure 6. The median flow for October at the mouth of the Quiver River would be increased to 114 cfs from 14 cfs under existing conditions. A graph comparing the existing median monthly flows to the NER Plan and LPP for the mouth of the Quiver River can be seen in Figure 7.

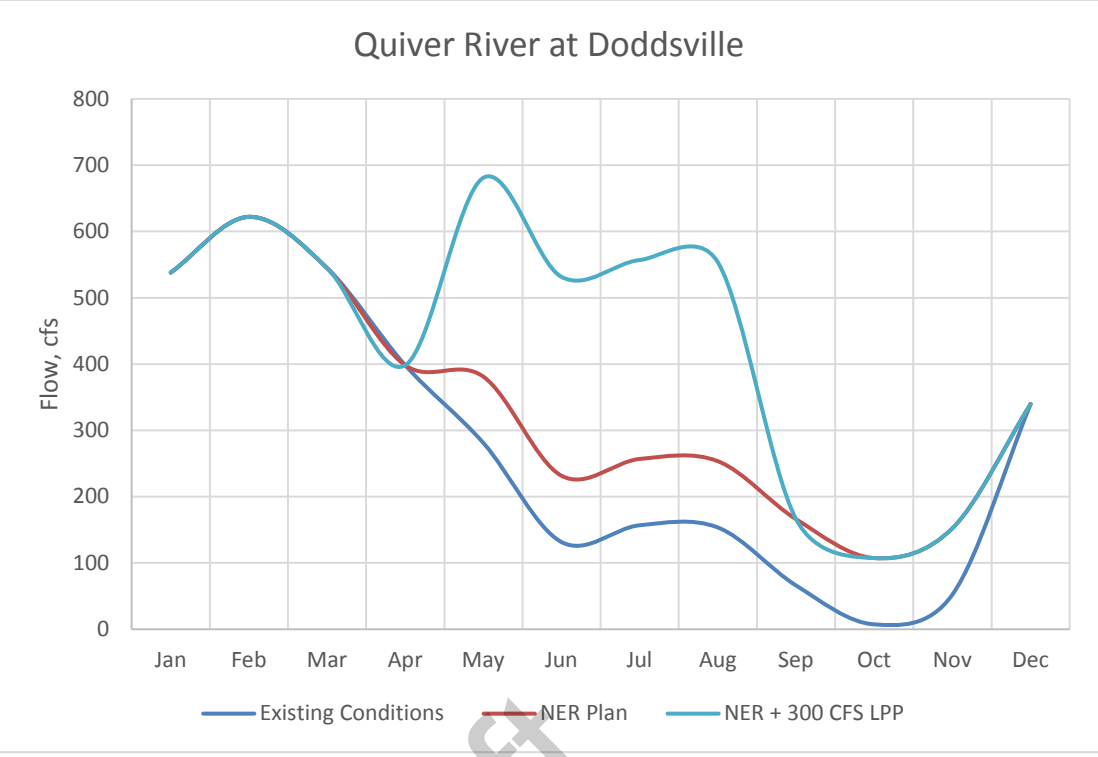


Figure 5: Flow Comparison for Quiver River at Doddsville

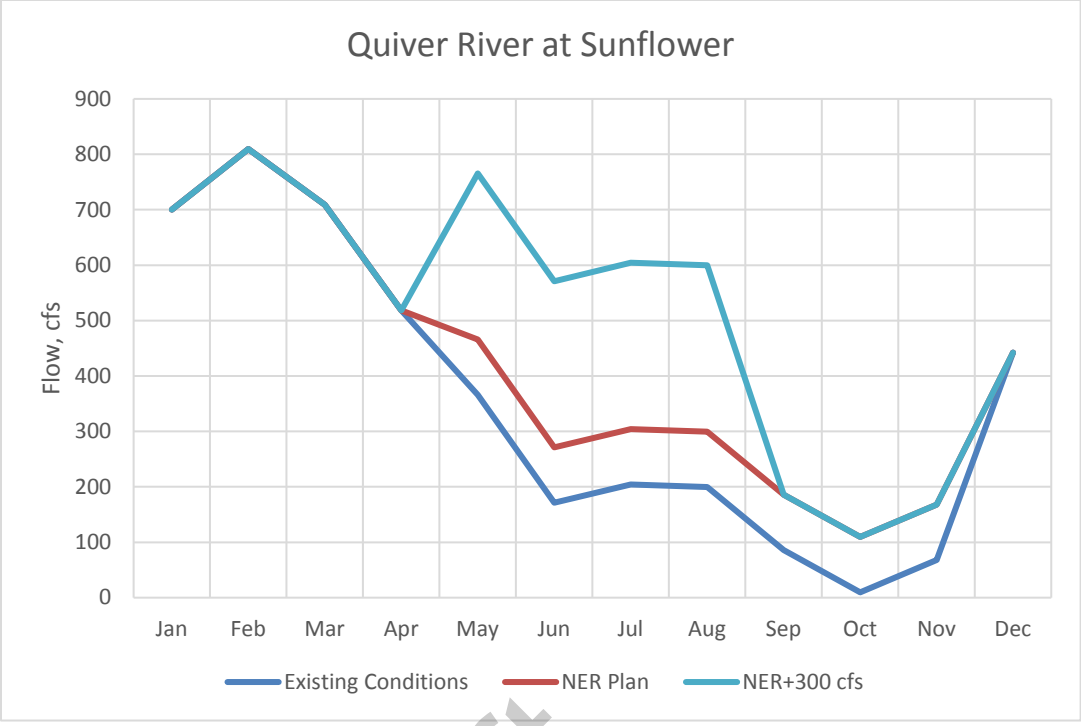


Figure 6: Flow Comparison for Quiver River at Sunflower

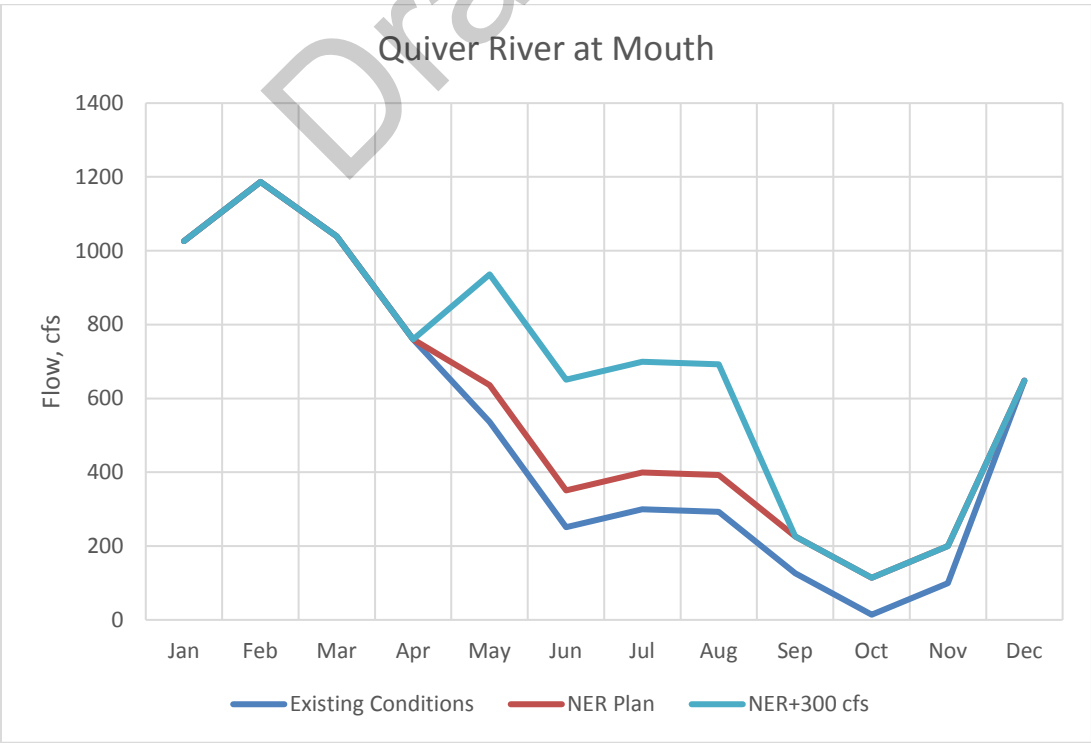


Figure 7: Flow Comparison for Quiver River at Mouth

b. Water Surface Elevations

The water surface elevations that were calculated in HEC-RAS for the median monthly flows, NER Plan and LPP at Doddsville, Sunflower and the mouth, were imported into Microsoft Excel and plotted to compare existing median monthly water surface elevations to the calculated water surface elevations for the NER Plan and LPP. In analyzing the results, the NER plan would increase the median water surface elevation at the Quiver River at Doddsville (Figure 8) in October approximately 1.1 feet. The median water surface elevation for the Quiver River at Sunflower (Figure 9) and at the mouth of the Quiver River (Figure 10) for the month of October would be increased approximately 0.5 and 2.7 feet, respectively.

The results shown below do not account for irrigation withdrawls that would occur if the project is constructed. The actual water surface elevations for the NER + 300 cfs plan would vary with the number and location of surface water irrigation permits that are allowed along the Quiver River by the Mississippi Department of Environmental Quality and the Yazoo-Mississippi Delta Water Management District as they are responsible for the permitting and operation of the project, respectively.

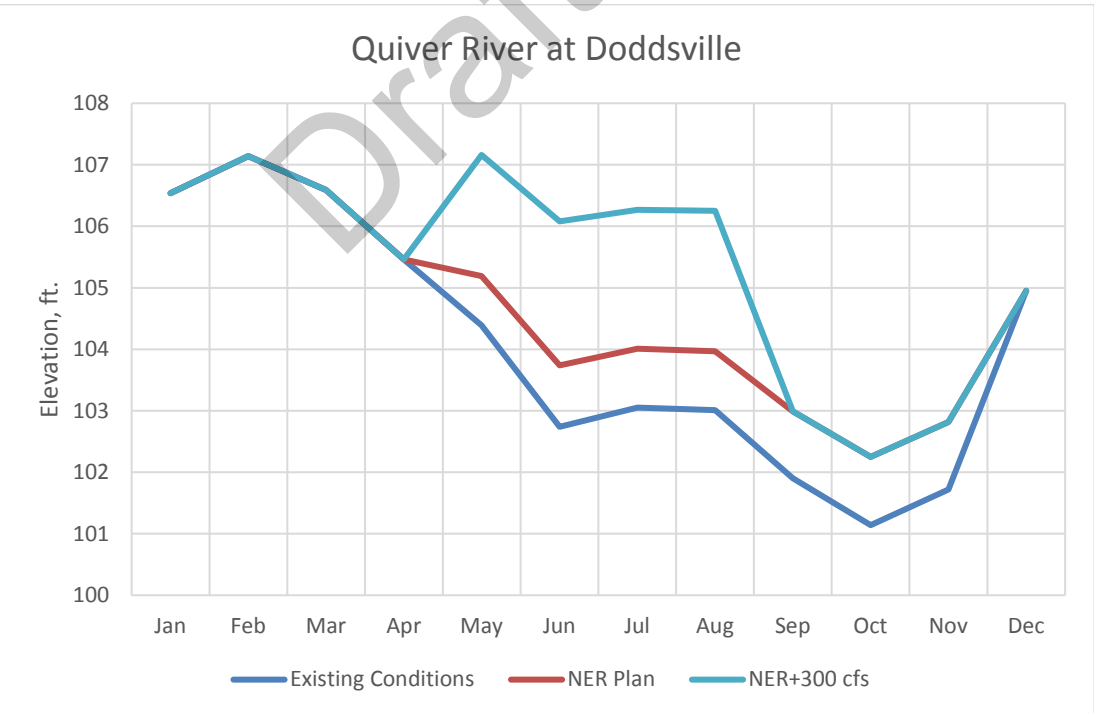


Figure 8: Water Surface Elevation Comparison for Quiver River at Doddsville

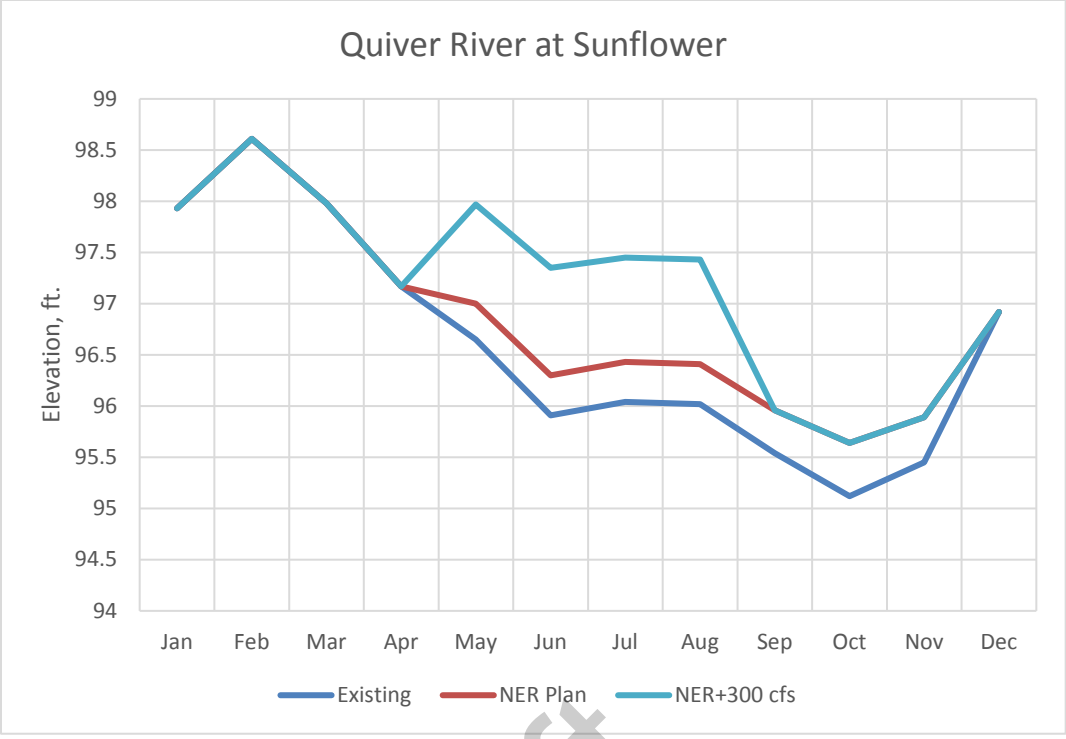


Figure 9: Water Surface Elevation Comparison for Quiver River at Sunflower

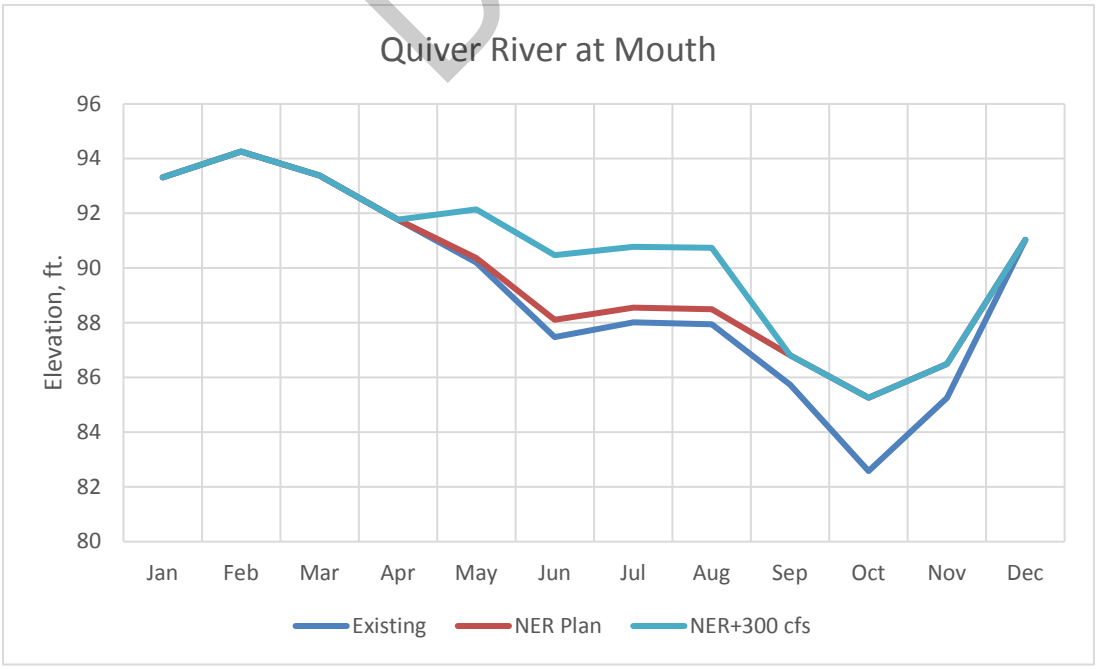


Figure 10: Water Surface Elevation Comparison for Quiver River at Mouth

c. Depth of Flow over Existing Quiver River Weirs

To determine the increase in depth of water that would be flowing over the existing weirs in the Quiver River, the HEC-RAS model results for the existing median monthly flows, NER Plan and LPP plan were exported to Microsoft Excel and plotted to analyze the difference. In analyzing the results, the median monthly October depth over the four weirs is approximately 0.1 feet. The NER plan would increase the depth flowing over the weirs by 0.4 to 0.6 feet preventing the depth of flow over the weirs from dropping below 0.5 foot for all the weirs on the Quiver River. Comparison plots for the existing median monthly depths over the weirs, depth of flow under the NER plan and the LPP can be seen in Figures 11 through 14.

The results shown below do not account for irrigation withdrawls that would occur if the project is constructed. The actual flow depth over the weirs for the NER + 300 cfs plan would vary with the number and location of surface water irrigation permits that are allowed along the Quiver River by the Mississippi Department of Environmental Quality and the Yazoo-Mississippi Delta Water Management District as they are responsible for the permitting and operation of the project, respectively.

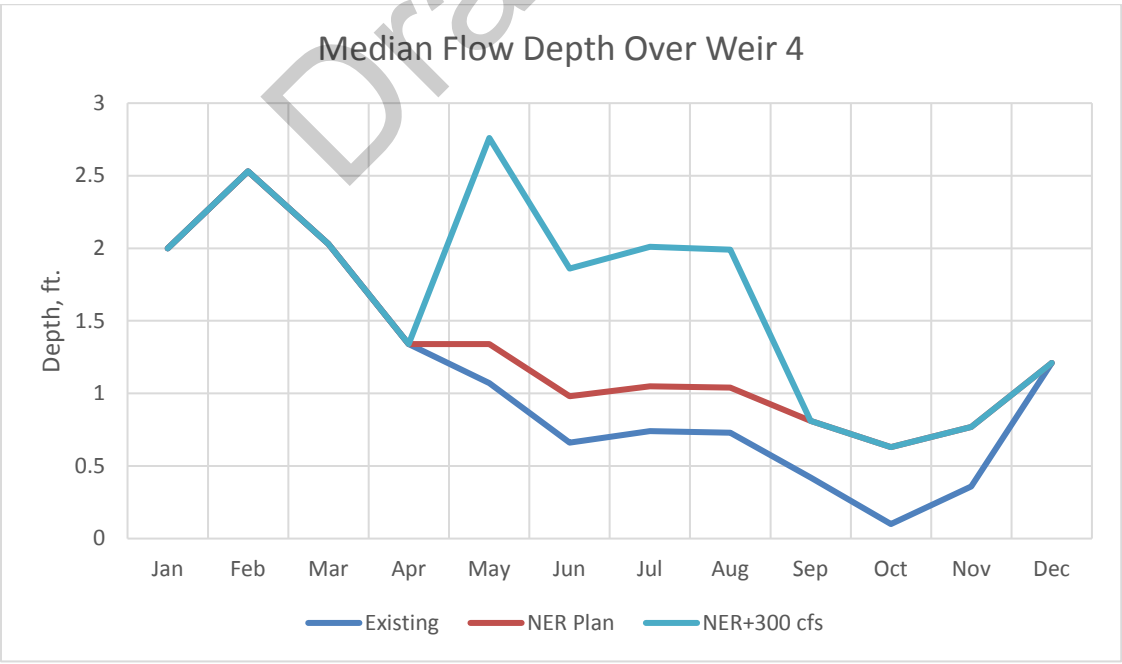


Figure 11: Weir 4 Flow Depth Comparison

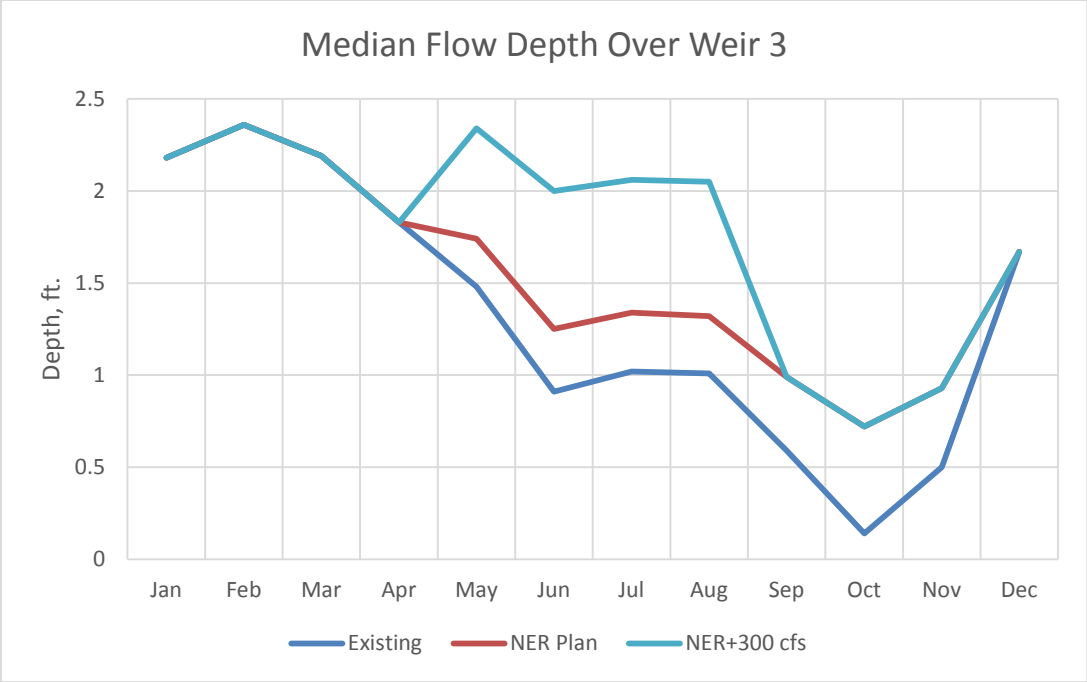


Figure 5: Weir 3 Flow Depth Comparison

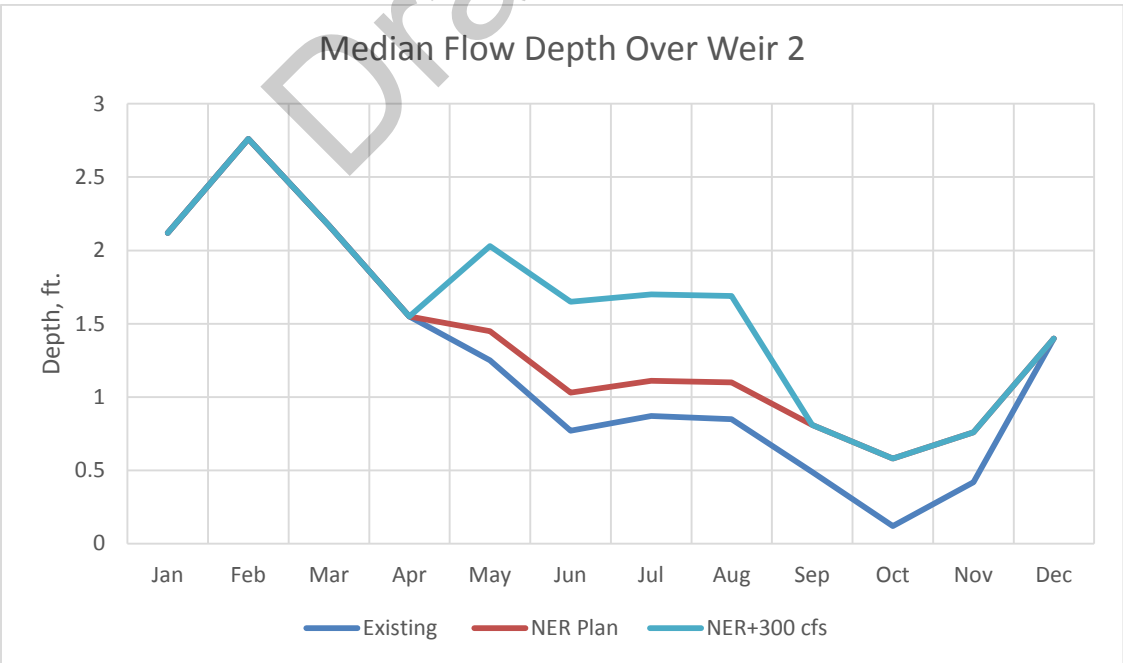


Figure 13: Weir 2 Flow Depth Comparison

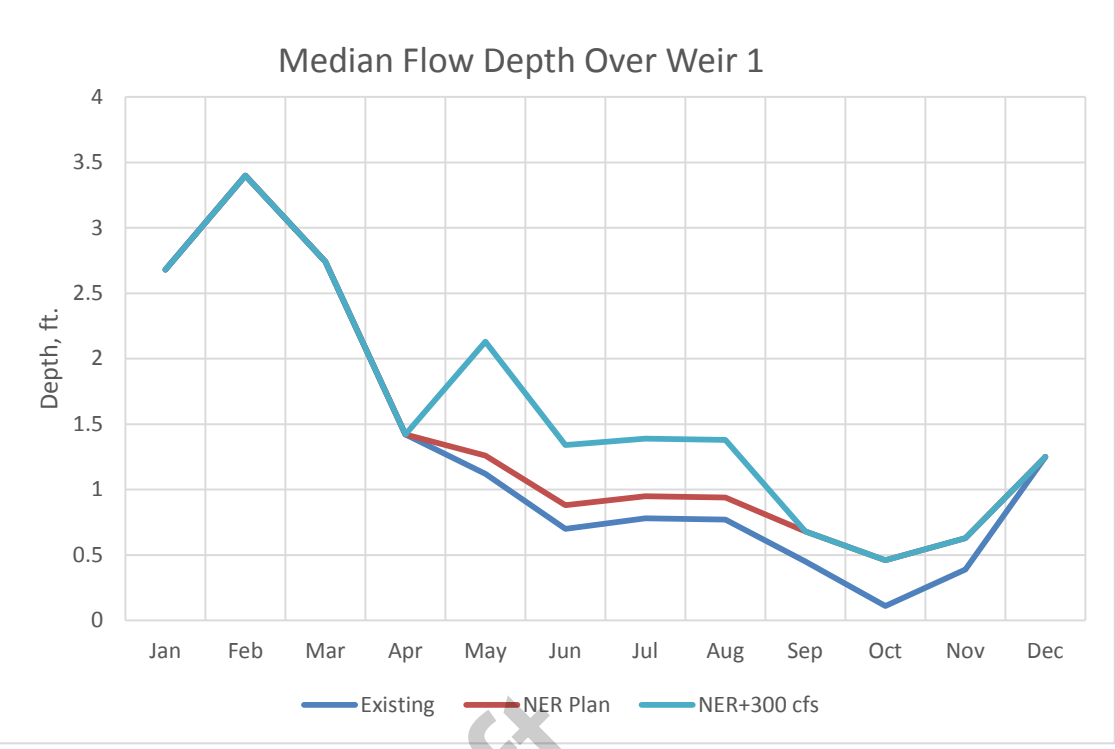


Figure 64: Weir 1 Flow Depth Comparison

d. Wetted Perimeter

The increase in the wetted perimeter from the proposed project was also analyzed in Microsoft Excel with results that were calculated using HEC-RAS. The increase in the median wetted perimeter for October was approximately 5.8 feet at Doddsville, 4.5 feet at Sunflower and 22.9 feet at the mouth. The increase at the mouth of the Quiver River is greater than at Doddsville and Sunflower because of the four weirs that are upstream of the mouth. Since the upstream weirs are already holding a constant pool, the water levels can only increase in depth. However, since the mouth of the Quiver River is not influenced by downstream weirs, the increase in flow not only increases the depth of water in the channel but also increases the wetted width of the cross-section. Graphs showing the existing median monthly wetted perimeter, NER wetted perimeter and LPP wetted perimeter for the Quiver River at Doddsville, Quiver River at Sunflower and at the Mouth of the Quiver River can be seen in Figures 15 through 17.

The results shown below do not account for irrigation withdrawls that would occur if the project is constructed. The actual wetted perimeter for the NER + 300 cfs plan would vary with the number and location of surface water irrigation permits that are allowed along the Quiver River by the Mississippi Department of Environmental Quality and the

Yazoo-Mississippi Delta Water Management District as they are responsible for the permitting and operation of the project, respectively.

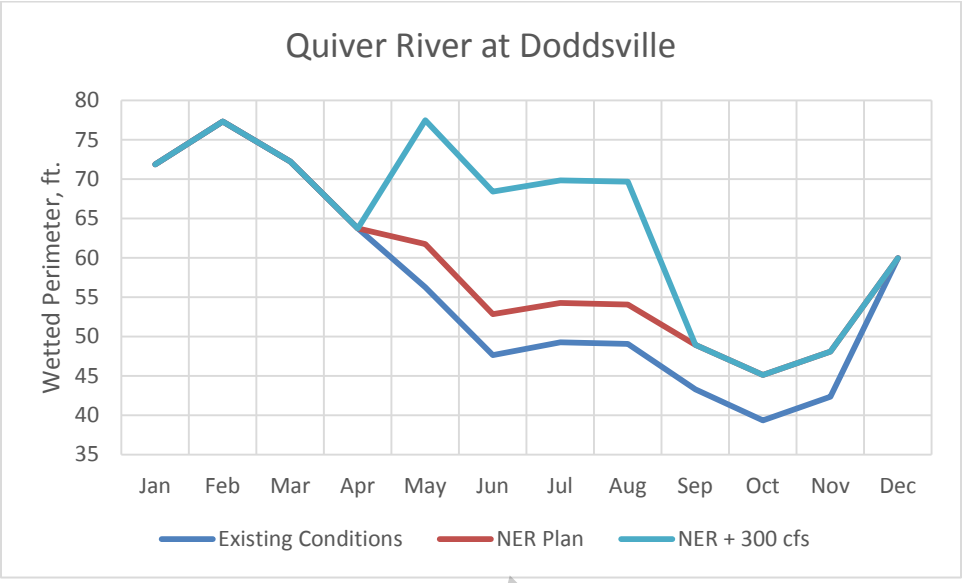


Figure 75: Wetted Perimeter Comparison for Quiver River at Doddsville

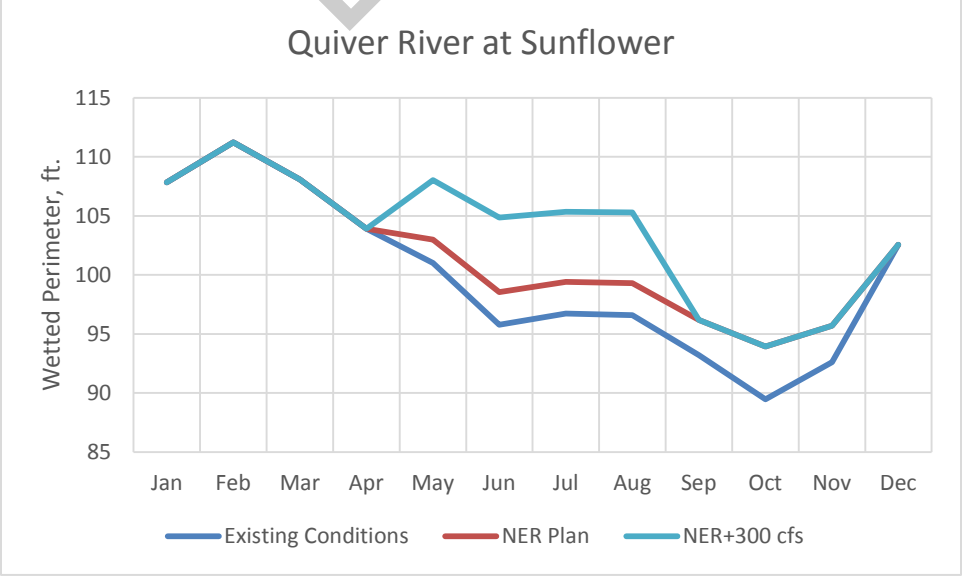


Figure 86: Wetted Perimeter Comparison for Quiver River at Sunflower

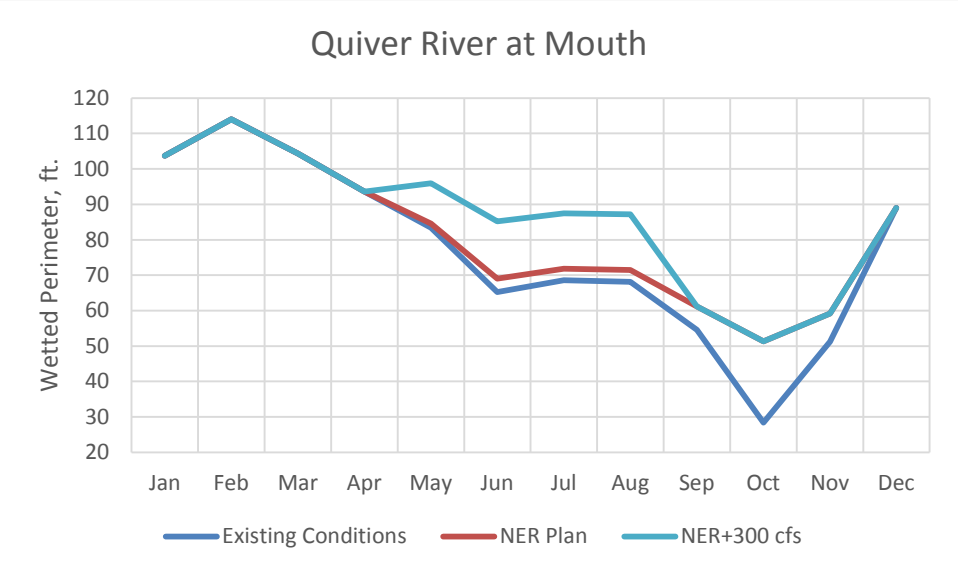


Figure 97: Wetted Perimeter Comparison for Quiver River at Mouth

References

Administrative Procedures Act Rules; Title 11: Mississippi Department of Environmental Quality; Part 6: Wastewater Pollution Control Regulations; Part 6, Chapter 2: Mississippi Commission on Environmental Quality Regulations for Water Quality Criteria for Intrastate, Interstate and Coastal Waters.

HEC-RAS Version 4.2

HEC-RAS Version 5.0

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Tennant, D.L., 1976, Instream flow regimens for fish, wildlife, recreation, and related environmental resources, in Instream flow needs, Volume II: Boise, ID, Proceedings of the symposium and specialty conference on instream flow needs, May 3-6, American Fisheries Society, p. 359-373.

Appendix C

Environmental

Species of Fish Collected by USACE - ERDC in the Yazoo River Basin Compared to the Quiver River

Family	Scientific Name	Common Name	Yazoo Basin Minus Quiver	Quiver River
Polyodontidae	*Polyodon spathula*	Paddlefish	1	
Lepisosteidae	*Lepisosteus oculatus*	Spotted gar	103	2
	Lepisosteus osseus	Longnose gar	49	1
	Lepisosteus platostomus	Shortnose gar	129	1
Amiidae	*Amia calva*	Bowfin	10	
Clupeidae	*Dorosoma cepedianum*	Gizzard shad	3161	16
	Dorosoma petenense	Threadfin shad	924	11
Esocidae	*Esox americanus*	Redfin pickerel	20	3
Cyprinidae	*Ctenopharyngodon idella*	Grass carp[I]	2	
	Cyprinella camura	Bluntface shiner	221	
	Cyprinella lutrensis	Red shiner	2183	105
	Cyprinella venusta	Blacktail shiner	27078	4690
	Cyprinus carpio	Common carp[I]	616	19
	Hybognathus hayi	Cypress minnow	38	
	Hybognathus nuchalis	Mississippi silvery minnow	29	
	Hypophthalmichthys molitrix	Silver carp[I]	5	
	Hypophthalmichthys nobilis	Bighead carp[I]	1	
	Luxilus chrysocephalus	Striped shiner	7	
	Lythrurus fumeus	Ribbon shiner	2	
	Lythrurus umbratilis	Redfin shiner	6	
	Macrhybopsis aestivalis	Speckled chub	2134	1129
	Macrhybopsis storeriana	Silver chub	5	
	Notemigonus crysoleucas	Golden shiner	1680	13
	Notropis atherinoides	Emerald shiner	611	287
	Notropis buchanani	Ghost shiner	6701	898
	Notropis maculatus	Taillight shiner	2	
	Notropis rafinesque	Yazoo shiner	661	
	Notropis sabinae	Sabine shiner	65	
	Notropis volucellus	Mimic shiner	70	
	Opsopoeodus emiliae	Pugnose minnow	878	36

	Pimephales notatus	Bluntnose minnow	88	
	Pimephales promelas	Fathead minnow[I]	1	
	Pimephales vigilax	Bullhead minnow	2801	496
	Semotilus atromaculatus	Creek chub	2	
Catostomidae	*Carpiodes carpio*	River carpsucker	4	
	Cycleptus elongates	Blue sucker	8	
	Erimyzon sucetta	Lake chubsucker	3	
	Ictiobus bubalus	Smallmouth buffalo	213	8
	Ictiobus cyprinellus	Bigmouth buffalo	102	
	Ictiobus niger	Black buffalo	12	2
	Moxostoma poecilurum	Blacktail Redhorse	1	
Ictaluridae	*Ameiurus melas*	Black bullhead	636	1
	Ameiurus natalis	Yellow bullhead	74	4
	Ictalurus furcatus	Blue catfish	157	17
	Ictalurus punctatus	Channel catfish	1356	184
Ictaluridae	*Noturus gyrinus*	Tadpole madtom	252	10
	Noturus nocturnus	Freckled madtom	43	
	Noturus phaeus	Brown madtom	5	
	Pylodictus olivaris	Flathead catfish	46	3
Aphredoderidae	*Aphredoderus sayanus*	Pirate perch	139	33
Fundulidae	*Fundulus chrysotus*	Golden topminnow	484	4
	Fundulus dispar	Starhead topminnow	1	
	Fundulus notatus	Blackstripe topminnow	3	
	Fundulus olivaceus	Blackspotted topminnow	38	
Poeciliidae	*Gambusia affinis*	Mosquitofish	38311	5215
Atherinopsidae	*Labidesthes sicculus*	Brook silverside	96	
	Menidia beryllina	Inland silverside	276	11
Moronidae	*Morone chrysops*	White bass	62	

Elassomatidae	*Elassoma zonatum*	Banded pygmy sunfish	101	12
Centrarchidae	*Centrarchus macropterus*	Flier	212	2
	Lepomis cyanellus	Green sunfish	1216	71
	Lepomis gulosus	Warmouth	1661	84
	Lepomis humilis	Orangespotted sunfish	8527	1268
	Lepomis macrochirus	Bluegill	11381	368
	Lepomis marginatus	Dollar sunfish	343	25
	Lepomis megalotis	Longear sunfish	936	113
	Lepomis microlophus	Redear sunfish	7	
	Lepomis miniatus	Redspotted sunfish	55	5
	Lepomis symmetricus	Bantam sunfish	297	29
	Micropterus dolomieu	Smallmouth bass[I]	2	
	Micropterus punctulatus	Spotted bass	21	
	Micropterus salmoides	Largemouth bass	250	40
	Pomoxis annularis	White crappie	3273	83
	Pomoxis nigromaculatus	Black crappie	955	21
Percidae	*Etheostoma chlorosomum*	Bluntnose darter	136	28
	Etheostoma fusiforme	Swamp darter	12	
	Etheostoma gracile	Slough darter	55	
	Percina maculata	Blackside darter	1	
	Percina nigrofasciata	Blackbanded darter	35	2
	Percina sciera	Dusky darter	11	
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum	1418	82
Cichlidae	*Tilapia nilotica*	Nile tilapia[I]	20	
Anguillidae	*Anguilla rostrata*	American eel	1	
Number of individuals			**123532**	**15432**
Number of Species			**83**	**43**

Species of Freshwater Mussels in the Yazoo River Basin Compared to the Quiver River Based on Jones et al. (2005), Current Holdings at the Mississippi Museum of Natural History, and Collections by USACE - ERDC.

SPECIES	COMMON NAME	Yazoo Basin	Quiver River
Actinonaias ligamentina	mucket	X	
Amblema plicata	threeridge	X	X
Anodonta suborbiculata	flat floater	X	X
Anodontoides radiatus	rayed creekshell	X	
Arcidens confragosus	rock pocketbook	X	X
Ellipsaria lineolata	butterfly	X	
Elliptio dilatata	spike	X	
Fusconaia ebena	ebonyshell	X	
Fusconaia flava	Wabash pigtoe	X	X
Glebula rotundata	round pearlshell	X	X
Lampsilis cardium	plain pocketbook	X	
Lampsilis hydiana	Louisiana fatmucket	X	X
Lampsilis siliquoidea	fatmucket	X	
Lampsilis teres	yellow sandshell	X	X
Leptodea fragilis	fragile papershell	X	X
Ligumia recta	black sandshell	X	
Ligumia subrostrata	pondmussel	X	X
Megalonaias nervosa	washboard	X	X
Obliquaria reflexa	threehorn wartyback	X	X
Obovaria subrotunda	round hickorynut	X	
Plectomerus dombeyanus	bankclimber	X	X
Plethobasus cyphyus	sheepnose	X	
Pleurobema rubrum	pyramid pigtoe	X	X
Potamilus capax	fat pocketbook	X	
Potamilus ohiensis	pink papershell	X	X
Potamilus purpuratus	bleufer	X	X
Pyganodon grandis	giant floater	X	X
Quadrula apiculata	southern mapleleaf	X	
Quadrula cylindrica	rabbitsfoot	X	
Quadrula nodulata	wartyback	X	X
Quadrula pustulosa	pimpleback	X	X
Quadrula quadrula	mapleleaf	X	X
Quadrula verrucosa	pistolgrip	X	X
Strophitus undulatus	squawfoot	X	

Toxolasma parvum	lilliput	X	X
Toxolasma texasiensis	Texas lilliput	X	X
Truncilla donaciformis	fawnsfoot	X	X
Truncilla truncata	deertoe	X	X
Uniomerus declivis	tapered pondhorn	X	X
Uniomerus tetralasmus	pondhorn	X	X
Utterbackia imbecillis	paper pondshell	X	X
Villosa lienosa	little spectaclecase	X	
Villosa vibex	southern rainbow	X	
Corbicula fluminea	Asian clam	X	X
Dreissena polymorpha	zebra mussel		
Total		**44**	**28**

Calculation of Existing Condition/Future Without Project Condition Habitat Suitability Index for the Quiver River using the Delta Stream Minnow Model

River	River Sta	Profile	Vel Chnl	Acres in section	HSI (velocity*.37) +.22	HUs Acres*HSI
Existing Condition						
Quiver River	15	Oct	0.35	1.25	0.35	0.436875
Quiver River	14.9230*	Oct	0.36	1.18	0.3532	0.416776
Quiver River	14.8461*	Oct	0.37	1.15	0.3569	0.410435
Quiver River	14.7692*	Oct	0.37	1.16	0.3569	0.414004
Quiver River	14.6923*	Oct	0.37	1.16	0.3569	0.414004
Quiver River	14.6153*	Oct	0.36	1.18	0.3532	0.416776
Quiver River	14.5384*	Oct	0.36	1.22	0.3532	0.430904
Quiver River	14.4615*	Oct	0.35	1.25	0.3495	0.436875
Quiver River	14.3846*	Oct	0.35	1.28	0.3495	0.44736
Quiver River	14.3076*	Oct	0.35	1.33	0.3495	0.464835
Quiver River	14.2307*	Oct	0.35	1.38	0.3495	0.48231
Quiver River	14.1538*	Oct	0.32	1.44	0.3384	0.487296
Quiver River	14.0769*	Oct	0.36	1.49	0.3532	0.526268
Quiver River	14	Oct	0.31	1.44	0.3347	0.481968
Quiver River	13.9*	Oct	0.31	1.45	0.3347	0.485315
Quiver River	13.8*	Oct	0.3	3.04	0.331	1.00624
Quiver River	13.6*	Oct	0.31	1.61	0.3347	0.538867
Quiver River	13.5*	Oct	0.3	1.72	0.331	0.56932
Quiver River	13.4*	Oct	0.23	1.89	0.3051	0.576639
Quiver River	13.3*	Oct	0.16	2.2	0.2792	0.61424
Quiver River	13.2*	Oct	0.11	2.99	0.2607	0.779493
Quiver River	13.1*	Oct	0.07	4.03	0.2459	0.990977
Quiver River	13	Oct	0.04	4.62	0.2348	1.084776
Quiver River	12.9166*	Oct	0.05	4.42	0.2385	1.05417
Quiver River	12.8333*	Oct	0.05	4.2	0.2385	1.0017
Quiver River	12.75*	Oct	0.05	3.98	0.2385	0.94923
Quiver River	12.6666*	Oct	0.06	3.76	0.2422	0.910672
Quiver River	12.5833*	Oct	0.06	3.55	0.2422	0.85981
Quiver River	12.5*	Oct	0.07	3.35	0.2459	0.823765
Quiver River	12.4166*	Oct	0.08	3.14	0.2496	0.783744
Quiver River	12.3333*	Oct	0.08	2.92	0.2496	0.728832
Quiver River	12.25*	Oct	0.09	2.69	0.2533	0.681377
Quiver River	12.1666*	Oct	0.1	2.64	0.257	0.67848
Quiver River	12.0833*	Oct	0.11	2.74	0.2607	0.714318
Quiver River	12	Oct	0.1	2.87	0.257	0.73759
Quiver River	11.9166*	Oct	0.08	3.06	0.2496	0.763776
Quiver River	11.8333*	Oct	0.06	3.22	0.2422	0.779884
Quiver River	11.75*	Oct	0.05	3.39	0.2385	0.808515
Quiver River	11.6666*	Oct	0.04	3.61	0.2348	0.847628
Quiver River	11.5833*	Oct	0.04	3.89	0.2348	0.913372
Quiver River	11.5*	Oct	0.03	4.19	0.2311	0.968309
Quiver River	11.4166*	Oct	0.03	4.45	0.2311	1.028395
Quiver River	11.3333*	Oct	0.02	4.66	0.2274	1.059684
Quiver River	11.25*	Oct	0.02	4.81	0.2274	1.093794
Quiver River	11.1666*	Oct	0.02	4.95	0.2274	1.12563
Quiver River	11.0833*	Oct	0.02	5.07	0.2274	1.152918
Quiver River	11	Oct	0.02	4.47	0.2274	1.016478
Quiver River	10.75*	Oct	0.02	4.51	0.2274	1.025574
Quiver River	10.5*	Oct	0.02	4.59	0.2274	1.043766
Quiver River	10.25*	Oct	0.02	4.74	0.2274	1.077876
Quiver River	10	Oct	0.02	3.66	0.2274	0.832284
Quiver River	9.9					

Quiver River	9.75*	Oct	0.09	2.46	0.2533	0.623118
Quiver River	9.5*	Oct	0.07	2.25	0.2459	0.553275
Quiver River	9.25*	Oct	0.06	2.13	0.2422	0.515886
Quiver River	9	Oct	0.07	2.71	0.2459	0.666389
Quiver River	8.8*	Oct	0.06	3.16	0.2422	0.765352
Quiver River	8.6*	Oct	0.05	3.64	0.2385	0.86814
Quiver River	8.4*	Oct	0.04	4.17	0.2348	0.979116
Quiver River	8.2*	Oct	0.03	4.65	0.2311	1.074615
Quiver River	8	Oct	0.03	4.36	0.2311	1.007596
Quiver River	7.83333*	Oct	0.03	4.34	0.2311	1.002974
Quiver River	7.66666*	Oct	0.02	4.25	0.2274	0.96645
Quiver River	7.5*	Oct	0.02	4.23	0.2274	0.961902
Quiver River	7.33333*	Oct	0.02	4.25	0.2274	0.96645
Quiver River	7.16666*	Oct	0.02	4.25	0.2274	0.96645
Quiver River	7	Oct	0.02	4.55	0.2274	1.03467
Quiver River	6.83333*	Oct	0.02	8.33	0.2274	1.894242
Quiver River	6.5*	Oct	0.1	2.89	0.257	0.74273
Quiver River	6.33333*	Oct	0.09	2.98	0.2533	0.754834
Quiver River	6.16666*	Oct	0.08	3.04	0.2496	0.758784
Quiver River	6	Oct	0.07	2.98	0.2459	0.732782
Quiver River	5.8*	Oct	0.07	3.24	0.2459	0.796716
Quiver River	5.6*	Oct	0.07	3.55	0.2459	0.872945
Quiver River	5.4*	Oct	0.06	3.93	0.2422	0.951846
Quiver River	5.2*	Oct	0.05	4.32	0.2385	1.03032
Quiver River	5	Oct	0.04	5.17	0.2348	1.213916
Quiver River	4.83333*	Oct	0.03	5.44	0.2311	1.257184
Quiver River	4.66666*	Oct	0.03	5.76	0.2311	1.331136
Quiver River	4.5*	Oct	0.03	6.13	0.2311	1.416643
Quiver River	4.33333*	Oct	0.03	6.57	0.2311	1.518327
Quiver River	4.16666*	Oct	0.02	6.82	0.2274	1.550868
Quiver River	4.1					
Quiver River	4	Oct	0.04	6.68	0.2348	1.568464
Quiver River	3.8*	Oct	0.03	6.64	0.2311	1.534504
Quiver River	3.6*	Oct	0.02	6.59	0.2274	1.498566
Quiver River	3.4*	Oct	0.02	6.54	0.2274	1.487196
Quiver River	3.2*	Oct	0.02	6.48	0.2274	1.473552
Quiver River	3	Oct	0.02	6.72	0.2274	1.528128
Quiver River	2.8*	Oct	0.02	7.31	0.2274	1.662294
Quiver River	2.6*	Oct	0.02	7.78	0.2274	1.769172
Quiver River	2.4*	Oct	0.02	8.56	0.2274	1.946544
Quiver River	2.2*	Oct	0.02	6.73	0.2274	1.530402
Quiver River	2.1					
Quiver River	2	Oct	0.23	4.02	0.3051	1.226502
Quiver River	1.91428*	Oct	0.27	3.54	0.3199	1.132446
Quiver River	1.82857*	Oct	0.29	3.3	0.3273	1.08009
Quiver River	1.74285*	Oct	0.33	2.8	0.3421	0.95788
Quiver River	1.65714*	Oct	0.36	2.32	0.3532	0.819424
Quiver River	1.57142*	Oct	0.37	2.16	0.3569	0.770904
Quiver River	1.48571*	Oct	0.38	2.07	0.3606	0.746442
Quiver River	1.4*	Oct	0.38	2.02	0.3606	0.728412

Quiver River	1.31428*	Oct	0.41	1.98	0.3717	0.735966
Quiver River	1.22857*	Oct	0.41	1.95	0.3717	0.724815
Quiver River	1.14285*	Oct	0.41	1.94	0.3717	0.721098
Quiver River	1.05714*	Oct	0.41	1.28	0.3717	0.475776
Quiver River	1	Oct	0.42	0	0.3754	0
			0.139327	374.95	0.27	94.27
				Total Acres	Average HSI	Total Habitat Units

Calculation of With Project Condition Habitat Suitability Index for the Quiver River using the Delta Stream Minnow Model

Plan 89 - 100 cfs Pump					Acres in section	HSI	HUs
River	River Sta	Profile	Q Total (cfs)	Vel Chnl (ft/s)		(velocity*.37) +.22	Acres*HSI
Quiver Riv	15	Oct	103.92	0.88	2.83	0.55	1.544048
Quiver Riv	14.9230*	Oct	103.92	0.9	2.82	0.55	1.55946
Quiver Riv	14.8461*	Oct	103.92	0.92	2.74	0.56	1.535496
Quiver Riv	14.7692*	Oct	103.92	0.95	2.62	0.57	1.49733
Quiver Riv	14.6923*	Oct	103.92	0.98	2.5	0.58	1.4565
Quiver Riv	14.6153*	Oct	103.92	1.01	2.37	0.59	1.407069
Quiver Riv	14.5384*	Oct	103.92	1.03	2.3	0.60	1.38253
Quiver Riv	14.4615*	Oct	103.92	1.03	2.27	0.60	1.364497
Quiver Riv	14.3846*	Oct	103.92	1.03	2.26	0.60	1.358486
Quiver Riv	14.3076*	Oct	103.92	1.03	2.26	0.60	1.358486
Quiver Riv	14.2307*	Oct	103.92	1.02	2.29	0.60	1.368046
Quiver Riv	14.1538*	Oct	103.92	1	2.32	0.59	1.3688
Quiver Riv	14.0769*	Oct	104.45	0.97	2.37	0.58	1.371993
Quiver Riv	14	Oct	104.45	0.92	2.26	0.56	1.266504
Quiver Riv	13.9*	Oct	104.45	0.91	2.35	0.56	1.308245
Quiver Riv	13.8*	Oct	104.45	0.89	2.45	0.55	1.345785
Quiver Riv	13.7*	Oct	104.78	0.85	2.58	0.53	1.37901
Quiver Riv	13.6*	Oct	104.78	0.81	2.77	0.52	1.439569
Quiver Riv	13.5*	Oct	104.78	0.75	3.32	0.50	1.6517
Quiver Riv	13.4*	Oct	104.78	0.66	3.99	0.46	1.852158
Quiver Riv	13.3*	Oct	104.78	0.54	4.5	0.42	1.8891
Quiver Riv	13.2*	Oct	104.78	0.43	5.04	0.38	1.910664
Quiver Riv	13.1*	Oct	104.78	0.34	5.54	0.35	1.915732
Quiver Riv	13	Oct	104.78	0.27	5.98	0.32	1.913002
Quiver Riv	12.9166*	Oct	104.98	0.29	5.71	0.33	1.868883
Quiver Riv	12.8333*	Oct	104.98	0.31	5.46	0.33	1.827462
Quiver Riv	12.75*	Oct	104.98	0.33	5.2	0.34	1.77892
Quiver Riv	12.6666*	Oct	104.98	0.36	4.96	0.35	1.751872
Quiver Riv	12.5833*	Oct	104.98	0.38	4.72	0.36	1.702032
Quiver Riv	12.5*	Oct	104.98	0.42	4.59	0.38	1.723086
Quiver Riv	12.4166*	Oct	104.98	0.45	4.99	0.39	1.928635
Quiver Riv	12.3333*	Oct	104.98	0.48	5.3	0.40	2.10728
Quiver Riv	12.25*	Oct	104.98	0.51	4.96	0.41	2.027152
Quiver Riv	12.1666*	Oct	104.98	0.55	4.52	0.42	1.91422
Quiver Riv	12.0833*	Oct	104.98	0.6	4.04	0.44	1.78568
Quiver Riv	12	Oct	104.98	0.69	3.7	0.48	1.75861
Quiver Riv	11.9166*	Oct	104.98	0.66	3.76	0.46	1.745392
Quiver Riv	11.8333*	Oct	104.98	0.63	3.85	0.45	1.744435
Quiver Riv	11.75*	Oct	104.98	0.6	3.97	0.44	1.75474
Quiver Riv	11.6666*	Oct	104.98	0.56	4.17	0.43	1.781424
Quiver Riv	11.5833*	Oct	104.98	0.51	4.39	0.41	1.794193
Quiver Riv	11.5*	Oct	104.98	0.47	4.59	0.39	1.808001
Quiver Riv	11.4166*	Oct	104.98	0.42	4.76	0.38	1.786904
Quiver Riv	11.3333*	Oct	104.98	0.38	4.91	0.36	1.770546
Quiver Riv	11.25*	Oct	104.98	0.34	5.04	0.35	1.742832
Quiver Riv	11.1666*	Oct	106.38	0.31	5.16	0.33	1.727052
Quiver Riv	11.0833*	Oct	106.38	0.28	5.24	0.32	1.695664
Quiver Riv	11	Oct	106.38	0.26	4.63	0.32	1.464006
Quiver Riv	10.75*	Oct	106.38	0.27	4.67	0.32	1.493933
Quiver Riv	10.5*	Oct	106.38	0.27	4.74	0.32	1.516326
Quiver Riv	10.25*	Oct	106.38	0.27	4.88	0.32	1.561112
Quiver Riv	10	Oct	106.38	0.26	4.12	0.32	1.302744

Quiver Riv	9.9		Inl Struct				
Quiver Riv	9.75*	Oct	106.38	0.65	3.16	0.46	1.45518
Quiver Riv	9.5*	Oct	106.38	0.66	2.75	0.46	1.27655
Quiver Riv	9.25*	Oct	106.38	0.67	2.47	0.47	1.155713
Quiver Riv	9	Oct	107.39	0.68	3.05	0.47	1.43838
Quiver Riv	8.8*	Oct	108.5	0.58	3.46	0.43	1.503716
Quiver Riv	8.6*	Oct	108.5	0.48	3.94	0.40	1.566544
Quiver Riv	8.4*	Oct	108.91	0.4	4.43	0.37	1.63024
Quiver Riv	8.2*	Oct	108.91	0.33	4.86	0.34	1.662606
Quiver Riv	8	Oct	108.91	0.28	4.52	0.32	1.462672
Quiver Riv	7.83333*	Oct	108.91	0.27	4.51	0.32	1.442749
Quiver Riv	7.66666*	Oct	108.91	0.27	4.46	0.32	1.426754
Quiver Riv	7.5*	Oct	108.91	0.26	4.45	0.32	1.40709
Quiver Riv	7.33333*	Oct	108.91	0.25	4.47	0.31	1.396875
Quiver Riv	7.16666*	Oct	108.91	0.25	4.4	0.31	1.375
Quiver Riv	7	Oct	108.91	0.24	4.72	0.31	1.457536
Quiver Riv	6.83333*	Oct	108.91	0.24	4.75	0.31	1.4668
Quiver Riv	6.66666*	Oct	108.91	0.23	4.1	0.31	1.25091
Quiver Riv	6.5*	Oct	108.91	0.62	3.44	0.45	1.545936
Quiver Riv	6.33333*	Oct	108.91	0.62	3.45	0.45	1.55043
Quiver Riv	6.16666*	Oct	108.91	0.61	3.38	0.45	1.506466
Quiver Riv	6	Oct	108.91	0.59	3.28	0.44	1.437624
Quiver Riv	5.8*	Oct	108.91	0.59	3.61	0.44	1.582263
Quiver Riv	5.6*	Oct	108.91	0.57	3.89	0.43	1.676201
Quiver Riv	5.4*	Oct	108.91	0.52	4.13	0.41	1.703212
Quiver Riv	5.2*	Oct	108.91	0.44	4.49	0.38	1.718772
Quiver Riv	5	Oct	108.91	0.37	5.35	0.36	1.909415
Quiver Riv	4.83333*	Oct	108.91	0.36	5.65	0.35	1.99558
Quiver Riv	4.66666*	Oct	108.91	0.33	6.01	0.34	2.056021
Quiver Riv	4.5*	Oct	109.61	0.31	6.42	0.33	2.148774
Quiver Riv	4.33333*	Oct	109.61	0.28	6.77	0.32	2.190772
Quiver Riv	4.16666*	Oct	109.61	0.25	6.94	0.31	2.16875
Quiver Riv	4.1		Inl Struct				
Quiver Riv	4	Oct	109.61	0.38	6.79	0.36	2.448474
Quiver Riv	3.8*	Oct	109.61	0.29	6.76	0.33	2.212548
Quiver Riv	3.6*	Oct	109.61	0.24	6.73	0.31	2.078224
Quiver Riv	3.4*	Oct	109.61	0.21	6.69	0.30	1.991613
Quiver Riv	3.2*	Oct	110.9	0.19	6.65	0.29	1.930495
Quiver Riv	3	Oct	110.9	0.17	6.96	0.28	1.968984
Quiver Riv	2.8*	Oct	110.9	0.17	7.6	0.28	2.15004
Quiver Riv	2.6*	Oct	110.9	0.16	8.36	0.28	2.334112
Quiver Riv	2.4*	Oct	110.9	0.16	9.41	0.28	2.627272
Quiver Riv	2.2*	Oct	112.14	0.15	8.03	0.28	2.212265
Quiver Riv	2.1		Inl Struct				
Quiver Riv	2	Oct	112.14	0.46	6.03	0.39	2.352906
Quiver Riv	1.91428*	Oct	112.98	0.49	5.79	0.40	2.323527
Quiver Riv	1.82857*	Oct	112.98	0.52	5.55	0.41	2.28882
Quiver Riv	1.74285*	Oct	112.98	0.55	5.26	0.42	2.22761
Quiver Riv	1.65714*	Oct	112.98	0.59	4.9	0.44	2.14767

Quiver Riv	1.57142*	Oct	112.98	0.62	4.56	0.45	2.049264
Quiver Riv	1.48571*	Oct	112.98	0.65	4.26	0.46	1.96173
Quiver Riv	1.4*	Oct	112.98	0.68	4.06	0.47	1.914696
Quiver Riv	1.31428*	Oct	113.94	0.71	3.89	0.48	1.877703
Quiver Riv	1.22857*	Oct	113.94	0.73	3.75	0.49	1.837875
Quiver Riv	1.14285*	Oct	113.94	0.76	3.62	0.50	1.814344
Quiver Riv	1.05714*	Oct	113.94	0.8	2.33	0.52	1.20228
Quiver Riv	1	Oct	114.09	0.83	0	0.53	0
				0.525377	467.05	0.41	180.825329
					Total Acres	Average HSI	Total Habitat Units

Calculation of Wetted Perimeter in Parks and Sandy Bayous

Parks and Sandy Bayous

Wetted Perimeter

Cross Section	Month	100 cfs	200 cfs	300 cfs	400 cfs
37	Jan	54.64	66.33	70.63	74.93
37	Feb	54.65	66.35	70.665	74.98
37	Mar	54.64	66.33	70.635	74.94
37	Apr	54.64	66.31	70.585	74.86
37	May	54.64	66.3	70.555	74.81
37	Jun	54.64	66.29	70.52	74.75
37	Jul	54.64	66.3	70.53	74.76
37	Aug	54.64	66.3	70.53	74.76
37	Sep	54.64	66.29	70.51	74.73
37	Oct	54.64	66.29	70.505	74.72
37	Nov	54.64	66.29	70.51	74.73
37	Dec	54.64	66.31	70.57	74.83
36	Jan	61.81	67.4	73.52	79.64
36	Feb	61.81	67.42	73.565	79.71
36	Mar	61.81	67.4	73.52	79.64
36	Apr	61.8	67.38	73.455	79.53
36	May	61.8	67.36	73.405	79.45
36	Jun	61.8	67.35	73.355	79.36
36	Jul	61.8	67.35	73.365	79.38
36	Aug	61.8	67.35	73.365	79.38
36	Sep	61.8	67.34	73.335	79.33
36	Oct	61.8	67.34	73.325	79.31
36	Nov	61.8	67.34	73.335	79.33
36	Dec	61.8	67.37	73.43	79.49
35	Jan	55.51	60.76	65.315	69.87
35	Feb	55.51	60.78	65.365	69.95
35	Mar	55.51	60.76	65.315	69.87
35	Apr	55.49	60.73	65.24	69.75
35	May	55.49	60.71	65.185	69.66
35	Jun	55.49	60.69	65.125	69.56
35	Jul	55.49	60.7	65.14	69.58
35	Aug	55.49	60.7	65.14	69.58
35	Sep	55.49	60.69	65.11	69.53
35	Oct	55.49	60.69	65.095	69.5
35	Nov	55.49	60.69	65.105	69.52
35	Dec	55.49	60.72	65.21	69.7
34	Jan	57.11	77.57	83.015	88.46
34	Feb	57.15	77.66	83.215	88.77
34	Mar	57.11	77.57	83.025	88.48
34	Apr	57.04	77.45	82.725	88
34	May	57.02	77.38	82.515	87.65
34	Jun	57.01	77.32	82.3	87.28
34	Jul	57.02	77.33	82.335	87.34
34	Aug	57.02	77.33	82.33	87.33
34	Sep	57.01	77.31	82.225	87.14
34	Oct	57.01	77.3	82.165	87.03
34	Nov	57.01	77.3	82.205	87.11

34	Dec	57.03	77.41	82.615	87.82
33	Jan	51.21	80.25	71.68	63.11
33	Feb	51.22	80.28	71.75	63.22
33	Mar	51.21	80.25	71.685	63.12
33	Apr	51.18	80.22	71.59	62.96
33	May	51.18	80.2	71.52	62.84
33	Jun	51.17	80.19	71.455	62.72
33	Jul	51.17	80.19	71.465	62.74
33	Aug	51.17	80.19	71.46	62.73
33	Sep	51.17	80.18	71.425	62.67
33	Oct	51.17	80.18	71.405	62.63
33	Nov	51.17	80.18	71.42	62.66
33	Dec	51.18	80.21	71.555	62.9
32	Jan	76.79	92.25	92.34	92.43
32	Feb	76.83	92.31	92.515	92.72
32	Mar	76.79	92.25	92.35	92.45
32	Apr	76.72	92.16	92.08	92
32	May	76.71	92.11	91.89	91.67
32	Jun	76.7	92.07	91.7	91.33
32	Jul	76.7	92.08	91.73	91.38
32	Aug	76.7	92.08	91.73	91.38
32	Sep	76.7	92.06	91.63	91.2
32	Oct	76.7	92.05	91.57	91.09
32	Nov	76.7	92.06	91.615	91.17
32	Dec	76.71	92.14	91.985	91.83
31	Jan	48.6	54.42	53.825	53.23
31	Feb	48.62	54.45	53.9	53.35
31	Mar	48.6	54.42	53.83	53.24
31	Apr	48.57	54.39	53.72	53.05
31	May	48.56	54.37	53.64	52.91
31	Jun	48.56	54.36	53.56	52.76
31	Jul	48.56	54.36	53.57	52.78
31	Aug	48.56	54.36	53.57	52.78
31	Sep	48.56	54.35	53.525	52.7
31	Oct	48.56	54.35	53.5	52.65
31	Nov	48.56	54.35	53.52	52.69
31	Dec	48.57	54.38	53.68	52.98
30	Jan	41.06	45.47	58.2	70.93
30	Feb	41.08	45.5	58.29	71.08
30	Mar	41.06	45.48	58.21	70.94
30	Apr	41.04	45.45	58.075	70.7
30	May	41.03	45.43	57.98	70.53
30	Jun	41.03	45.42	57.885	70.35
30	Jul	41.03	45.42	57.9	70.38
30	Aug	41.03	45.42	57.895	70.37
30	Sep	41.03	45.41	57.845	70.28
30	Oct	41.03	45.41	57.815	70.22
30	Nov	41.03	45.41	57.835	70.26
30	Dec	41.03	45.44	58.025	70.61
29	Jan	39.13	43.39	47.89	52.39

29	Feb	39.15	43.42	47.975	52.53
29	Mar	39.13	43.39	47.895	52.4
29	Apr	39.1	43.36	47.765	52.17
29	May	39.09	43.34	47.67	52
29	Jun	39.09	43.32	47.57	51.82
29	Jul	39.09	43.32	47.585	51.85
29	Aug	39.09	43.32	47.585	51.85
29	Sep	39.09	43.31	47.53	51.75
29	Oct	39.09	43.31	47.505	51.7
29	Nov	39.09	43.31	47.525	51.74
29	Dec	39.1	43.34	47.71	52.08
28	Jan	38.08	43.62	57.835	72.05
28	Feb	38.12	43.67	57.99	72.31
28	Mar	38.08	43.63	57.85	72.07
28	Apr	38.02	43.56	57.615	71.67
28	May	38.01	43.52	57.445	71.37
28	Jun	38	43.49	57.265	71.04
28	Jul	38	43.5	57.295	71.09
28	Aug	38	43.5	57.29	71.08
28	Sep	38	43.49	57.2	70.91
28	Oct	38	43.48	57.145	70.81
28	Nov	38	43.49	57.19	70.89
28	Dec	38.01	43.54	57.525	71.51
27	Jan	24.98	29.51	42.39	55.27
27	Feb	25.07	29.62	42.64	55.66
27	Mar	24.99	29.52	42.41	55.3
27	Apr	24.88	29.37	42.025	54.68
27	May	24.84	29.28	41.75	54.22
27	Jun	24.82	29.21	41.515	53.82
27	Jul	24.82	29.21	41.535	53.86
27	Aug	24.82	29.21	41.535	53.86
27	Sep	24.81	29.19	41.46	53.73
27	Oct	24.81	29.17	41.415	53.66
27	Nov	24.81	29.18	41.445	53.71
27	Dec	24.86	29.32	41.885	54.45
26	Jan	52.22	59.63	69.23	78.83
26	Feb	52.87	60.19	69.73	79.27
26	Mar	52.27	59.68	69.27	78.86
26	Apr	51.29	58.82	68.48	78.14
26	May	50.8	58.24	67.92	77.6
26	Jun	50.37	57.69	67.335	76.98
26	Jul	50.43	57.76	67.42	77.08
26	Aug	50.42	57.75	67.405	77.06
26	Sep	50.25	57.51	67.12	76.73
26	Oct	50.16	57.38	66.955	76.53
26	Nov	50.23	57.48	67.08	76.68
26	Dec	51.02	58.52	68.19	77.86
25	Jan	58.01	66.48	73.555	80.63
25	Feb	59.03	67.33	74.21	81.09
25	Mar	58.09	66.54	73.605	80.67
25	Apr	56.46	65.19	72.5	79.81

25	May	55.6	64.23	71.645	79.06
25	Jun	54.84	63.3	70.745	78.19
25	Jul	54.94	63.42	70.875	78.33
25	Aug	54.93	63.41	70.865	78.32
25	Sep	54.6	63.01	70.425	77.84
25	Oct	54.44	62.78	70.165	77.55
25	Nov	54.56	62.95	70.36	77.77
25	Dec	56	64.71	72.065	79.42
24	Jan	46.54	50.94	53.605	56.27
24	Feb	47.21	51.32	53.885	56.45
24	Mar	46.59	50.97	53.625	56.28
24	Apr	45.49	50.36	53.17	55.98
24	May	44.9	49.76	52.74	55.72
24	Jun	44.36	49.11	52.22	55.33
24	Jul	44.43	49.2	52.3	55.4
24	Aug	44.42	49.18	52.285	55.39
24	Sep	44.19	48.9	52.035	55.17
24	Oct	44.07	48.74	51.89	55.04
24	Nov	44.16	48.86	52	55.14
24	Dec	45.18	50.08	52.97	55.86
23	Jan	49.2	54.3	57.615	60.93
23	Feb	50.08	55.04	58.09	61.14
23	Mar	49.27	54.36	57.655	60.95
23	Apr	47.81	53.14	56.87	60.6
23	May	46.99	52.23	56.275	60.32
23	Jun	46.22	51.33	55.605	59.88
23	Jul	46.33	51.45	55.715	59.98
23	Aug	46.32	51.43	55.7	59.97
23	Sep	45.99	51.03	55.335	59.64
23	Oct	45.81	50.8	55.115	59.43
23	Nov	45.94	50.98	55.285	59.59
23	Dec	47.38	52.68	56.57	60.46
22	Jan	47.57	53.39	53.4	53.41
22	Feb	48.6	54.12	53.925	53.73
22	Mar	47.65	53.45	53.445	53.44
22	Apr	45.88	52.22	52.555	52.89
22	May	44.83	51.28	51.865	52.45
22	Jun	43.82	50.31	51.12	51.93
22	Jul	43.96	50.44	51.23	52.02
22	Aug	43.94	50.42	51.215	52.01
22	Sep	43.5	49.98	50.85	51.72
22	Oct	43.28	49.72	50.625	51.53
22	Nov	43.45	49.92	50.795	51.67
22	Dec	45.33	51.75	52.21	52.67
21	Jan	50.95	55.13	57.8	60.47
21	Feb	51.9	55.72	58.3	60.88
21	Mar	51.03	55.18	57.84	60.5
21	Apr	49.34	54.14	56.965	59.79
21	May	48.32	53.18	56.2	59.22
21	Jun	47.3	52.16	55.345	58.53
21	Jul	47.45	52.3	55.47	58.64

21	Aug	47.43	52.28	55.455	58.63
21	Sep	46.96	51.81	55.025	58.24
21	Oct	46.72	51.54	54.765	57.99
21	Nov	46.9	51.75	54.965	58.18
21	Dec	48.81	53.66	56.58	59.5
20	Jan	46.88	51.66	55.56	59.46
20	Feb	48.17	52.75	56.4	60.05
20	Mar	46.99	51.75	55.63	59.51
20	Apr	44.64	49.83	54.14	58.45
20	May	43.16	48.3	52.82	57.34
20	Jun	41.63	46.61	51.275	55.94
20	Jul	41.85	46.85	51.515	56.18
20	Aug	41.82	46.82	51.485	56.15
20	Sep	41.1	46.02	50.685	55.35
20	Oct	40.72	45.53	50.18	54.83
20	Nov	41.01	45.9	50.565	55.23
20	Dec	43.87	49.08	53.485	57.89
19	Jan	52.07	55.07	59.84	64.61
19	Feb	52.97	55.83	60.47	65.11
19	Mar	52.14	55.13	59.89	64.65
19	Apr	50.42	53.76	58.74	63.72
19	May	48.93	52.6	57.71	62.82
19	Jun	47.14	51.22	56.435	61.65
19	Jul	47.43	51.43	56.64	61.85
19	Aug	47.39	51.4	56.615	61.83
19	Sep	46.47	50.71	55.925	61.14
19	Oct	45.93	50.21	55.445	60.68
19	Nov	46.34	50.61	55.82	61.03
19	Dec	49.69	53.2	58.235	63.27
18	Jan	51.41	54.78	56.995	59.21
18	Feb	52.72	55.9	57.77	59.64
18	Mar	51.52	54.87	57.055	59.24
18	Apr	48.91	52.8	55.625	58.45
18	May	47	50.96	54.3	57.64
18	Jun	44.57	48.61	52.245	55.88
18	Jul	44.98	48.98	52.585	56.19
18	Aug	44.92	48.93	52.54	56.15
18	Sep	43.53	47.68	51.38	55.08
18	Oct	42.64	46.84	50.59	54.34
18	Nov	43.32	47.48	51.195	54.91
18	Dec	47.96	51.92	55.02	58.12
17	Jan	65.39	69.16	71.815	74.47
17	Feb	66.8	70.38	72.655	74.93
17	Mar	65.51	69.26	71.885	74.51
17	Apr	62.65	66.99	70.18	73.37
17	May	60.14	64.93	68.41	71.89
17	Jun	55.98	62.2	66.04	69.88
17	Jul	56.7	62.63	66.435	70.24
17	Aug	56.61	62.57	66.38	70.19
17	Sep	54.1	60.8	64.87	68.94
17	Oct	52.39	59.29	63.675	68.06

17	Nov	53.7	60.45	64.595	68.74
17	Dec	61.59	66	69.32	72.64

Appendix D

Socio-Economics

BIG SUNFLOWER RIVER WATERSHED
QUIVER RIVER, MISSISSIPPI
DRAFT FEASIBILITY REPORT

APPENDIX B
ECONOMIC ANALYSIS

INTRODUCTION

This appendix describes the results of an economic evaluation of proposed water resource improvements in the Quiver River area of Leflore, Sunflower, and Tallahatchie Counties Mississippi. The focus of this study is to identify existing environmental restoration and water supply measures in the Big Sunflower River Watershed (Quiver River), Mississippi. This analysis will use integrated water resources management (IWRM) approach to deal with the planning process.

PROJECT AREA

The study area is part of the Big Sunflower River and Yazoo River watersheds in the Mississippi Delta (Figure 1). The Quiver River originates in west-central Tallahatchie County and meanders more than 60 miles south through Tallahatchie and Leflore Counties before its confluence with the Big Sunflower River just north of U.S. Highway 82 in Sunflower County. Major streams located in the area include the Tallahatchie and Quiver Rivers and Cassidy, Sandy, Black, and Parks Bayous and Swan Lake.

ECONOMIC BASE AREA

LOCATION AND DESCRIPTION

The economic base area includes portions of Leflore, Sunflower, and Tallahatchie Counties, Mississippi. This area is west of the Tallahatchie River in the northwest corner of the State of Mississippi. The county seat of Leflore County is Greenwood. The county seat of Sunflower County is Indianola. Tallahatchie County is one of ten counties in Mississippi to have two county seats. Those two county seats are Charleston and Sumner.

Leflore, Sunflower, and Tallahatchie Counties have an approximate land area of 606 square miles, 707, and 652 square miles, respectively. Of this area there is over 14, 9.2, and 6.9 square miles covered with water in Leflore, Sunflower, and Tallahatchie Counties, respectively.

CLIMATE

The project area has long, hot, humid summers, mild winters, and generally adequate rainfall. Bright sunshine and high temperatures, broken by short periods of scattered showers and thunderstorms mainly in the afternoon or evening, characterize the summer. On average, there are 95 days a year with measurable rainfall. Typically, there are about 87 days a year that the

temperature exceeds 90 degrees F. In the fall, days are warm and nights are cool. This normally is the driest season and commonly the most pleasant.

Winters are generally mild, with a monthly average high temperature of 53 degrees F for January. First autumn freeze is generally around mid-November. The last spring freeze is around mid-March. Temperatures below freezing occur only for brief periods and temperatures below 10 degrees F are rare. Snowfall averages 1.2 to 1.5 inches per year for project area. The all-time record lowest temperature in the area was -8 degrees F recorded in Sumner, MS.

PRECIPITATION

Precipitation is normally adequate for the needs of a general farming area. The average annual rainfall in Leflore, Sunflower, and Tallahatchie Counties typically around 55 inches. Winter and spring are the wettest seasons with approximately 60 percent of the annual precipitation. The month of October generally has the least amount of rainfall. Storms and flashfloods, however, can occur at any time of the year.

SOCIOECONOMIC ENVIRONMENT

The socioeconomic environment of Tallahatchie and Leflore Counties is described below. It is within this economic base that damages would occur and benefits from a project would be achieved. In view of this, a socioeconomic profile of Leflore, Sunflower, and Tallahatchie Counties is included in this analysis to describe the demographic, economic, and social setting of the project area. A brief overview of this analysis is depicted in Table B-1. Among the socioeconomic parameters discussed are population, housing, employment, and income.

TABLE B-1
SOCIOECONOMIC OVERVIEW FOR THE YEAR 2010
TALLAHATCHIE AND LEFLORE COUNTIES, MISSISSIPPI

Item	Leflore County	Sunflower County	Tallahatchie County	State of Mississippi
	Population and Housing			
Population	32,317	29,450	15,378	2,967,297
Total Housing Units	13,199	9,697	5,530	1,274,719
Total Households	11,577	8,451	4,856	1,115,768
Homeownership Rate (%)	52.5	58.5	72.5	69.6
Persons Per Household	2.59	2.86	2.67	2.58
	Income			
Per Capita Income ($)	12,957	11,993	12,687	20,956
	Farmed Acreage			

Land in Farms	293,155	372,666	340,711	10,931,080

SOURCE: American FactFinder and QuickFacts, U.S. Census Bureau; 2012 Census of Agriculture.

POPULATION

Historical population statistics for the years 1950 to 2010 are presented in Table B-2 for Leflore, Sunflower, and Tallahatchie Counties as well as the State of Mississippi. The population of Leflore, Sunflower, and Tallahatchie Counties showed decreases during this time with Tallahatchie County showing a slight 3.2 percent increase between 2000 and 2010. During the same period of 2000 to 2010, the population of the State of Mississippi increased by 4.3 percent from 2,844,656 to 2,967,297.

TABLE B-2
HISTORICAL POPULATION STATISTICS
LEFLORE COUNTY, TALLAHATCHIE COUNTY, AND THE STATE OF MISSISSIPPI

Area	Year						
	1950	1960	1970	1980	1990	2000	2010
Leflore County	51,813	47,142	42,111	41,525	37,341	37,947	32,317
Sunflower County	56,031	45,750	37,047	34,844	32,867	34,369	29,450
Tallahatchie County	30,486	24,081	19,338	17,157	15,210	14,903	15,378
State of Mississippi	2,178,914	2,178,141	2,216,994	2,520,770	2,575,475	2,844,656	2,967,297

SOURCES: 2010 Census of Population and Housing, Mississippi, U.S. Department of the Census and State and County QuickFacts, U.S. Census Bureau.

PER CAPITA INCOME

In 2010, Leflore County had the highest per capita income (PCI) of the three counties at $12,957. During this same period, Sunflower County had the lowest PCI at $11,993. These 2010 PCIs are lower than the state average of $19,977.

BUSINESS AND EMPLOYMENT

During 2010, the leading industry in the project area were typically Agriculture, Manufacturing, Retail Trade, Educational & Health Services, and Food Services. During this same period the leading industries for the entire state of Mississippi were, Educational & Health Services, Manufacturing, Retail Trade, and Food Services.

In 2010, Mississippi had a civilian employed population of 1,216,060 people. Combined the project area composes approximately 2% of this number. Leflore, Sunflower, and Tallahatchie Counties had civilian employed population of 10,609, 8,682, and 5,271, respectively.

With a combined area of more than 1 million acres devoted to production, the three counties in the project area depend heavily on agriculture. Sunflower and Tallahatchie counties both have 83% of their total land acres in cultivation of crops. At 77%, Leflore County also has the predominance of the land acres in agriculture.

ALTERNATIVE PLANS OF ECOSYSTEM IMPROVEMENT

In evaluating the environmental and water supply problems of the Quiver River area, several alternative measures were investigated. These included the no-action and the alternatives discussed in the following paragraphs.

Alternative 1 - NO-ACTION

The no-action alternative, representing the without-project condition, depicts existing conditions in the area and expect the continuation of existing trends. In most cases, the no-action alternative would not meet the objective of improving environmental conditions in the area and is not supported by local interests.

ALTERNATIVE 2 – 100 CFS

This alternative would build an electric pumping station on the Tallahatchie River approximately 2 miles north of Sharkey, MS. The station would have the capacity to pump 100 CFS from the Tallahatchie River. A 1,500 foot long channel would be excavated (63,000 cubic yards) to connect the pump station to Cassidy Bayou. Water would flow from Cassidy Bayou into Swan Lake. Water would flow from Swan Lake to Black Bayou, then to Sandy Bayou and then Parks Bayou, and finally into the Quiver River approximately 2.5 miles northeast of Brooks, MS. This

alternative will require new weirs in Cassidy and Black Bayou so that water can reach the required water surface elevation without flowing back into the Tallahatchie.

At Black Bayou 2.4 acres will be cleared to construct the weir and 1.3 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 100 CFS to pass. This will include up to 13,905 feet and 45,000 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared to allow construction and along the streambanks in areas where conservation easements are acquired; 100 acres of tree planting is anticipated.

The pumping station would be operated to ensure 100 CFS is maintained in the Quiver River. Water transfer to meet the ecological project flows are most likely in September and October, but some may also be needed in August and November. During October, nearly all of the 100 CFS will be needed to maintain the project flow. Irrigation season generally extends from May to August and water can be withdrawn from the system as long as the 100 CFS project flow is maintained. Operation of the pump is not likely from December through April when the extra water is not needed for irrigation or project flows. It is assumed the pump cannot be regulated to deliver increments less than 100 CFS.

ALTERNATIVE 3 – 200 CFS

This alternative is essentially the same as Alternative 2, however the pump station would have two 100 CFS pumps so that it can deliver 200 CFS for irrigation and ecological purposes, but only 100 CFS when it is only needed to maintain the project flow.

At Black Bayou 2.4 acres will be cleared to construct the weir and 1.5 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 200 CFS to pass. This will include up to 22,700 feet and 114,100 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared to allow construction and along the streambanks in areas where conservation easements are acquired; 100 acres of tree planting is anticipated.

ALTERNATIVE 4 – 300 CFS

This alternative is essentially the same as Alternative 2, however the pump station would have one 100 CFS pump, and one 200 CFS pump so that it can deliver 300 CFS for irrigation and ecological purposes, but only 100 CFS when it is only needed to maintain the project flow.

At Black Bayou 2.5 acres will be cleared to construct the weir and 1.7 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 300 CFS to pass. This will include up to 38,600 feet and 191,700 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared to allow construction and along the streambanks in areas where conservation easements are acquired; 100 acres of tree planting is anticipated.

ALTERNATIVE 5 – 400 CFS

This alternative is essentially the same as Alternative 2, however the pump station would have two 100 CFS pumps and one 200 CFS pump so that it can deliver 400 CFS for irrigation and ecological purposes, but only 100 CFS when it is only needed to maintain the project flow.

At Black Bayou 2.6 acres will be cleared to construct the weir and 1.8 acres will be cleared at the Cassidy Bayou site. In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 400 CFS to pass. This will include up to 41,700 feet and 249,200 cubic yards of channel work.

Bottomland hardwoods will be replanted on any area cleared to allow construction and along the streambanks in areas where conservation easements are acquired; 100 acres of tree planting is anticipated.

No alternatives were considered past 400 CFS since flows past that were considered at risk for induced flooding.

PROJECT FIRST COSTS

A summary of the project first costs and annual costs for the alternatives are depicted in Table B-3. Construction costs range from $11,635,000 for alternative two, the 100 CFS pump, to $20,236,000 for alternative five, the 400 CFS pump. Adaptive management costs were estimated to be $150,000 over the first 10 years of operation. When summed for the life of the project the present value of the cost of adaptive management is $132,000 for any of alternative with ecosystem improvements (Attachment B-1). Interest during construction ranges from a low of $517,000 for alternative two to a high of $895,000 for alternative 5. Details for the computation of interest during construction can be found in Attachment B-2 through B-11. Total

first costs vary from $12,284,000 to $21,263,000, for alternative 2 through alternative 5, respectively. A detailed cost estimate for the alternatives is shown in Appendix A.

TABLE B-3
SUMMARY OF ESTIMATED FIRST AND ANNUAL COSTS, BY ALTERNATIVE, ENVIRONMENTAL OUTPUTS, QUIVER RIVER STUDY, 2016.

Item	Alternative 2	Alternative 3	Alternative 4	Alternative 5
NER Construction Costs ($)	11,635,000	15,829,000	17,578,000	20,236,000
Adaptive Management ($)	132,000	132,000	132,000	132,000
Interest During Construction ($)	517,000	702,000	778,469	895,000
Gross Investment Costs ($)	12,284,000	16,663,000	18,488,469	21,263,000
Interest ($/year)	353,000	479,000	532,000	611,000
Sinking Fund ($/year)	113,000	153,000	170,000	196,000
O&M ($/year)	23,000	23,000	23,000	23,000
Total Annual Costs ($/year)	489,000	655,000	725,000	830,000

2-7/8 % Federal Interest Rate.
50 Year Project Life
August 2016 dollars

ANNUAL COSTS

32.Average annual costs were based on an expected economic life of 50 years, a current Federal discount rate of 2-7/8% and August 2016 price levels. The sinking fund entry is the amount of funds that needs to be put back on an annual basis to repay a long term debt. The interest entry is cost of borrowing the funds needed to build the project. Operation and maintenance charges were derived from information obtained from cost and mechanical engineers. Even though different pump sizes are involved, since they would be pumping the same amount of water (100 CFS) costs are estimated at approximately $23,000 annually for all four pump sizes. This cost covers the labor for electricity, labor, maintenance, and periodic mowing and spraying. Total annual costs for the NER part of this study amount to $489,000 for Alternative 2, $655,000 for Alternative 3, $725,000 for Alternative 4, and $830,000 for Alternative 5.

ANALYSIS OF ENVIRONMENTAL OUTPUTS

33. As explained in the main section of this document, restoring the flows to the Quiver River result in benefits to many species of fish and mussels and will allow for the possibility of displaced species returning to the area. Restoring a project flow of 100 cfs was found to be the optimum flow. All alternatives with NER benefits were found to have identical benefits since only the project flow of 100 cfs would be maintained.

LEAST COST ANALYSIS

Alternative conditions were analyzed to determine the impact on the area with and without the implementation of improvements. Increases in the AAHUs and their average costs for

Alternative 5 are shown in Table B-4. Since all alternatives were assumed to provide the same 86.56 AAHUs this effectively becomes a least cost analysis. Alternative 2, the 100 cfs pump, with an annual cost of $489,000 is the least expensive alternative to implement. Alternative 5, the 400cfs pump, at $830,000 annually is the most expensive alternative to implement. These annual costs were there divided by the additional HUs they provide we have the average cost per HU. As expected, the costs are between the least cost alternative, Alterative 2 at $5,600 per additional habitat unit and the most expensive alternative, Alternative 5 at $9,600 per additional habitat unit.

TABLE B-4
ANNUAL COSTS, ADDITIONAL OUTPUT, AND AVERAGE COST PER HABITAT UNIT, BY ALTERNATIVE, QUIVER RIVER STUDY, 2016.

Item	Annual Costs	Additional Costs	Average Cost per HU
	(S/YR)	(HU)	($/HU)
Alternative 2	489,000	86.56	5,600
Alternative 3	655,000	86.56	7,600
Alternative 4	725,000	86.56	8,400
Alternative 5	830,000	86.56	9,600

2-7/8 % Federal Interest Rate.
50 Year Project Life
August 2016 dollars

SELECTED NER PLAN

With the lowest annual cost of $489,000 and the lowest average cost per habitat unit gained at $5,600 per HU, Alternative 2 is the selected plan for NER.

NATIONAL ECONOMIC DEVELOPMENT (NED) - WATER SUPPLY ANALYSIS

BENEFITS FROM NED

The area around the Quiver River is predominately used for agriculture. This area has seen groundwater use exceed natural recharge by approximately 300,000 acre feet per year. The decline in groundwater results in increased operating costs because of the greater pumping depth and the decreased efficiency associated with greater pumping depth. Average pumping depth for ground water is about 70 feet while the average depth needed to pump surface water is only 20 feet. The efficiency of a pump decrease as the distance the pump has to lift increases. Because of this, the less the water has to be lifted, the less diesel it takes to make the lift. These savings in diesel costs will be used as the benefit for the water supply analysis for the Quiver River area. From data obtained from work performed by the University of Arkansas Cooperative Extension Service it takes 3.5 times as much diesel to lift water 70 feet than it does to lift it 20 feet. That is there is a 61% decrease in cost to pump 20 foot lift than the 70 foot lift.

Crops in the Quiver River area tend to be equally spread out equally among rice, irrigated soybeans, and irrigated corn (one-third each). Mississippi Agricultural and Forestry Experiment

Station (MAFES)budgets for 2016 show that rice farmers are on average the largest user of irrigation water needing 33 acre inches of irrigation to raise their crop. The price for diesel in these MAFES budgets is $2.00 per gallon. Irrigated corn and soybean farmers tend to use 13 to 13.5 acre inches of water, respectively. An average of 19.83 acres inches was derived as a composite across crops by using one-third each of the total rice, cord, and soybean water usage (0.333 * (13+13.5+33)). June tends to be the month that requires the most irrigation use by farmers (9 inches for rice, 9.75 inches for Corn, and 4.5 inches for Soybeans). With this in mind a 100 cfs pump can potentially irrigate 9,214 acres while at the other end of the spectrum a 400 cfs pump can irrigate 36,855 acres. Table B-5 shows the potential acres of irrigation, the diesel cost of pumping the irrigation water from a 20 foot lift, diesel cost of pumping a 70 foot lift, and the benefits of pumping 20 foot versus 70 foot. Once again, pumping from 20 foot lift is more efficient than the 70 foot lift. The result in annual benefits is $181,000, $361,000, $543,000, and $724,000 for the 100, 200, 300, and 400 cfs pumps, respectively.

TABLE B-5
POTENTIAL ACRES OF IRRIGATION AVAILABLE, COST OF PUMPING AT 20 FEET DEPTH, COST OF PUMPING AT 70 FOOT DEPTH, AND BENEFITS OF USING 20 FOOT PUMPING, QUIVER RIVER STUDY.

Item		Alternative 2	Alternative 3	Alternative 4	Alternative 5
Irrigation	Acres	9,214	18,427	27,641	36,855
Cost of 20'	$	72,000	145,000	217,000	289,000
Cost of 70'	$	253,000	506,000	760,000	1,013,000
Benefits	$	181,000	361,000	543,000	724,000

SUMMARY OF PRELIMINARY COSTS

The same alternatives were brought forward for the NED analysis that were in the NER analysis. These costs were preliminary costs utilized in identification of the NED plan. All costs are based on August 2016 price levels. Annualized costs are based on the current Federal interest rate of 2-7/8 percent and a 50-year project life.

Project First Costs

The difference with the NED section is that we are considering any NER costs to be a sunk costs. So only the incremental NED costs are attributed to the NED alternatives. With alternative 2, no additional first costs are necessary since a 100 cfs sized will be used for both NER and NED projects. Alternative 3 would have first costs that include the difference in price between a 100 cfs pump and a 200 cfs pump ($4,379,000) and the difference in interest during construction ($192,000) for a total investment cost of $4,571,000. Alternative 4 would have first costs that include the difference in price between a 100 cfs pump and a 300 cfs pump ($6,204,000) and the difference in interest during construction ($273,000) for a total investment cost of $6,477,000. Alternative 5 would have first costs that include the difference in price between a 100 cfs pump and a 400 cfs pump ($8,879,000) and the difference in interest during instruction ($395,000) for a total gross investment cost of $9,374,000.

Annual Costs

Annual Costs with the NED section are made up of much the same categories as the NER section. Annual operating and maintenance costs are made up of the electricity to run the pumps, periodic mowing and spraying, labor to operate and keep up the machinery, and machinery maintenance. Sinking funds are the annual stream of funds, paid over the life of the project, required to pay back of the first costs of that project. Interest costs are the economic cost of borrowing funds or what those funds could be making in their next best use. As NED first costs, only the incremental NED costs are attributed to the NED alternatives. Since alternative 2 has the same first costs as the proposed NER plan, the only annual costs for the NED plan would be the additional $30,000 in annual O&M for the additional operation of the pump. Since Alternative 3 requires a larger 200 cfs pump for the NED portion it has an increase in annual costs of $224,000 a year when annualized over the project life. Alternative 4 requires $318,000 in annual costs to cover the additional costs of the larger pumps, and their use. An additional $449,000 is needed in annual costs to move to alternative 5.

TABLE B-6
FIRST COSTS, NER COSTS, ADDITIONAL COSTS, ADDITIONAL NED COSTS, INTEREST DURING CONSTRUCTION, GROSS INVESMENT COST, ANNUAL INTEREST, SINKING FUND, OPERATING AND MAINTENANCE COSTS, TOTAL ANNUAL COSTS, BY ALTERNATIVE FOR NED PLANS, QUIVER RIVER STUDY.

Item	Alternative 2	Alternative 3	Alternative 4	Alternative 5
NED Construction Costs ($)	12,284,000	16,663,000	18,488,000	21,263,000
NER Construction Costs ($)	12,284,000	12,284,000	12,284,000	12,284,000
Add NED Costs ($)	-	4,379,000	6,204,000	8,979,000
IDC ($)	-	192,000	272,726	394,720
Gross Investment Costs ($)	-	4,571,000	6,476,726	9,373,720
Interest ($/year)	-	131,000	186,000	269,000
Sinking Fund ($/year)	-	42,000	60,000	86,000
O&M ($/year)	30,000	51,000	72,000	93,000
Total Annual Costs ($/year)	30,000	224,000	318,000	449,000

2-7/8 % Federal Interest Rate.
50 Year Project Life
August 2016 dollars

EXPECTED ANNUAL BENEFITS

The expected annual benefits from with-project improvements in the Quiver River area are presented in Table B-7. NED benefits are calculated based on the difference between the diesel costs of pumping water from existing 70 foot wells or pumping water 20 foot from surface water. Annual NED benefits are $181,000 for alternative 2, $361,000 for alternative 3, $543,000 for

alternative 4, and $724,000 for alternative 5.

TABLE B-7
TOTAL EXPECTED ANNUAL BENEFITS, EXCESS BENEFITS, AND
BENEFIT-COST RATIO WITH PROJECT IMPROVEMENTS

Item	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Annual Costs ($)	30,000	224,000	318,000	449,000
Total Annual Benefits ($)	181,000	361,000	543,000	724,000
Excess Annual Benefits ($)	151,000	137,000	225,000	275,000
Benefit-Costs Ratio (%)	6.0	1.6	1.7	1.6

2-7/8 % Federal Interest Rate.
50 Year Project Life
August 2016 dollars

EXCESS BENEFITS

Excess benefits are the annual benefits less the annual costs. Alternative 2 has annual benefits that exceed annual costs by $151,000, alternative 3 has excess benefits of $137,000, alternative 4 has excess benefits of $225,000, and alternative 5 has the highest excess benefits at $275,000.

BENEFIT-COST RATIO

Based on these costs and benefits, a benefit-cost ratio was computed. The benefit-cost ratio is based on dividing the annual benefits by the annual costs. A benefit-cost ratio of greater than 1 (meaning there are at least the same amount of annual benefits as there are annual costs) is required to select an alternative as the NED plan. Based on the analysis performed, alternative 2 has the highest benefit-cost ratio of 6.0:1. Alternative 3 and 5 were found to have a benefit-cost ratio of 1.6:1. Alternative 4 had a slightly higher benefit-cost ratio than alternative 3 and 5 at 1.7:1.

THE RECOMMENDED PLAN

Given that our selected plan for NER is a 100 cfs pump the NED plan was formulated. Representing the NED plan, the recommended plan for Quiver River is alternative 5. Based on the results of the standard economic analysis, this alternative is cost-effective and provides the highest excess benefits over cost. In addition, local sources indicate favorable support of this project. A detailed description of the recommended plan is presented in the Main Report and Appendix A.

SENSITIVITY ANALYSIS
OF THE RECOMMENDED PLAN

Since the results of this project was a single point answer about the expected annual benefits, a sensitivity analysis was performed on the selected plan to see how the excess benefits and the benefit-cost ratio are effected by change. The price of diesel fuel costs is arguably the most volatile part of this study. With the price of diesel fuel in the 2016 MAFES crop budgets ($2.00 per gallon) the annual excess benefits are $275,000. If the 2015 MAFES diesel price ($2.56 per gallon) was used the excess benefits would have been $477,000 with a benefit-cost ratio of 2.1:1. On the other hand, if the price drops to price expected in the 2017 MAFES crop budgets ($1.70 per gallon) we should expect excess benefits of $166,000 with a benefit-cost ratio of 1.4:1. Similarly if the price per gallon drops to $1.50 the benefit-cost ratio stays above unity with a 1.2:1. At a price of around $1.24 per gallon we reach the threshold of a 1:1 benefit-cost ratio and excess benefits approaches zero.

FINAL COSTS

After the identification of the recommended plan, detailed costs were generated. Table B-8 summarizes results of the final economic analysis for the recommended plan in the Quiver River Project area for both the current federal interest rate of 2-7/8% and at 7%. This summary includes the resulting economic findings based on MCACES costs for August 2016. The gross investment for NER based on these final costs is $12,284,000, while annualized costs are $489,000 at 2-7/8%. This results in a cost of $5,600 per habitat unit. On the NED side, the additional annual investment costs of $449,000 results in excess benefits of $275,000 per year and a final benefit-cost ratio of 1.6. If these were refigured at an interest rate of 7%, the annual NER costs would increase to $968,000 per year. This would result in an average cost per annual habitat unit of $11,200. The NED calculations would result in total annual costs of $816,000 and a below unity benefit-cost ratio of 0.9:1. Excess benefits would be -92,000 a year with this scenario.

TABLE B-8
FINAL SUMMARY OF RECOMMENDED PLAN BY INTEREST RATE

Item	2-7/8 %	7 %
NER SECTION		
TOTAL CONSTRUCTION COSTS ($)	11,635,000	11,635,000
Adaptive Management ($)	132,000	112,000
Interest During Construction ($)	517,000	1,292,000
GROSS INVESTMENT COSTS ($)	12,284,000	13,039,000
Sinking Fund ($/year)	113,000	32,000
Interest ($/year)	353,000	913,000
O&M ($/year)	23,000	23,000
TOTAL ANNUAL COSTS ($/year)	489,000	968,000
NER Annual Benefits (AAHU)	86.56	86.56
Average Cost per Habitat Unit ($/AAHU)	5,600	11,200
NED SECTION		
ADDITIONAL CONSTRUCTION COSTS ($)	8,979,000	8,979,000

Interest During Construction ($)	394,720	988,000
GROSS INVESTMENT COSTS ($)	9,374,000	9,967,000
Sinking Fund ($/year)	86,000	25,000
Interest ($/year)	270,000	698,000
O&M ($/year)	93,000	93,000
TOTAL ANNUAL COSTS ($/year)	449,000	816,000
NER Annual Benefits (AAHU)	724,000	724,000
Excess Benefits ($/year)	275,000	-92,000
Benefit-Cost Ratio NED	1.6	0.9

50 Year Project Life
August 2016 dollars

CONCLUSION

In accordance with planning guidelines, this documentation has demonstrated project need, discussed implementable improvement measures, described resulting economic evaluations and methodologies, and identified an NER plan and then a locally preferred NED plan based on the NER plan. Alternative 5 provides the needed 100 cfs environmental flow to Quiver River while maintaining a 1.65 benefit-cost ratio to the NED portion of the study. It is the most economically efficient solution and is favored by local entities.

Attachment B-1.			
Present Value of Adaptive Management @ 2-7/8%			
Int Rate = 0.02875		Project Life = 50	
Year	Amount	Factor	PV
0	(33,000)	1.00000	(33,000)
1	-	0.97205	-
2	(10,000)	0.94489	(9,449)
3	(12,000)	0.91848	(11,022)
4	(10,000)	0.89281	(8,928)
5	(12,000)	0.86786	(10,414)
6	(18,250)	0.84361	(15,396)
7	(18,250)	0.82003	(14,966)
8	(18,250)	0.79712	(14,547)
9	(18,250)	0.77484	(14,141)
Total	(150,000)		**(131,863)**
2-7/8% Federal Interest Rate. 50 Year Project Life 2016 dollars			
Present Value of Adaptive Management @ 7%			
Int Rate = 0.07		Project Life = 50	
Year	Amount	Factor	PV
0	(33,000)	1.00000	(33,000)
1	-	0.93458	-
2	(10,000)	0.87344	(8,734)
3	(12,000)	0.81630	(9,796)
4	(10,000)	0.76290	(7,629)
5	(12,000)	0.71299	(8,556)
6	(18,250)	0.66634	(12,161)
7	(18,250)	0.62275	(11,365)
8	(18,250)	0.58201	(10,622)
9	(18,250)	0.54393	(9,927)
Total	(150,000)		**(111,789)**
7% Interest Rate. 50 Year Project Life 2016 dollars			

Attachment B-2
NER 100 CFS Alternative
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	2,941,629	0	0	2,941,629	3,202,709	1.0888
	2	2021	2,941,629	0	0	2,941,629	3,113,204	1.0583
	1	2022	2,941,629	0	0	2,941,629	3,026,201	1.0288
	0	2023	2,941,629	0	0	2,941,629	2,941,629	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$11,766,516	$0	$0	$11,766,516	$12,283,742	

Summary:

Implementation Costs:	$11,766,516
Interest During Construction:	517,227
Total Construction Costs:	$12,283,742
Average Annual Total Construction Costs:	$466,000
O&M	23,000
Average Annual Total Construction Costs (Rounded):	$489,000

Attachment B-3
NER 200 CFS Alternative
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	3,990,230	0	0	3,990,230	4,344,376	1.0888
	2	2021	3,990,230	0	0	3,990,230	4,222,966	1.0583
	1	2022	3,990,230	0	0	3,990,230	4,104,949	1.0288
	0	2023	3,990,230	0	0	3,990,230	3,990,230	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$15,960,919	$0	$0	$15,960,919	$16,662,521	

Summary:

Implementation Costs:	$15,960,919
Interest During Construction:	701,602
Total Construction Costs:	$16,662,521
Average Annual Total Construction Costs:	$632,000
O&M	23,000
Average Annual Total Construction Costs (Rounded):	$655,000

Attachment B-4
NER 300 CFS Alternative
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	4,427,395	0	0	4,427,395	4,820,342	1.0888
	2	2021	4,427,395	0	0	4,427,395	4,685,630	1.0583
	1	2022	4,427,395	0	0	4,427,395	4,554,683	1.0288
	0	2023	4,427,395	0	0	4,427,395	4,427,395	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$17,709,582	$0	$0	$17,709,582	$18,488,051	

Summary:

Implementation Costs:	$17,709,582
Interest During Construction:	778,469
Total Construction Costs:	$18,488,051
Average Annual Total Construction Costs:	$702,000
O&M	23,000
Average Annual Total Construction Costs (Rounded):	$725,000

Attachment B-5
NER 400 CFS Alternative
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	5,092,001	0	0	5,092,001	5,543,934	1.0888
	2	2021	5,092,001	0	0	5,092,001	5,389,000	1.0583
	1	2022	5,092,001	0	0	5,092,001	5,238,396	1.0288
	0	2023	5,092,001	0	0	5,092,001	5,092,001	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$20,368,004	$0	$0	$20,368,004	$21,263,330	

Summary:

Implementation Costs:	$20,368,004
Interest During Construction:	895,327
Total Construction Costs:	$21,263,330
Average Annual Total Construction Costs:	$807,000
O&M	23,000
Average Annual Total Construction Costs (Rounded):	$830,000

Attachment B-6
NED Additional costs 100 CFS - Alternative 2
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	0	0	0	0	0	1.0888
	2	2021	0	0	0	0	0	1.0583
	1	2022	0	0	0	0	0	1.0288
	0	2023	0	0	0	0	0	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$0	$0	$0	$0	$0	

Summary:

Implementation Costs:	$0
Interest During Construction:	0
Total Construction Costs:	$0
Average Annual Total Construction Costs:	$0
O&M	30,000
Average Annual Total Construction Costs (Rounded):	$30,000

Attachment B-7
NED Additional costs 200 CFS - Alternative 3
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	1,094,695	0	0	1,094,695	1,191,853	1.0888
	2	2021	1,094,695	0	0	1,094,695	1,158,544	1.0583
	1	2022	1,094,695	0	0	1,094,695	1,126,167	1.0288
	0	2023	1,094,695	0	0	1,094,695	1,094,695	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$4,378,778	$0	$0	$4,378,778	$4,571,259	

Summary:

Implementation Costs:	$4,378,778
Interest During Construction:	192,480
Total Construction Costs:	$4,571,259
Average Annual Total Construction Costs:	$173,000
O&M	51,000
Average Annual Total Construction Costs (Rounded):	$224,000

Attachment B-8
NED Additional costs 300 CFS - Alternative 4
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	1,551,077	0	0	1,551,077	1,688,741	1.0888
	2	2021	1,551,077	0	0	1,551,077	1,641,546	1.0583
	1	2022	1,551,077	0	0	1,551,077	1,595,671	1.0288
	0	2023	1,551,077	0	0	1,551,077	1,551,077	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$6,204,308	$0	$0	$6,204,308	$6,477,034	

Summary:

Implementation Costs:	$6,204,308
Interest During Construction:	272,726
Total Construction Costs:	$6,477,034
Average Annual Total Construction Costs:	$246,000
O&M	72,000
Average Annual Total Construction Costs (Rounded):	$318,000

Attachment B-9
NED Additional costs 400 CFS - Alternative 5
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.02875

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	1.4051
	11	2012	0	0	0	0	0	1.3659
	10	2013	0	0	0	0	0	1.3277
	9	2014	0	0	0	0	0	1.2906
	8	2015	0	0	0	0	0	1.2545
	7	2016	0	0	0	0	0	1.2195
	6	2017	0	0	0	0	0	1.1854
	5	2018	0	0	0	0	0	1.1523
	4	2019	0	0	0	0	0	1.1201
	3	2020	2,244,897	0	0	2,244,897	2,444,139	1.0888
	2	2021	2,244,897	0	0	2,244,897	2,375,834	1.0583
	1	2022	2,244,897	0	0	2,244,897	2,309,438	1.0288
	0	2023	2,244,897	0	0	2,244,897	2,244,897	1.0000
1	-1	2024	0	0	0	0	0	0.9721
2	-2	2025	0	0	0	0	0	0.9449
3	-3	2026	0	0	0	0	0	0.9185
4	-4	2027	0	0	0	0	0	0.8928
5	-5	2028	0	0	0	0	0	0.8679
6	-6	2029	0	0	0	0	0	0.8436
7	-7	2030	0	0	0	0	0	0.8200
8	-8	2031	0	0	0	0	0	0.7971
9	-9	2032	0	0	0	0	0	0.7748
10	-10	2033	0	0	0	0	0	0.7532
11	-11	2034	0	0	0	0	0	0.7321
12	-12	2035	0	0	0	0	0	0.7117
13	-13	2036	0	0	0	0	0	0.6918
14	-14	2037	0	0	0	0	0	0.6725
15	-15	2038	0	0	0	0	0	0.6537
16	-16	2039	0	0	0	0	0	0.6354
17	-17	2040	0	0	0	0	0	0.6176
18	-18	2041	0	0	0	0	0	0.6004
19	-19	2042	0	0	0	0	0	0.5836
20	-20	2043	0	0	0	0	0	0.5673
21	-21	2044	0	0	0	0	0	0.5514
22	-22	2045	0	0	0	0	0	0.5360
23	-23	2046	0	0	0	0	0	0.5210
24	-24	2047	0	0	0	0	0	0.5065
25	-25	2048	0	0	0	0	0	0.4923
26	-26	2049	0	0	0	0	0	0.4786
27	-27	2050	0	0	0	0	0	0.4652
28	-28	2051	0	0	0	0	0	0.4522
29	-29	2052	0	0	0	0	0	0.4396
30	-30	2053	0	0	0	0	0	0.4273
31	-31	2054	0	0	0	0	0	0.4153
32	-32	2055	0	0	0	0	0	0.4037
33	-33	2056	0	0	0	0	0	0.3924
34	-34	2057	0	0	0	0	0	0.3815
35	-35	2058	0	0	0	0	0	0.3708
36	-36	2059	0	0	0	0	0	0.3605
37	-37	2060	0	0	0	0	0	0.3504
38	-38	2061	0	0	0	0	0	0.3406
39	-39	2062	0	0	0	0	0	0.3311
40	-40	2063	0	0	0	0	0	0.3218
41	-41	2064	0	0	0	0	0	0.3128
42	-42	2065	0	0	0	0	0	0.3041
			$8,979,588	$0	$0	$8,979,588	$9,374,308	

Summary:

Implementation Costs:	$8,979,588
Interest During Construction:	394,720
Total Construction Costs:	$9,374,308
Average Annual Total Construction Costs:	$356,000
O&M	93,000
Average Annual Total Construction Costs (Rounded):	$449,000

Attachment B-10
NER 100 CFS Alternative
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.07

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	2.2522
	11	2012	0	0	0	0	0	2.1049
	10	2013	0	0	0	0	0	1.9672
	9	2014	0	0	0	0	0	1.8385
	8	2015	0	0	0	0	0	1.7182
	7	2016	0	0	0	0	0	1.6058
	6	2017	0	0	0	0	0	1.5007
	5	2018	0	0	0	0	0	1.4026
	4	2019	0	0	0	0	0	1.3108
	3	2020	2,936,750	0	0	2,936,750	3,597,645	1.2250
	2	2021	2,936,750	0	0	2,936,750	3,362,285	1.1449
	1	2022	2,936,750	0	0	2,936,750	3,142,323	1.0700
	0	2023	2,936,750	0	0	2,936,750	2,936,750	1.0000
1	-1	2024	0	0	0	0	0	0.9346
2	-2	2025	0	0	0	0	0	0.8734
3	-3	2026	0	0	0	0	0	0.8163
4	-4	2027	0	0	0	0	0	0.7629
5	-5	2028	0	0	0	0	0	0.7130
6	-6	2029	0	0	0	0	0	0.6663
7	-7	2030	0	0	0	0	0	0.6227
8	-8	2031	0	0	0	0	0	0.5820
9	-9	2032	0	0	0	0	0	0.5439
10	-10	2033	0	0	0	0	0	0.5083
11	-11	2034	0	0	0	0	0	0.4751
12	-12	2035	0	0	0	0	0	0.4440
13	-13	2036	0	0	0	0	0	0.4150
14	-14	2037	0	0	0	0	0	0.3878
15	-15	2038	0	0	0	0	0	0.3624
16	-16	2039	0	0	0	0	0	0.3387
17	-17	2040	0	0	0	0	0	0.3166
18	-18	2041	0	0	0	0	0	0.2959
19	-19	2042	0	0	0	0	0	0.2765
20	-20	2043	0	0	0	0	0	0.2584
21	-21	2044	0	0	0	0	0	0.2415
22	-22	2045	0	0	0	0	0	0.2257
23	-23	2046	0	0	0	0	0	0.2109
24	-24	2047	0	0	0	0	0	0.1971
25	-25	2048	0	0	0	0	0	0.1842
26	-26	2049	0	0	0	0	0	0.1722
27	-27	2050	0	0	0	0	0	0.1609
28	-28	2051	0	0	0	0	0	0.1504
29	-29	2052	0	0	0	0	0	0.1406
30	-30	2053	0	0	0	0	0	0.1314
31	-31	2054	0	0	0	0	0	0.1228
32	-32	2055	0	0	0	0	0	0.1147
33	-33	2056	0	0	0	0	0	0.1072
34	-34	2057	0	0	0	0	0	0.1002
35	-35	2058	0	0	0	0	0	0.0937
36	-36	2059	0	0	0	0	0	0.0875
37	-37	2060	0	0	0	0	0	0.0818
38	-38	2061	0	0	0	0	0	0.0765
39	-39	2062	0	0	0	0	0	0.0715
40	-40	2063	0	0	0	0	0	0.0668
41	-41	2064	0	0	0	0	0	0.0624
42	-42	2065	0	0	0	0	0	0.0583
			$11,747,000	$0	$0	$11,747,000	$13,039,003	

Summary:

Implementation Costs:	$11,747,000
Interest During Construction:	1,292,003
Total Construction Costs:	$13,039,003
Average Annual Total Construction Costs:	$945,000
O&M	23,000
Average Annual Total Construction Costs (Rounded):	$968,000

Attachment B-11
NED Additional costs 400 CFS - Alternative 5
Average Annual Total Construction Costs

Period of Analysis in Years = 50
FY "X" Federal Disount Rate = 0.07

Project Year	Discounting/ Compounding Year	Calandar Year	Construction	Real Estate	Mitigation	Total	Compounded Value	Compound Factor
	12	2011	0	$0	$0	$0	$0	2.2522
	11	2012	0	0	0	0	0	2.1049
	10	2013	0	0	0	0	0	1.9672
	9	2014	0	0	0	0	0	1.8385
	8	2015	0	0	0	0	0	1.7182
	7	2016	0	0	0	0	0	1.6058
	6	2017	0	0	0	0	0	1.5007
	5	2018	0	0	0	0	0	1.4026
	4	2019	0	0	0	0	0	1.3108
	3	2020	2,244,897	0	0	2,244,897	2,750,095	1.2250
	2	2021	2,244,897	0	0	2,244,897	2,570,183	1.1449
	1	2022	2,244,897	0	0	2,244,897	2,402,040	1.0700
	0	2023	2,244,897	0	0	2,244,897	2,244,897	1.0000
1	-1	2024	0	0	0	0	0	0.9346
2	-2	2025	0	0	0	0	0	0.8734
3	-3	2026	0	0	0	0	0	0.8163
4	-4	2027	0	0	0	0	0	0.7629
5	-5	2028	0	0	0	0	0	0.7130
6	-6	2029	0	0	0	0	0	0.6663
7	-7	2030	0	0	0	0	0	0.6227
8	-8	2031	0	0	0	0	0	0.5820
9	-9	2032	0	0	0	0	0	0.5439
10	-10	2033	0	0	0	0	0	0.5083
11	-11	2034	0	0	0	0	0	0.4751
12	-12	2035	0	0	0	0	0	0.4440
13	-13	2036	0	0	0	0	0	0.4150
14	-14	2037	0	0	0	0	0	0.3878
15	-15	2038	0	0	0	0	0	0.3624
16	-16	2039	0	0	0	0	0	0.3387
17	-17	2040	0	0	0	0	0	0.3166
18	-18	2041	0	0	0	0	0	0.2959
19	-19	2042	0	0	0	0	0	0.2765
20	-20	2043	0	0	0	0	0	0.2584
21	-21	2044	0	0	0	0	0	0.2415
22	-22	2045	0	0	0	0	0	0.2257
23	-23	2046	0	0	0	0	0	0.2109
24	-24	2047	0	0	0	0	0	0.1971
25	-25	2048	0	0	0	0	0	0.1842
26	-26	2049	0	0	0	0	0	0.1722
27	-27	2050	0	0	0	0	0	0.1609
28	-28	2051	0	0	0	0	0	0.1504
29	-29	2052	0	0	0	0	0	0.1406
30	-30	2053	0	0	0	0	0	0.1314
31	-31	2054	0	0	0	0	0	0.1228
32	-32	2055	0	0	0	0	0	0.1147
33	-33	2056	0	0	0	0	0	0.1072
34	-34	2057	0	0	0	0	0	0.1002
35	-35	2058	0	0	0	0	0	0.0937
36	-36	2059	0	0	0	0	0	0.0875
37	-37	2060	0	0	0	0	0	0.0818
38	-38	2061	0	0	0	0	0	0.0765
39	-39	2062	0	0	0	0	0	0.0715
40	-40	2063	0	0	0	0	0	0.0668
41	-41	2064	0	0	0	0	0	0.0624
42	-42	2065	0	0	0	0	0	0.0583
			$8,979,588	$0	$0	$8,979,588	$9,967,215	

Summary:

Implementation Costs:	$8,979,588
Interest During Construction:	987,627
Total Construction Costs:	$9,967,215
Average Annual Total Construction Costs:	$723,000
O&M	93,000
Average Annual Total Construction Costs (Rounded):	$816,000

Appendix E

Cost

Alternative 2

Estimated by CEMVK-EC-TC
Designed by Vicksburg District
Prepared by Danny McPhearson
Preparation Date 8/17/2016
Effective Date of Pricing 8/17/2016
Estimated Construction Time Days

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Project Cost Summary Report			**9,120,353**	**2,514,299**	**0**	**11,634,653**
Quiver River Pump Station	**1.00**	**LS**	**9,120,353**	**2,514,299**	**0**	**11,634,653**
Lands and Damages	**1.00**	**LS**	**489,000**	**0**	**0**	**489,000**
(Note: Cost for Lands and Damages were provided by Real Estate Divison, Vicksburg District. Dated 3 December 2015.)						
Relocations	**1.00**	**LS**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Cemetery, Utilities, & Structure	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Utilities	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Electrical	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			2,914,129.84			*3,642,662.31*
Channels and Canals	**1.00**	**JOB**	**2,914,130**	**728,532**	**0**	**3,642,662**
			2,914,129.84			*3,642,662.31*
Channels	**1.00**	**JOB**	**2,914,130**	**728,532**	**0**	**3,642,662**
			2,914,129.84			*3,642,662.31*
Channels	**1.00**	**JOB**	**2,914,130**	**728,532**	**0**	**3,642,662**
(Note: Transfer Channel Excavation)						
			76,344.55			*95,430.69*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**76,345**	**19,086**	**0**	**95,431**
			36,428.33			*45,535.41*
Mobilization	**1.00**	**EA**	**36,428**	**9,107**	**0**	**45,535**
			36,428.33			*45,535.41*
Mobilization of Equipment	**1.00**	**EA**	**36,428**	**9,107**	**0**	**45,535**
			33,524.61			*41,905.76*
Demobilization	**1.00**	**EA**	**33,525**	**8,381**	**0**	**41,906**
Misc Costs incl project sign	**1.00**	**LS**	**987**	**247**	**0**	**1,233**
Utilities	**1.00**	**LS**	**2,561**	**640**	**0**	**3,202**
(Note: Quantities for 2 trailer)						
			1,421.72			*1,777.15*
Office Trailers Setup and Removal	**2.00**	**EA**	**2,843**	**711**	**0**	**3,554**
(Note: One trailer for the contractor and one for the Government inspector.)						
			46.11			*57.64*
Mechanical Dredging	**15,410.00**	**LF**	**710,547**	**177,637**	**0**	**888,184**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 13,900 LF +1,510 LF = 15,410 LF)						
			710,547.12			*888,183.90*
Site Work	**1.00**	**EA**	**710,547**	**177,637**	**0**	**888,184**
			1,637.96			*2,047.45*
Clearing and Grubbing	**71.00**	**ACR**	**116,295**	**29,074**	**0**	**145,369**
(Note: Both the channel and the disposal area will be cleared. Trees and bush will be cleared with dozers. The material will be pushed into piles and burned. Debris not burned will be buried in the						

Labor ID: EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
disposal area. The quantity includes the area for disposal. Only the wooded area will be required to be cleared. No work will be required for corp lands. 65.26 ACR + (150'x1510')/43560.17 SF/ARC = 70.45 ACR Used 71 ACR)						
			5.51			*6.89*
Excavation and Disposal (Note: 45,000 CY + 62,856 CY = 107,856 CY)	**107,856.00**	**BCY**	**594,252**	**148,563**	**0**	**742,815**
			2,121,952.49			*2,652,440.61*
Associated General Items	**1.00**	**EA**	**2,121,952**	**530,488**	**0**	**2,652,441**
			1,081,610.26			*1,352,012.82*
Black Bayou Weir (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,081,610**	**270,403**	**0**	**1,352,013**
			1,081,610.26			*1,352,012.82*
Site Work	**1.00**	**EA**	**1,081,610**	**270,403**	**0**	**1,352,013**
			2,483.27			*3,104.08*
Clearing & Grubbing	**2.40**	**ACR**	**5,960**	**1,490**	**0**	**7,450**
			9,059.32			*11,324.15*
Surface Grading for Riprap Protection	**2.40**	**ACR**	**21,742**	**5,436**	**0**	**27,178**
			18.99			*23.74*
Embankment for Core of Weir	**1,970.00**	**ECY**	**37,414**	**9,354**	**0**	**46,768**
			40.87			*51.08*
Sheet Pile Cutoff (Note: Assumed 40' depth.)	**4,800.00**	**SF**	**196,156**	**49,039**	**0**	**245,195**
			194.76			*243.45*
Wales (Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)	**120.00**	**LF**	**23,371**	**5,843**	**0**	**29,214**
			74.57			*93.22*
Filter Stone (Note: Assumed 6" Thick)	**2,160.00**	**TON**	**161,078**	**40,269**	**0**	**201,347**
			76.57			*95.71*
R400 Riprap (Note: Assume 24" Thick)	**8,610.00**	**TON**	**659,259**	**164,815**	**0**	**824,074**
			1,040,342.23			*1,300,427.79*
Cassidy Bayou (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,040,342**	**260,086**	**0**	**1,300,428**
			1,040,342.23			*1,300,427.79*
Site Work	**1.00**	**EA**	**1,040,342**	**260,086**	**0**	**1,300,428**
			2,483.27			*3,104.08*
Clearing & Grubbing	**1.30**	**ACR**	**3,228**	**807**	**0**	**4,035**
			9,059.32			*11,324.15*
Surface Grading for Riprap Protection	**1.30**	**ACR**	**11,777**	**2,944**	**0**	**14,721**
			41.56			*51.95*

Labor ID: EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Sheet Pile Cutoff	**11,200.00**	**SF**	**465,488**	**116,372**	**0**	**581,861**
(Note: Assumed 35' depth.)						
			194.76			*243.45*
Wales	**320.00**	**LF**	**62,323**	**15,581**	**0**	**77,904**
(Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)						
			74.57			*93.22*
Filter Stone	**1,470.00**	**TON**	**109,623**	**27,406**	**0**	**137,028**
(Note: Assumed 6" Thick)						
			76.57			*95.71*
R400 Riprap	**5,880.00**	**TON**	**450,226**	**112,556**	**0**	**562,782**
(Note: Assume 24" Thick)						
			5,285.69			*6,607.11*
Disposal Areas	**1.00**	**EA**	**5,286**	**1,321**	**0**	**6,607**
			5,285.69			*6,607.11*
Site Work	**1.00**	**EA**	**5,286**	**1,321**	**0**	**6,607**
			0.34			*0.43*
Reforestation	**15,410.00**	**LF**	**5,286**	**1,321**	**0**	**6,607**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 13,900 LF +1,510 LF = 15,410 LF Assumed that the spoil or disposal area (50') with be reforested with bottom land hardwood.)						
Pumping Plant	**1.00**	**LS**	**3,564,609**	**1,247,613**	**0**	**4,812,223**
Quiver River Pumping Plant	**1.00**	**LS**	**3,564,609**	**1,247,613**	**0**	**4,812,223**
			153,076.75			*206,653.61*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**153,077**	**53,577**	**0**	**206,654**
Care and Diversion of Water	**1.00**	**LS**	**298,027**	**104,309**	**0**	**402,336**
			47,171.96			*63,682.14*
Site Work	**1.00**	**EA**	**47,172**	**16,510**	**0**	**63,682**
			8.74			*11.79*
Cofferdam	**5,400.00**	**ECY**	**47,172**	**16,510**	**0**	**63,682**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			2.45			*3.30*
Cofferdam: Construct	**5,400.00**	**ECY**	**13,204**	**4,621**	**0**	**17,825**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			6.29			*8.49*
Cofferdam: Removal	**5,400.00**	**ECY**	**33,968**	**11,889**	**0**	**45,857**
			250,854.95			*338,654.18*
Mechanical	**1.00**	**EA**	**250,855**	**87,799**	**0**	**338,654**
			501.71			*677.31*
Dewatering	**500.00**	**LF**	**250,855**	**87,799**	**0**	**338,654**

Labor ID: EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: The qty of length is multiplied by five since the Cost Book indicates the cost is per month and I am assuming a five month (minimum) dewatering period.)						
Earthwork for Structures	**1.00**	**LS**	**1,266,625**	**443,319**	**0**	**1,709,944**
			1,266,625.21			*1,709,944.03*
Site Work	**1.00**	**EA**	**1,266,625**	**443,319**	**0**	**1,709,944**
			2,483.27			*3,352.41*
Clearing and Grubbing	**3.50**	**ACR**	**8,691**	**3,042**	**0**	**11,733**
			11.76			*15.88*
Excavation, Structural	**17,000.00**	**CY**	**199,985**	**69,995**	**0**	**269,980**
(Note: Assume that material will be excavated and stockpiled on site.)						
			11.76			*15.88*
Pump Station	**16,000.00**	**CY**	**188,221**	**65,878**	**0**	**254,099**
			11.76			*15.88*
Discharge Pipes	**1,000.00**	**CY**	**11,764**	**4,117**	**0**	**15,881**
			6.47			*8.73*
Channel Excavation as Part of Structure	**36,000.00**	**CY**	**232,924**	**81,523**	**0**	**314,448**
(Note: Assume that material will be excavated and stockpiled on site.)						
			12.96			*17.50*
Compacted Fill	**24,450.00**	**CY**	**316,884**	**110,909**	**0**	**427,793**
			12.96			*17.50*
Pump Station	**23,650.00**	**CY**	**306,515**	**107,280**	**0**	**413,796**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor will be used.)						
			12.96			*17.50*
Compacted Fill from onsite excavation.	**23,650.00**	**CY**	**306,515**	**107,280**	**0**	**413,796**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			12.96			*17.50*
Discharge Pipes	**800.00**	**CY**	**10,368**	**3,629**	**0**	**13,997**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor.)						
			12.96			*17.50*
Compacted Fill from onsite excavated stockpile	**800.00**	**CY**	**10,368**	**3,629**	**0**	**13,997**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			28.12			*37.96*
Pervious Backfill	**3,750.00**	**CY**	**105,432**	**36,901**	**0**	**142,333**
(Note: Assume that the sand will be obtained from off site by a supplier. The material will be dumped in or near the location of placement.)						
			17.28			*23.33*
Impervious Fill	**240.00**	**CY**	**4,147**	**1,452**	**0**	**5,599**
			4.79			*6.46*
Engineering Fabric	**2,600.00**	**SY**	**12,441**	**4,354**	**0**	**16,796**
(Note: Will be delivered to jobsite.)						

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			125.99			*170.08*
6" Filter Stone (Note: Will be delivered to jobsite.)	**225.00**	**CY**	**28,347**	**9,921**	**0**	**38,268**
			125.99			*170.08*
9" Filter Stone (Note: Will be delivered to jobsite.)	**350.00**	**CY**	**44,095**	**15,433**	**0**	**59,528**
			77.87			*105.13*
R90 RipRap (Note: Will be delivered to jobsite.)	**1,050.00**	**TON**	**81,764**	**28,618**	**0**	**110,382**
			77.87			*105.13*
R200 RipRap (Note: Will be delivered to jobsite.)	**1,400.00**	**TON**	**109,019**	**38,157**	**0**	**147,176**
			106.79			*144.16*
Crushed Stone Surfacing (Note: A dozer will be used to spread and compact material. The material will be dumped in place by the supplier.)	**900.00**	**CY**	**96,109**	**33,638**	**0**	**129,747**
			3,585.91			*4,840.98*
Erosion Control	**2.50**	**ACR**	**8,965**	**3,138**	**0**	**12,102**
			8,910.42			*12,029.06*
Manholes, 48"	**2.00**	**EA**	**17,821**	**6,237**	**0**	**24,058**
			116,035.18			*156,647.49*
Foundation Work	**1.00**	**EA**	**116,035**	**40,612**	**0**	**156,647**
			116,035.18			*156,647.49*
Site Work	**1.00**	**EA**	**116,035**	**40,612**	**0**	**156,647**
			2,578.56			*3,481.06*
Piling, Steel Bearing	**45.00**	**EA**	**116,035**	**40,612**	**0**	**156,647**
			57.30			*77.36*
HP 12x48 Piles (Note: Piles at 45 LF/EA.)	**2,025.00**	**LF**	**116,035**	**40,612**	**0**	**156,647**
			106,408.53			*143,651.51*
Utilities	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			106,408.53			*143,651.51*
Electrical	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			70,939.02			*95,767.68*
Power Supply Line	**1.50**	**MI**	**106,409**	**37,243**	**0**	**143,652**
Pumping Plant Substructure	**1.00**	**LS**	**760,632**	**266,221**	**0**	**1,026,853**
			356.75			*481.62*
Concrete	**2,040.00**	**CY**	**727,777**	**254,722**	**0**	**982,499**
			275.23			*371.56*
Concrete, in Place Including C	**2,040.00**	**CY**	**561,475**	**196,516**	**0**	**757,991**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			312.94			*422.47*
Pump Station	**440.00**	**CY**	**137,692**	**48,192**	**0**	**185,885**
(Note: A waste of 5% for the concrete was applied. A ratio of 17.65 SFC/CY for the forming to concrete was used.)						
			264.86			*357.57*
Wing Wall	**1,600.00**	**CY**	**423,783**	**148,324**	**0**	**572,107**
(Note: A waste of 5% for the concrete was applied. A ratio of 12.5 SFC/CY for the forming to concrete was used.)						
			0.73			*0.98*
Reinforcing Steel	**224,400.00**	**LB**	**163,489**	**57,221**	**0**	**220,710**
			0.74			*1.00*
Pump Station	**48,400.00**	**LB**	**35,697**	**12,494**	**0**	**48,191**
			0.73			*0.98*
Wing Wall	**176,000.00**	**LB**	**127,792**	**44,727**	**0**	**172,519**
			1.38			*1.86*
Misc. Material (Water stops, joint material, and etc.)	**2,040.00**	**CY**	**2,813**	**985**	**0**	**3,798**
(Note: Quantity is CY of inplace concrete. The material and placement is based on percent of concrete.)						
			32,854.81			*44,354.00*
Metals	**1.00**	**EA**	**32,855**	**11,499**	**0**	**44,354**
			32,854.81			*44,354.00*
Trash Racks	**1.00**	**EA**	**32,855**	**11,499**	**0**	**44,354**
			28,527.74			*38,512.45*
Pumping Plant Superstructure	**1.00**	**EA**	**28,528**	**9,985**	**0**	**38,512**
			3,622.35			*4,890.18*
Metals	**1.00**	**EA**	**3,622**	**1,268**	**0**	**4,890**
			3.02			*4.08*
Miscellaneous Metals	**1,200.00**	**LB**	**3,622**	**1,268**	**0**	**4,890**
Doors and Windows	**1.00**	**LS**	**1,638**	**573**	**0**	**2,211**
			1,638.14			*2,211.50*
Floor Access Doors (3'x3")	**1.00**	**EA**	**1,638**	**573**	**0**	**2,211**
			23,267.24			*31,410.78*
Special Construction	**1.00**	**EA**	**23,267**	**8,144**	**0**	**31,411**
			61.55			*83.10*
Pre-engineered Steel Building (18'Wx21'Lx16H)	**378.00**	**SF**	**23,267**	**8,144**	**0**	**31,411**
			792,491.36			*1,069,863.34*
Pumping Machinery & Appurtenance	**1.00**	**EA**	**792,491**	**277,372**	**0**	**1,069,863**
			96,536.42			*130,324.17*
Mechanical	**1.00**	**EA**	**96,536**	**33,788**	**0**	**130,324**
			405.03			*546.79*
Main Pump Discharge Piping (42")	**180.00**	**LF**	**72,906**	**25,517**	**0**	**98,423**
(Note: UOM is the total combine lenght of discharge line.)						

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			2,824.21			*3,812.69*
Intake and Exhaust Systems	**1.00**	**EA**	**2,824**	**988**	**0**	**3,813**
			10,403.22			*14,044.35*
42" Couplings Installment	**2.00**	**EA**	**20,806**	**7,282**	**0**	**28,089**
			695,954.94			*939,539.17*
Electrical	**1.00**	**EA**	**695,955**	**243,584**	**0**	**939,539**
			598,859.53			*808,460.36*
Main Pump Motors & Pumps (Note: Incl.)	**1.00**	**EA**	**598,860**	**209,601**	**0**	**808,460**
			19,743.67			*26,653.96*
Transformers	**1.00**	**EA**	**19,744**	**6,910**	**0**	**26,654**
			27,730.27			*37,435.86*
Motor Control Center	**1.00**	**EA**	**27,730**	**9,706**	**0**	**37,436**
			7,828.15			*10,568.00*
Switchgear and Buswork	**1.00**	**EA**	**7,828**	**2,740**	**0**	**10,568**
			1,617.31			*2,183.37*
Capacitor Banks	**3.00**	**EA**	**4,852**	**1,698**	**0**	**6,550**
			80.07			*108.09*
350 MCM Service Conductor, 1 Run and Neutral	**450.00**	**FT**	**36,031**	**12,611**	**0**	**48,642**
			910.21			*1,228.79*
Heater, Electric Space, Fan Powered, 5kW	**1.00**	**EA**	**910**	**319**	**0**	**1,229**
			42,785.70			*57,760.70*
Associated General Items	**1.00**	**EA**	**42,786**	**14,975**	**0**	**57,761**
			42,785.70			*57,760.70*
Site Work	**1.00**	**EA**	**42,786**	**14,975**	**0**	**57,761**
			61.12			*82.52*
Chain Link Fence	**700.00**	**LF**	**42,786**	**14,975**	**0**	**57,761**
			1,622,434.83			*2,028,043.53*
Planning, Engineering and Design	**1.00**	**EA**	**1,622,435**	**405,609**	**0**	**2,028,044**
			519,179.14			*648,973.93*
Construction Management	**1.00**	**EA**	**519,179**	**129,795**	**0**	**648,974**

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Alternative 3

Estimated by CEMVK-EC-TC
Designed by Vicksburg District
Prepared by Danny McPhearson
Preparation Date 8/17/2016
Effective Date of Pricing 8/17/2016
Estimated Construction Time Days

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Project Cost Summary Report			**12,325,757**	**3,503,299**	**0**	**15,829,056**
Quiver River Pump Station	**1.00**	**LS**	**12,325,757**	**3,503,299**	**0**	**15,829,056**
Lands and Damages	**1.00**	**LS**	**489,000**	**0**	**0**	**489,000**
(Note: Cost for Lands and Damages were provided by Real Estate Divison, Vicksburg District. Dated 3 December 2015.)						
Relocations	**1.00**	**LS**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Cemetery, Utilities, & Structure	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Utilities	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Electrical	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
Channels and Canals	**1.00**	**LS**	**3,447,718**	**861,930**	**0**	**4,309,648**
			3,447,718.47			*4,309,648.09*
Channels	**1.00**	**JOB**	**3,447,718**	**861,930**	**0**	**4,309,648**
			3,447,718.47			*4,309,648.09*
Channels	**1.00**	**JOB**	**3,447,718**	**861,930**	**0**	**4,309,648**
(Note: Transfer Channel Excavation)						
			77,058.05			*96,322.56*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**77,058**	**19,265**	**0**	**96,323**
			36,768.78			*45,960.98*
Mobilization	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			36,768.78			*45,960.98*
Mobilization of Equipment	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			33,837.92			*42,297.40*
Demobilization	**1.00**	**EA**	**33,838**	**8,459**	**0**	**42,297**
Misc Costs incl project sign	**1.00**	**LS**	**996**	**249**	**0**	**1,245**
Utilities	**1.00**	**LS**	**2,585**	**646**	**0**	**3,232**
(Note: Quantities for 2 trailer)						
			1,435.01			*1,793.76*
Office Trailers Setup and Removal	**2.00**	**EA**	**2,870**	**718**	**0**	**3,588**
(Note: One trailer for the contractor and one for the Government inspector.)						
			45.50			*56.87*
Mechanical Dredging	**24,210.00**	**LF**	**1,101,465**	**275,366**	**0**	**1,376,831**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 22,700 LF +1,510 LF = 24,210 LF)						
			1,101,464.77			*1,376,830.97*
Site Work	**1.00**	**EA**	**1,101,465**	**275,366**	**0**	**1,376,831**
			1,653.27			*2,066.58*
Clearing and Grubbing	**71.00**	**ACR**	**117,382**	**29,345**	**0**	**146,727**
(Note: Both the channel and the disposal area will be cleared. Trees and bush will be cleared with dozers. The material will be pushed into piles and burned. Debris not burned will be buried in the disposal area. The quantity includes the area for disposal. Only the wooded area will be required to be cleared. No work will be required for corp lands. 65.26 ACR + (150'x1510')/43560.17 SF/ARC						

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
= 70.45 ACR Used 71 ACR)						
			5.56			*6.95*
Excavation and Disposal (Note: 114,100 CY + 62,856 CY = 254,556 CY)	**176,956.00**	**BCY**	**984,083**	**246,021**	**0**	**1,230,104**
			2,260,813.92			*2,826,017.40*
Associated General Items	**1.00**	**EA**	**2,260,814**	**565,203**	**0**	**2,826,017**
			1,091,718.76			*1,364,648.45*
Black Bayou Weir (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,091,719**	**272,930**	**0**	**1,364,648**
			1,091,718.76			*1,364,648.45*
Site Work	**1.00**	**EA**	**1,091,719**	**272,930**	**0**	**1,364,648**
			2,506.47			*3,133.09*
Clearing & Grubbing	**2.40**	**ACR**	**6,016**	**1,504**	**0**	**7,519**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**2.40**	**ACR**	**21,946**	**5,486**	**0**	**27,432**
			19.17			*23.96*
Embankment for Core of Weir	**1,970.00**	**ECY**	**37,764**	**9,441**	**0**	**47,205**
			41.25			*51.56*
Sheet Pile Cutoff (Note: Assumed 40' depth.)	**4,800.00**	**SF**	**197,990**	**49,497**	**0**	**247,487**
			196.58			*245.72*
Wales (Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)	**120.00**	**LF**	**23,589**	**5,897**	**0**	**29,487**
			75.27			*94.09*
Filter Stone (Note: Assumed 6" Thick)	**2,160.00**	**TON**	**162,583**	**40,646**	**0**	**203,229**
			77.28			*96.61*
R400 Riprap (Note: Assume 24" Thick)	**8,610.00**	**TON**	**665,421**	**166,355**	**0**	**831,776**
			1,169,095.16			*1,461,368.94*
Cassidy Bayou (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,169,095**	**292,274**	**0**	**1,461,369**
			1,169,095.16			*1,461,368.94*
Site Work	**1.00**	**EA**	**1,169,095**	**292,274**	**0**	**1,461,369**
			2,506.47			*3,133.09*
Clearing & Grubbing	**1.50**	**ACR**	**3,760**	**940**	**0**	**4,700**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**1.50**	**ACR**	**13,716**	**3,429**	**0**	**17,145**
			19.17			*23.96*
Embankment for Core of Weir	**210.00**	**ECY**	**4,026**	**1,006**	**0**	**5,032**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			41.95			*52.44*
Sheet Pile Cutoff	**11,200.00**	**SF**	**469,839**	**117,460**	**0**	**587,298**
(Note: Assumed 35' depth.)						
			196.58			*245.72*
Wales	**320.00**	**LF**	**62,905**	**15,726**	**0**	**78,632**
(Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)						
			75.27			*94.09*
Filter Stone	**1,550.00**	**TON**	**116,669**	**29,167**	**0**	**145,836**
(Note: Assumed 6" Thick)						
			77.28			*96.61*
R400 Riprap	**7,260.00**	**TON**	**561,086**	**140,272**	**0**	**701,358**
(Note: Assume 24" Thick)						
			8,381.73			*10,477.16*
Disposal Areas	**1.00**	**EA**	**8,382**	**2,095**	**0**	**10,477**
			8,381.73			*10,477.16*
Site Work	**1.00**	**EA**	**8,382**	**2,095**	**0**	**10,477**
			0.35			*0.43*
Reforestation	**24,210.00**	**LF**	**8,382**	**2,095**	**0**	**10,477**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 22,700 LF +1,510 LF = 24,210 LF Assumed that the spoil or disposal area (50') with be reforested with bottom land hardwood.)						
Pumping Plant	**1.00**	**LS**	**5,441,099**	**1,904,385**	**0**	**7,345,483**
Quiver River Pumping Plant	**1.00**	**LS**	**5,441,099**	**1,904,385**	**0**	**7,345,483**
			154,507.38			*208,584.96*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**154,507**	**54,078**	**0**	**208,585**
Care and Diversion of Water	**1.00**	**LS**	**304,666**	**106,633**	**0**	**411,299**
			51,466.49			*69,479.76*
Site Work	**1.00**	**EA**	**51,466**	**18,013**	**0**	**69,480**
			8.80			*11.88*
Cofferdam	**5,850.00**	**ECY**	**51,466**	**18,013**	**0**	**69,480**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			2.47			*3.33*
Cofferdam: Construct	**5,850.00**	**ECY**	**14,438**	**5,053**	**0**	**19,491**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			6.33			*8.55*
Cofferdam: Removal	**5,850.00**	**ECY**	**37,028**	**12,960**	**0**	**49,988**
			253,199.39			*341,819.17*
Mechanical	**1.00**	**EA**	**253,199**	**88,620**	**0**	**341,819**
			506.40			*683.64*

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Dewatering	**500.00**	**LF**	**253,199**	**88,620**	**0**	**341,819**
(Note: The qty of length is multiplied by five since the Cost Book indicates the cost is per month and I am assuming a five month (minimum) dewatering period.)						
Earthwork for Structures	**1.00**	**LS**	**1,397,926**	**489,274**	**0**	**1,887,200**
			1,397,925.77			*1,887,199.79*
Site Work	**1.00**	**EA**	**1,397,926**	**489,274**	**0**	**1,887,200**
			2,506.47			*3,383.74*
Clearing and Grubbing	**3.50**	**ACR**	**8,773**	**3,070**	**0**	**11,843**
			11.87			*16.03*
Excavation, Structural	**19,050.00**	**CY**	**226,196**	**79,168**	**0**	**305,364**
(Note: Assume that material will be excavated and stockpiled on site.)						
			11.87			*16.03*
Pump Station	**17,250.00**	**CY**	**204,823**	**71,688**	**0**	**276,511**
			11.87			*16.03*
Discharge Pipes	**1,800.00**	**CY**	**21,373**	**7,480**	**0**	**28,853**
			6.53			*8.82*
Channel Excavation as Part of Structure	**38,950.00**	**CY**	**254,366**	**89,028**	**0**	**343,394**
(Note: Assume that material will be excavated and stockpiled on site.)						
			13.08			*17.66*
Compacted Fill	**27,410.00**	**CY**	**358,567**	**125,498**	**0**	**484,065**
			13.08			*17.66*
Pump Station	**26,010.00**	**CY**	**340,253**	**119,088**	**0**	**459,341**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor will be used.)						
			13.08			*17.66*
Compacted Fill from onsite excavation.	**26,010.00**	**CY**	**340,253**	**119,088**	**0**	**459,341**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			13.08			*17.66*
Discharge Pipes	**1,400.00**	**CY**	**18,314**	**6,410**	**0**	**24,724**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor.)						
			13.08			*17.66*
Compacted Fill from onsite excavated stockpile	**1,400.00**	**CY**	**18,314**	**6,410**	**0**	**24,724**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			28.38			*38.31*
Pervious Backfill	**4,050.00**	**CY**	**114,931**	**40,226**	**0**	**155,157**
(Note: Assume that the sand will be obtained from off site by a supplier. The material will be dumped in or near the location of placement.)						
			17.44			*23.55*
Impervious Fill	**260.00**	**CY**	**4,535**	**1,587**	**0**	**6,122**
			4.83			*6.52*
Engineering Fabric	**2,800.00**	**SY**	**13,524**	**4,733**	**0**	**18,257**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
6" Filter Stone	**243.00**	**CY**	**30,901**	**10,815**	**0**	**41,716**
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
9" Filter Stone	**375.00**	**CY**	**47,686**	**16,690**	**0**	**64,376**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R90 RipRap	**1,125.00**	**TON**	**88,423**	**30,948**	**0**	**119,372**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R200 RipRap	**1,500.00**	**TON**	**117,898**	**41,264**	**0**	**159,162**
(Note: Will be delivered to jobsite.)						
			107.79			*145.51*
Crushed Stone Surfacing	**975.00**	**CY**	**105,091**	**36,782**	**0**	**141,873**
(Note: A dozer will be used to spread and compact material. The material will be dumped in place by the supplier.)						
			3,619.43			*4,886.23*
Erosion Control	**2.50**	**ACR**	**9,049**	**3,167**	**0**	**12,216**
			8,993.69			*12,141.48*
Manholes, 48"	**2.00**	**EA**	**17,987**	**6,296**	**0**	**24,283**
			200,914.21			*271,234.19*
Foundation Work	**1.00**	**EA**	**200,914**	**70,320**	**0**	**271,234**
			200,914.21			*271,234.19*
Site Work	**1.00**	**EA**	**200,914**	**70,320**	**0**	**271,234**
			2,480.42			*3,348.57*
Piling, Steel Bearing	**81.00**	**EA**	**200,914**	**70,320**	**0**	**271,234**
			55.12			*74.41*
HP 12x48 Piles	**3,645.00**	**LF**	**200,914**	**70,320**	**0**	**271,234**
(Note: Piles at 45 LF/EA.)						
			106,408.53			*143,651.51*
Utilities	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			106,408.53			*143,651.51*
Electrical	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			70,939.02			*95,767.68*
Power Supply Line	**1.50**	**MI**	**106,409**	**37,243**	**0**	**143,652**
Pumping Plant Substructure	**1.00**	**LS**	**898,692**	**314,542**	**0**	**1,213,235**
			364.28			*491.77*
Concrete	**2,285.00**	**CY**	**832,369**	**291,329**	**0**	**1,123,698**
			281.89			*380.55*

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Concrete, in Place Including C	**2,285.00**	**CY**	**644,109**	**225,438**	**0**	**869,547**
			315.86			*426.41*
Pump Station	**685.00**	**CY**	**216,365**	**75,728**	**0**	**292,093**
(Note: A waste of 5% for the concrete was applied. A ratio of 17.65 SFC/CY for the forming to concrete was used.)						
			267.34			*360.91*
Wing Wall	**1,600.00**	**CY**	**427,743**	**149,710**	**0**	**577,453**
(Note: A waste of 5% for the concrete was applied. A ratio of 12.5 SFC/CY for the forming to concrete was used.)						
			0.74			*0.99*
Reinforcing Steel	**251,350.00**	**LB**	**185,079**	**64,778**	**0**	**249,857**
			0.74			*1.00*
Pump Station	**75,350.00**	**LB**	**56,093**	**19,633**	**0**	**75,726**
			0.73			*0.99*
Wing Wall	**176,000.00**	**LB**	**128,986**	**45,145**	**0**	**174,132**
			1.39			*1.88*
Misc. Material (Water stops, joint material, and etc.)	**2,285.00**	**CY**	**3,181**	**1,113**	**0**	**4,294**
(Note: Quantity is CY of inplace concrete. The material and placement is based on percent of concrete.)						
			66,323.73			*89,537.04*
Metals	**1.00**	**EA**	**66,324**	**23,213**	**0**	**89,537**
			33,161.87			*44,768.52*
Trash Racks	**2.00**	**EA**	**66,324**	**23,213**	**0**	**89,537**
			42,912.41			*57,931.76*
Pumping Plant Superstructure	**1.00**	**EA**	**42,912**	**15,019**	**0**	**57,932**
			4,113.23			*5,552.87*
Metals	**1.00**	**EA**	**4,113**	**1,440**	**0**	**5,553**
			3.05			*4.11*
Miscellaneous Metals	**1,350.00**	**LB**	**4,113**	**1,440**	**0**	**5,553**
Doors and Windows	**1.00**	**LS**	**3,307**	**1,157**	**0**	**4,464**
			1,653.45			*2,232.16*
Floor Access Doors (3'x3")	**2.00**	**EA**	**3,307**	**1,157**	**0**	**4,464**
			35,492.27			*47,914.56*
Special Construction	**1.00**	**EA**	**35,492**	**12,422**	**0**	**47,915**
			49.71			*67.11*
Pre-engineered Steel Building (34'Wx21'Lx16H)	**714.00**	**SF**	**35,492**	**12,422**	**0**	**47,915**
			2,288,551.63			*3,089,544.70*
Pumping Machinery & Appurtenance	**1.00**	**EA**	**2,288,552**	**800,993**	**0**	**3,089,545**
			178,140.82			*240,490.11*
Mechanical	**1.00**	**EA**	**178,141**	**62,349**	**0**	**240,490**
			370.23			*499.81*
Main Pump Discharge Piping	**360.00**	**LF**	**133,282**	**46,649**	**0**	**179,931**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: UOM is the total combine lenght of 3 discharge lines.)						
			2,856.92			*3,856.84*
Intake and Exhaust Systems	**1.00**	**EA**	**2,857**	**1,000**	**0**	**3,857**
			10,500.45			*14,175.60*
42" Couplings Installment	**4.00**	**EA**	**42,002**	**14,701**	**0**	**56,702**
			2,110,410.81			*2,849,054.59*
Electrical	**1.00**	**EA**	**2,110,411**	**738,644**	**0**	**2,849,055**
			604,456.35			*816,016.07*
Main Pump Motors & Pumps (Note: Incl.)	**3.00**	**EA**	**1,813,369**	**634,679**	**0**	**2,448,048**
			28,604.23			*38,615.71*
Transformers	**1.00**	**EA**	**28,604**	**10,011**	**0**	**38,616**
			28,070.92			*37,895.74*
Motor Control Center	**3.00**	**EA**	**84,213**	**29,474**	**0**	**113,687**
			7,914.04			*10,683.95*
Switchgear and Buswork	**1.00**	**EA**	**7,914**	**2,770**	**0**	**10,684**
			3,554.88			*4,799.09*
Capacitor Banks	**4.00**	**EA**	**14,220**	**4,977**	**0**	**19,196**
			306.99			*414.43*
350 MCM Service Conductor, 3 Runs and Neutral	**525.00**	**FT**	**161,169**	**56,409**	**0**	**217,578**
			922.42			*1,245.27*
Heater, Electric Space, Fan Powered, 5kW	**1.00**	**EA**	**922**	**323**	**0**	**1,245**
			46,520.80			*62,803.08*
Associated General Items	**1.00**	**EA**	**46,521**	**16,282**	**0**	**62,803**
			46,520.80			*62,803.08*
Site Work	**1.00**	**EA**	**46,521**	**16,282**	**0**	**62,803**
			61.62			*83.18*
Chain Link Fence	**755.00**	**LF**	**46,521**	**16,282**	**0**	**62,803**
			2,224,954.34			*2,781,192.93*
Planning, Engineering and Design	**1.00**	**EA**	**2,224,954**	**556,239**	**0**	**2,781,193**
			711,985.39			*889,981.74*
Construction Management	**1.00**	**EA**	**711,985**	**177,996**	**0**	**889,982**

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Alternative 4

Estimated by	CEMVK-EC-TC
Designed by	Vicksburg District
Prepared by	Danny McPhearson
Preparation Date	8/17/2016
Effective Date of Pricing	8/17/2016
Estimated Construction Time	Days

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Project Cost Summary Report			**13,685,423**	**3,892,297**	**0**	**17,577,719**
Quiver River Pump Station	**1.00**	**LS**	**13,685,423**	**3,892,297**	**0**	**17,577,719**
Lands and Damages	**1.00**	**LS**	**489,000**	**0**	**0**	**489,000**
(Note: Cost for Lands and Damages were provided by Real Estate Divison, Vicksburg District. Dated 3 December 2015.)						
Relocations	**1.00**	**LS**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Cemetery, Utilities, & Structure	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Utilities	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Electrical	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
Channels and Canals	**1.00**	**LS**	**3,979,211**	**994,803**	**0**	**4,974,014**
			3,979,211.24			*4,974,014.05*
Channels	**1.00**	**JOB**	**3,979,211**	**994,803**	**0**	**4,974,014**
			3,979,211.24			*4,974,014.05*
Channels	**1.00**	**JOB**	**3,979,211**	**994,803**	**0**	**4,974,014**
(Note: Transfer Channel Excavation)						
			77,058.05			*96,322.56*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**77,058**	**19,265**	**0**	**96,323**
			36,768.78			*45,960.98*
Mobilization	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			36,768.78			*45,960.98*
Mobilization of Equipment	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			33,837.92			*42,297.40*
Demobilization	**1.00**	**EA**	**33,838**	**8,459**	**0**	**42,297**
Misc Costs incl project sign	**1.00**	**LS**	**996**	**249**	**0**	**1,245**
Utilities	**1.00**	**LS**	**2,585**	**646**	**0**	**3,232**
(Note: Quantities for 2 trailer)						
			1,435.01			*1,793.76*
Office Trailers Setup and Removal	**2.00**	**EA**	**2,870**	**718**	**0**	**3,588**
(Note: One trailer for the contractor and one for the Government inspector.)						
			38.22			*47.78*
Mechanical Dredging	**40,110.00**	**LF**	**1,533,012**	**383,253**	**0**	**1,916,265**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 38,600 LF +1,510 LF = 40,110 LF)						
			1,533,011.77			*1,916,264.71*
Site Work	**1.00**	**EA**	**1,533,012**	**383,253**	**0**	**1,916,265**
			1,653.27			*2,066.58*
Clearing and Grubbing	**71.00**	**ACR**	**117,382**	**29,345**	**0**	**146,727**
(Note: Both the channel and the disposal area will be cleared. Trees and bush will be cleared with dozers. The material will be pushed into piles and burned. Debris not burned will be buried in the disposal area. The quantity includes the area for disposal. Only the wooded area will be required to be cleared. No work will be required for corp lands. 65.26 ACR + (150'x1510')/43560.17 SF/ARC						

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
= 70.45 ACR Used 71 ACR)						
			5.56			*6.95*
Excavation and Disposal (Note: 191,700 CY + 62,856 CY = 254,556 CY)	**254,556.00**	**BCY**	**1,415,630**	**353,907**	**0**	**1,769,537**
			2,355,254.96			*2,944,068.70*
Associated General Items	**1.00**	**EA**	**2,355,255**	**588,814**	**0**	**2,944,069**
			1,125,965.01			*1,407,456.26*
Black Bayou Weir (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,125,965**	**281,491**	**0**	**1,407,456**
			1,125,965.01			*1,407,456.26*
Site Work	**1.00**	**EA**	**1,125,965**	**281,491**	**0**	**1,407,456**
			2,506.47			*3,133.09*
Clearing & Grubbing	**2.50**	**ACR**	**6,266**	**1,567**	**0**	**7,833**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**2.50**	**ACR**	**22,860**	**5,715**	**0**	**28,575**
			19.17			*23.96*
Embankment for Core of Weir	**2,170.00**	**ECY**	**41,598**	**10,399**	**0**	**51,997**
			41.25			*51.56*
Sheet Pile Cutoff (Note: Assumed 40' depth.)	**4,800.00**	**SF**	**197,990**	**49,497**	**0**	**247,487**
			196.58			*245.72*
Wales (Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)	**120.00**	**LF**	**23,589**	**5,897**	**0**	**29,487**
			75.27			*94.09*
Filter Stone (Note: Assumed 6" Thick)	**2,220.00**	**TON**	**167,100**	**41,775**	**0**	**208,874**
			77.28			*96.61*
R400 Riprap (Note: Assume 24" Thick)	**8,930.00**	**TON**	**690,152**	**172,538**	**0**	**862,690**
			1,229,289.95			*1,536,612.44*
Cassidy Bayou (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,229,290**	**307,322**	**0**	**1,536,612**
			1,229,289.95			*1,536,612.44*
Site Work	**1.00**	**EA**	**1,229,290**	**307,322**	**0**	**1,536,612**
			2,506.47			*3,133.09*
Clearing & Grubbing	**1.70**	**ACR**	**4,261**	**1,065**	**0**	**5,326**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**1.70**	**ACR**	**15,545**	**3,886**	**0**	**19,431**
			19.17			*23.96*
Embankment for Core of Weir	**330.00**	**ECY**	**6,326**	**1,581**	**0**	**7,907**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			41.95			*52.44*
Sheet Pile Cutoff	**11,200.00**	**SF**	**469,839**	**117,460**	**0**	**587,298**
(Note: Assumed 35' depth.)						
			196.58			*245.72*
Wales	**320.00**	**LF**	**62,905**	**15,726**	**0**	**78,632**
(Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)						
			75.27			*94.09*
Filter Stone	**1,590.00**	**TON**	**119,679**	**29,920**	**0**	**149,599**
(Note: Assumed 6" Thick)						
			77.28			*96.61*
R400 Riprap	**7,940.00**	**TON**	**613,640**	**153,410**	**0**	**767,050**
(Note: Assume 24" Thick)						
			13,886.46			*17,358.08*
Disposal Areas	**1.00**	**EA**	**13,886**	**3,472**	**0**	**17,358**
			13,886.46			*17,358.08*
Site Work	**1.00**	**EA**	**13,886**	**3,472**	**0**	**17,358**
			0.35			*0.43*
Reforestation	**40,110.00**	**LF**	**13,886**	**3,472**	**0**	**17,358**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 38,600 LF +1,510 LF = 40,110 LF Assumed that the spoil or disposal area (50') with be reforested with bottom land hardwood.)						
Pumping Plant	**1.00**	**LS**	**5,931,911**	**2,076,169**	**0**	**8,008,080**
Quiver River Pumping Plant	**1.00**	**LS**	**5,931,911**	**2,076,169**	**0**	**8,008,080**
			154,507.38			*208,584.96*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**154,507**	**54,078**	**0**	**208,585**
Care and Diversion of Water	**1.00**	**LS**	**308,625**	**108,019**	**0**	**416,644**
			55,425.45			*74,824.36*
Site Work	**1.00**	**EA**	**55,425**	**19,399**	**0**	**74,824**
			8.80			*11.88*
Cofferdam	**6,300.00**	**ECY**	**55,425**	**19,399**	**0**	**74,824**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			2.47			*3.33*
Cofferdam: Construct	**6,300.00**	**ECY**	**15,549**	**5,442**	**0**	**20,991**
(Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)						
			6.33			*8.55*
Cofferdam: Removal	**6,300.00**	**ECY**	**39,877**	**13,957**	**0**	**53,834**
			253,199.39			*341,819.17*
Mechanical	**1.00**	**EA**	**253,199**	**88,620**	**0**	**341,819**
			506.40			*683.64*

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Dewatering	**500.00**	**LF**	**253,199**	**88,620**	**0**	**341,819**
(Note: The qty of length is multiplied by five since the Cost Book indicates the cost is per month and I am assuming a five month (minimum) dewatering period.)						
Earthwork for Structures	**1.00**	**LS**	**1,517,262**	**531,042**	**0**	**2,048,303**
			1,517,261.55			*2,048,303.09*
Site Work	**1.00**	**EA**	**1,517,262**	**531,042**	**0**	**2,048,303**
			2,506.47			*3,383.74*
Clearing and Grubbing	**3.50**	**ACR**	**8,773**	**3,070**	**0**	**11,843**
			11.87			*16.03*
Excavation, Structural	**21,100.00**	**CY**	**250,537**	**87,688**	**0**	**338,225**
(Note: Assume that material will be excavated and stockpiled on site.)						
			11.87			*16.03*
Pump Station	**18,500.00**	**CY**	**219,665**	**76,883**	**0**	**296,548**
			11.87			*16.03*
Discharge Pipes	**2,600.00**	**CY**	**30,872**	**10,805**	**0**	**41,677**
			6.53			*8.82*
Channel Excavation as Part of Structure	**41,900.00**	**CY**	**273,631**	**95,771**	**0**	**369,402**
(Note: Assume that material will be excavated and stockpiled on site.)						
			13.08			*17.66*
Compacted Fill	**30,370.00**	**CY**	**397,288**	**139,051**	**0**	**536,339**
			13.08			*17.66*
Pump Station	**28,370.00**	**CY**	**371,125**	**129,894**	**0**	**501,019**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor will be used.)						
			13.08			*17.66*
Compacted Fill from onsite excavation.	**28,370.00**	**CY**	**371,125**	**129,894**	**0**	**501,019**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			13.08			*17.66*
Discharge Pipes	**2,000.00**	**CY**	**26,163**	**9,157**	**0**	**35,320**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor.)						
			13.08			*17.66*
Compacted Fill from onsite excavated stockpile	**2,000.00**	**CY**	**26,163**	**9,157**	**0**	**35,320**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			28.38			*38.31*
Pervious Backfill	**4,350.00**	**CY**	**123,444**	**43,206**	**0**	**166,650**
(Note: Assume that the sand will be obtained from off site by a supplier. The material will be dumped in or near the location of placement.)						
			17.44			*23.55*
Impervious Fill	**280.00**	**CY**	**4,884**	**1,709**	**0**	**6,593**
			4.83			*6.52*
Engineering Fabric	**3,000.00**	**SY**	**14,489**	**5,071**	**0**	**19,561**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
6" Filter Stone	**260.00**	**CY**	**33,062**	**11,572**	**0**	**44,634**
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
9" Filter Stone	**400.00**	**CY**	**50,865**	**17,803**	**0**	**68,668**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R90 RipRap	**1,200.00**	**TON**	**94,318**	**33,011**	**0**	**127,330**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R200 RipRap	**1,600.00**	**TON**	**125,758**	**44,015**	**0**	**169,773**
(Note: Will be delivered to jobsite.)						
			107.79			*145.51*
Crushed Stone Surfacing	**1,050.00**	**CY**	**113,175**	**39,611**	**0**	**152,787**
(Note: A dozer will be used to spread and compact material. The material will be dumped in place by the supplier.)						
			3,619.43			*4,886.23*
Erosion Control	**2.50**	**ACR**	**9,049**	**3,167**	**0**	**12,216**
			8,993.69			*12,141.48*
Manholes, 48"	**2.00**	**EA**	**17,987**	**6,296**	**0**	**24,283**
			290,209.42			*391,782.71*
Foundation Work	**1.00**	**EA**	**290,209**	**101,573**	**0**	**391,783**
			290,209.42			*391,782.71*
Site Work	**1.00**	**EA**	**290,209**	**101,573**	**0**	**391,783**
			2,480.42			*3,348.57*
Piling, Steel Bearing	**117.00**	**EA**	**290,209**	**101,573**	**0**	**391,783**
			55.12			*74.41*
HP 12x48 Piles	**5,265.00**	**LF**	**290,209**	**101,573**	**0**	**391,783**
(Note: Piles at 45 LF/EA.)						
			106,408.53			*143,651.51*
Utilities	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			106,408.53			*143,651.51*
Electrical	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			70,939.02			*95,767.68*
Power Supply Line	**1.50**	**MI**	**106,409**	**37,243**	**0**	**143,652**
Pumping Plant Substructure	**1.00**	**LS**	**1,029,644**	**360,375**	**0**	**1,390,019**
			367.65			*496.33*
Concrete	**2,530.00**	**CY**	**930,158**	**325,555**	**0**	**1,255,714**
			285.18			*384.99*

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Concrete, in Place Including C	**2,530.00**	**CY**	**721,495**	**252,523**	**0**	**974,018**
			315.86			*426.41*
Pump Station	**930.00**	**CY**	**293,751**	**102,813**	**0**	**396,564**
(Note: A waste of 5% for the concrete was applied. A ratio of 17.65 SFC/CY for the forming to concrete was used.)						
			267.34			*360.91*
Wing Wall	**1,600.00**	**CY**	**427,743**	**149,710**	**0**	**577,453**
(Note: A waste of 5% for the concrete was applied. A ratio of 12.5 SFC/CY for the forming to concrete was used.)						
			0.74			*1.00*
Reinforcing Steel	**278,300.00**	**LB**	**205,142**	**71,800**	**0**	**276,941**
			0.74			*1.00*
Pump Station	**102,300.00**	**LB**	**76,155**	**26,654**	**0**	**102,810**
			0.73			*0.99*
Wing Wall	**176,000.00**	**LB**	**128,986**	**45,145**	**0**	**174,132**
			1.39			*1.88*
Misc. Material (Water stops, joint material, and etc.)	**2,530.00**	**CY**	**3,522**	**1,233**	**0**	**4,754**
(Note: Quantity is CY of inplace concrete. The material and placement is based on percent of concrete.)						
			99,485.60			*134,305.56*
Metals	**1.00**	**EA**	**99,486**	**34,820**	**0**	**134,306**
			33,161.87			*44,768.52*
Trash Racks	**3.00**	**EA**	**99,486**	**34,820**	**0**	**134,306**
			56,068.02			*75,691.83*
Pumping Plant Superstructure	**1.00**	**EA**	**56,068**	**19,624**	**0**	**75,692**
			4,570.26			*6,169.85*
Metals	**1.00**	**EA**	**4,570**	**1,600**	**0**	**6,170**
			3.05			*4.11*
Miscellaneous Metals	**1,500.00**	**LB**	**4,570**	**1,600**	**0**	**6,170**
Doors and Windows	**1.00**	**LS**	**4,960**	**1,736**	**0**	**6,696**
			1,653.45			*2,232.16*
Floor Access Doors (3'x3")	**3.00**	**EA**	**4,960**	**1,736**	**0**	**6,696**
			46,537.40			*62,825.49*
Special Construction	**1.00**	**EA**	**46,537**	**16,288**	**0**	**62,825**
			45.23			*61.05*
Pre-engineered Steel Building (49'Wx21'Lx16H)	**1,029.00**	**SF**	**46,537**	**16,288**	**0**	**62,825**
			2,419,331.52			*3,266,097.55*
Pumping Machinery & Appurtenance	**1.00**	**EA**	**2,419,332**	**846,766**	**0**	**3,266,098**
			265,782.78			*358,806.75*
Mechanical	**1.00**	**EA**	**265,783**	**93,024**	**0**	**358,807**
			370.23			*499.81*
Main Pump Discharge Piping	**540.00**	**LF**	**199,923**	**69,973**	**0**	**269,896**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: UOM is the total combine lenght of 3 discharge lines.)						
			2,856.92			*3,856.84*
Intake and Exhaust Systems	**1.00**	**EA**	**2,857**	**1,000**	**0**	**3,857**
			10,500.45			*14,175.60*
42" Couplings Installment	**6.00**	**EA**	**63,003**	**22,051**	**0**	**85,054**
			2,153,548.74			*2,907,290.80*
Electrical	**1.00**	**EA**	**2,153,549**	**753,742**	**0**	**2,907,291**
			604,456.35			*816,016.07*
Main Pump Motors & Pumps	**3.00**	**EA**	**1,813,369**	**634,679**	**0**	**2,448,048**
(Note: Incl.)						
			39,258.66			*52,999.19*
Transformers	**1.00**	**EA**	**39,259**	**13,741**	**0**	**52,999**
			28,070.92			*37,895.74*
Motor Control Center	**3.00**	**EA**	**84,213**	**29,474**	**0**	**113,687**
			10,263.67			*13,855.96*
Switchgear and Buswork	**1.00**	**EA**	**10,264**	**3,592**	**0**	**13,856**
			3,554.88			*4,799.09*
Capacitor Banks	**6.00**	**EA**	**21,329**	**7,465**	**0**	**28,795**
			306.99			*414.43*
350 MCM Service Conductor, 3 Runs and Neutral	**600.00**	**FT**	**184,193**	**64,468**	**0**	**248,660**
			922.42			*1,245.27*
Heater, Electric Space, Fan Powered, 5kW	**1.00**	**EA**	**922**	**323**	**0**	**1,245**
			49,856.03			*67,305.64*
Associated General Items	**1.00**	**EA**	**49,856**	**17,450**	**0**	**67,306**
			49,856.03			*67,305.64*
Site Work	**1.00**	**EA**	**49,856**	**17,450**	**0**	**67,306**
			61.55			*83.09*
Chain Link Fence	**810.00**	**LF**	**49,856**	**17,450**	**0**	**67,306**
			2,480,530.57			*3,100,663.22*
Planning, Engineering and Design	**1.00**	**EA**	**2,480,531**	**620,133**	**0**	**3,100,663**
			793,769.78			*992,212.23*
Construction Management	**1.00**	**EA**	**793,770**	**198,442**	**0**	**992,212**

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Alternative 5

Estimated by	CEMVK-EC-TC
Designed by	Vicksburg District
Prepared by	Danny McPhearson
Preparation Date	8/17/2016
Effective Date of Pricing	8/17/2016
Estimated Construction Time	Days

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Project Cost Summary Report			**15,722,975**	**4,513,166**	**0**	**20,236,141**
Quiver River Pump Station	**1.00**	**LS**	**15,722,975**	**4,513,166**	**0**	**20,236,141**
Lands and Damages	**1.00**	**LS**	**489,000**	**0**	**0**	**489,000**
(Note: Cost for Lands and Damages were provided by Real Estate Divison, Vicksburg District. Dated 3 December 2015.)						
Relocations	**1.00**	**LS**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Cemetery, Utilities, & Structure	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Utilities	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
			11,000.00			*13,750.00*
Electrical	**1.00**	**EA**	**11,000**	**2,750**	**0**	**13,750**
Channels and Canals	**1.00**	**LS**	**4,396,393**	**1,099,098**	**0**	**5,495,491**
			4,396,393.08			*5,495,491.35*
Channels	**1.00**	**JOB**	**4,396,393**	**1,099,098**	**0**	**5,495,491**
			4,396,393.08			*5,495,491.35*
Channels	**1.00**	**JOB**	**4,396,393**	**1,099,098**	**0**	**5,495,491**
(Note: Transfer Channel Excavation)						
			77,058.05			*96,322.56*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**77,058**	**19,265**	**0**	**96,323**
			36,768.78			*45,960.98*
Mobilization	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			36,768.78			*45,960.98*
Mobilization of Equipment	**1.00**	**EA**	**36,769**	**9,192**	**0**	**45,961**
			33,837.92			*42,297.40*
Demobilization	**1.00**	**EA**	**33,838**	**8,459**	**0**	**42,297**
Misc Costs incl project sign	**1.00**	**LS**	**996**	**249**	**0**	**1,245**
Utilities	**1.00**	**LS**	**2,585**	**646**	**0**	**3,232**
(Note: Quantities for 2 trailer)						
			1,435.01			*1,793.76*
Office Trailers Setup and Removal	**2.00**	**EA**	**2,870**	**718**	**0**	**3,588**
(Note: One trailer for the contractor and one for the Government inspector.)						
			42.88			*53.60*
Mechanical Dredging	**43,210.00**	**LF**	**1,852,779**	**463,195**	**0**	**2,315,974**
(Note: Quantity is based on the lengthener feet of channel requiring excavation. 41,700 LF +1,510 LF = 43,210 LF)						
			1,852,779.19			*2,315,973.99*
Site Work	**1.00**	**EA**	**1,852,779**	**463,195**	**0**	**2,315,974**
			1,653.27			*2,066.58*
Clearing and Grubbing	**71.00**	**ACR**	**117,382**	**29,345**	**0**	**146,727**
(Note: Both the channel and the disposal area will be cleared. Trees and bush will be cleared with dozers. The material will be pushed into piles and burned. Debris not burned will be buried in the disposal area. The quantity includes the area for disposal. Only the wooded area will be required to be cleared. No work will be required for corp lands. 65.26 ACR + (150'x1510')/43560.17 SF/ARC						

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
= 70.45 ACR Used 71 ACR)						
			5.56			*6.95*
Excavation and Disposal (Note: 249,200 CY + 62,856 CY = 312,056 CY)	**312,056.00**	**BCY**	**1,735,397**	**433,849**	**0**	**2,169,247**
			2,451,596.13			*3,064,495.16*
Associated General Items	**1.00**	**EA**	**2,451,596**	**612,899**	**0**	**3,064,495**
			1,161,155.65			*1,451,444.56*
Black Bayou Weir (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,161,156**	**290,289**	**0**	**1,451,445**
			1,161,155.65			*1,451,444.56*
Site Work	**1.00**	**EA**	**1,161,156**	**290,289**	**0**	**1,451,445**
			2,506.47			*3,133.09*
Clearing & Grubbing	**2.60**	**ACR**	**6,517**	**1,629**	**0**	**8,146**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**2.60**	**ACR**	**23,774**	**5,944**	**0**	**29,718**
			19.17			*23.96*
Embankment for Core of Weir	**2,380.00**	**ECY**	**45,624**	**11,406**	**0**	**57,029**
			41.25			*51.56*
Sheet Pile Cutoff (Note: Assumed 40' depth.)	**4,800.00**	**SF**	**197,990**	**49,497**	**0**	**247,487**
			196.58			*245.72*
Wales (Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)	**120.00**	**LF**	**23,589**	**5,897**	**0**	**29,487**
			75.27			*94.09*
Filter Stone (Note: Assumed 6" Thick)	**2,290.00**	**TON**	**172,368**	**43,092**	**0**	**215,461**
			77.28			*96.61*
R400 Riprap (Note: Assume 24" Thick)	**9,250.00**	**TON**	**714,883**	**178,721**	**0**	**893,604**
			1,290,440.48			*1,613,050.60*
Cassidy Bayou (Note: See Quiver R Weirs Quantity Work Sheet.)	**1.00**	**EA**	**1,290,440**	**322,610**	**0**	**1,613,051**
			1,290,440.48			*1,613,050.60*
Site Work	**1.00**	**EA**	**1,290,440**	**322,610**	**0**	**1,613,051**
			2,506.47			*3,133.09*
Clearing & Grubbing	**1.80**	**ACR**	**4,512**	**1,128**	**0**	**5,640**
			9,143.99			*11,429.98*
Surface Grading for Riprap Protection	**1.80**	**ACR**	**16,459**	**4,115**	**0**	**20,574**
			19.17			*23.96*
Embankment for Core of Weir	**480.00**	**ECY**	**9,201**	**2,300**	**0**	**11,502**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
			41.95			*52.44*
Sheet Pile Cutoff (Note: Assumed 35' depth.)	**11,200.00**	**SF**	**469,839**	**117,460**	**0**	**587,298**
			196.58			*245.72*
Wales (Note: Assume that a MC 12x37 will be used as a wale. There will be a wale on both sides of the sheet pile.)	**320.00**	**LF**	**62,905**	**15,726**	**0**	**78,632**
			75.27			*94.09*
Filter Stone (Note: Assumed 6" Thick)	**1,630.00**	**TON**	**122,690**	**30,673**	**0**	**153,363**
			77.28			*96.61*
R400 Riprap (Note: Assume 24" Thick)	**8,640.00**	**TON**	**667,739**	**166,935**	**0**	**834,674**
			14,959.71			*18,699.64*
Disposal Areas	**1.00**	**EA**	**14,960**	**3,740**	**0**	**18,700**
			14,959.71			*18,699.64*
Site Work	**1.00**	**EA**	**14,960**	**3,740**	**0**	**18,700**
			0.35			*0.43*
Reforestation (Note: Quantity is based on the lengthener feet of channel requiring excavation. 41,700 LF +1,510 LF = 43,210 LF Assumed that the spoil or disposal area (50') with be reforested with bottom land hardwood.)	**43,210.00**	**LF**	**14,960**	**3,740**	**0**	**18,700**
Pumping Plant	**1.00**	**LS**	**7,046,723**	**2,466,353**	**0**	**9,513,076**
Quiver River Pumping Plant	**1.00**	**LS**	**7,046,723**	**2,466,353**	**0**	**9,513,076**
			154,507.38			*208,584.96*
Mob, Demob & Preparatory Work	**1.00**	**EA**	**154,507**	**54,078**	**0**	**208,585**
Care and Diversion of Water	**1.00**	**LS**	**312,584**	**109,404**	**0**	**421,988**
			59,384.41			*80,168.95*
Site Work	**1.00**	**EA**	**59,384**	**20,785**	**0**	**80,169**
			8.80			*11.88*
Cofferdam (Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)	**6,750.00**	**ECY**	**59,384**	**20,785**	**0**	**80,169**
			2.47			*3.33*
Cofferdam: Construct (Note: Material will be directly obtained form the structural excavation. The cost of excavated and hauling is covered under the excavation items. Only spreading and compaction is covered under this item.)	**6,750.00**	**ECY**	**16,659**	**5,831**	**0**	**22,490**
			6.33			*8.55*
Cofferdam: Removal	**6,750.00**	**ECY**	**42,725**	**14,954**	**0**	**57,679**
			253,199.39			*341,819.17*
Mechanical	**1.00**	**EA**	**253,199**	**88,620**	**0**	**341,819**
			506.40			*683.64*

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Dewatering	**500.00**	**LF**	**253,199**	**88,620**	**0**	**341,819**
(Note: The qty of length is multiplied by five since the Cost Book indicates the cost is per month and I am assuming a five month (minimum) dewatering period.)						
Earthwork for Structures	**1.00**	**LS**	**1,636,724**	**572,854**	**0**	**2,209,578**
			1,636,724.49			*2,209,578.07*
Site Work	**1.00**	**EA**	**1,636,724**	**572,854**	**0**	**2,209,578**
			2,506.47			*3,383.74*
Clearing and Grubbing	**3.50**	**ACR**	**8,773**	**3,070**	**0**	**11,843**
			11.87			*16.03*
Excavation, Structural	**23,150.00**	**CY**	**274,878**	**96,207**	**0**	**371,085**
(Note: Assume that material will be excavated and stockpiled on site.)						
			11.87			*16.03*
Pump Station	**19,750.00**	**CY**	**234,507**	**82,078**	**0**	**316,585**
			11.87			*16.03*
Discharge Pipes	**3,400.00**	**CY**	**40,371**	**14,130**	**0**	**54,501**
			6.53			*8.82*
Channel Excavation as Part of Structure	**44,850.00**	**CY**	**292,897**	**102,514**	**0**	**395,410**
(Note: Assume that material will be excavated and stockpiled on site.)						
			13.08			*17.66*
Compacted Fill	**33,330.00**	**CY**	**436,010**	**152,604**	**0**	**588,614**
			13.08			*17.66*
Pump Station	**30,730.00**	**CY**	**401,998**	**140,699**	**0**	**542,697**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor will be used.)						
			13.08			*17.66*
Compacted Fill from onsite excavation.	**30,730.00**	**CY**	**401,998**	**140,699**	**0**	**542,697**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			13.08			*17.66*
Discharge Pipes	**2,600.00**	**CY**	**34,012**	**11,904**	**0**	**45,916**
(Note: Material will be loaded into trucks from a stockpile of excavated material or borrow pit, hauled and dumped in place. Material willl be spread and compacted with a bulldozer and assisted by a tractor pulled roller. For areas where the tractor and roller cannot adequately compact, a walk behind compactor.)						
			13.08			*17.66*
Compacted Fill from onsite excavated stockpile	**2,600.00**	**CY**	**34,012**	**11,904**	**0**	**45,916**
(Note: Material will be obtained from the structural and channel excavation stockpiled at jobsite.)						
			28.38			*38.31*
Pervious Backfill	**4,650.00**	**CY**	**131,958**	**46,185**	**0**	**178,143**
(Note: Assume that the sand will be obtained from off site by a supplier. The material will be dumped in or near the location of placement.)						
			17.44			*23.55*
Impervious Fill	**300.00**	**CY**	**5,233**	**1,831**	**0**	**7,064**
			4.83			*6.52*
Engineering Fabric	**3,200.00**	**SY**	**15,455**	**5,409**	**0**	**20,865**

Labor ID: EQ ID: EP14R03 | Currency in US dollars | TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
6" Filter Stone	**278.00**	**CY**	**35,351**	**12,373**	**0**	**47,724**
(Note: Will be delivered to jobsite.)						
			127.16			*171.67*
9" Filter Stone	**425.00**	**CY**	**54,044**	**18,915**	**0**	**72,960**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R90 RipRap	**1,275.00**	**TON**	**100,213**	**35,075**	**0**	**135,288**
(Note: Will be delivered to jobsite.)						
			78.60			*106.11*
R200 RipRap	**1,700.00**	**TON**	**133,618**	**46,766**	**0**	**180,384**
(Note: Will be delivered to jobsite.)						
			107.79			*145.51*
Crushed Stone Surfacing	**1,125.00**	**CY**	**121,259**	**42,441**	**0**	**163,700**
(Note: A dozer will be used to spread and compact material. The material will be dumped in place by the supplier.)						
			3,619.43			*4,886.23*
Erosion Control	**2.50**	**ACR**	**9,049**	**3,167**	**0**	**12,216**
			8,993.69			*12,141.48*
Manholes, 48"	**2.00**	**EA**	**17,987**	**6,296**	**0**	**24,283**
			379,504.62			*512,331.24*
Foundation Work	**1.00**	**EA**	**379,505**	**132,827**	**0**	**512,331**
			379,504.62			*512,331.24*
Site Work	**1.00**	**EA**	**379,505**	**132,827**	**0**	**512,331**
			2,480.42			*3,348.57*
Piling, Steel Bearing	**153.00**	**EA**	**379,505**	**132,827**	**0**	**512,331**
			55.12			*74.41*
HP 12x48 Piles	**6,885.00**	**LF**	**379,505**	**132,827**	**0**	**512,331**
(Note: Piles at 45 LF/EA.)						
			106,408.53			*143,651.51*
Utilities	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			106,408.53			*143,651.51*
Electrical	**1.00**	**EA**	**106,409**	**37,243**	**0**	**143,652**
			70,939.02			*95,767.68*
Power Supply Line	**1.50**	**MI**	**106,409**	**37,243**	**0**	**143,652**
Pumping Plant Substructure	**1.00**	**LS**	**1,160,425**	**406,149**	**0**	**1,566,574**
			370.37			*500.00*
Concrete	**2,775.00**	**CY**	**1,027,778**	**359,722**	**0**	**1,387,500**
			287.82			*388.56*

Labor ID: EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
Concrete, in Place Including C	**2,775.00**	**CY**	**798,711**	**279,549**	**0**	**1,078,260**
			315.72			*426.22*
Pump Station	**1,175.00**	**CY**	**370,968**	**129,839**	**0**	**500,806**
(Note: A waste of 5% for the concrete was applied. A ratio of 17.65 SFC/CY for the forming to concrete was used.)						
			267.34			*360.91*
Wing Wall	**1,600.00**	**CY**	**427,743**	**149,710**	**0**	**577,453**
(Note: A waste of 5% for the concrete was applied. A ratio of 12.5 SFC/CY for the forming to concrete was used.)						
			0.74			*1.00*
Reinforcing Steel	**305,250.00**	**LB**	**225,204**	**78,822**	**0**	**304,026**
			0.74			*1.00*
Pump Station	**129,250.00**	**LB**	**96,218**	**33,676**	**0**	**129,894**
			0.73			*0.99*
Wing Wall	**176,000.00**	**LB**	**128,986**	**45,145**	**0**	**174,132**
			1.39			*1.88*
Misc. Material (Water stops, joint material, and etc.)	**2,775.00**	**CY**	**3,863**	**1,352**	**0**	**5,215**
(Note: Quantity is CY of inplace concrete. The material and placement is based on percent of concrete.)						
			132,647.47			*179,074.08*
Metals	**1.00**	**EA**	**132,647**	**46,427**	**0**	**179,074**
			33,161.87			*44,768.52*
Trash Racks	**4.00**	**EA**	**132,647**	**46,427**	**0**	**179,074**
			64,293.23			*86,795.85*
Pumping Plant Superstructure	**1.00**	**EA**	**64,293**	**22,503**	**0**	**86,796**
			5,027.29			*6,786.84*
Metals	**1.00**	**EA**	**5,027**	**1,760**	**0**	**6,787**
			3.05			*4.11*
Miscellaneous Metals	**1,650.00**	**LB**	**5,027**	**1,760**	**0**	**6,787**
Doors and Windows	**1.00**	**LS**	**6,614**	**2,315**	**0**	**8,929**
			1,653.45			*2,232.16*
Floor Access Doors (3'x3")	**4.00**	**EA**	**6,614**	**2,315**	**0**	**8,929**
			52,652.12			*71,080.36*
Special Construction	**1.00**	**EA**	**52,652**	**18,428**	**0**	**71,080**
			38.57			*52.07*
Pre-engineered Steel Building (65'Wx21'Lx16H)	**1,365.00**	**SF**	**52,652**	**18,428**	**0**	**71,080**
			3,179,084.59			*4,291,764.19*
Pumping Machinery & Appurtenance	**1.00**	**EA**	**3,179,085**	**1,112,680**	**0**	**4,291,764**
			353,424.73			*477,123.38*
Mechanical	**1.00**	**EA**	**353,425**	**123,699**	**0**	**477,123**
			370.23			*499.81*
Main Pump Discharge Piping	**720.00**	**LF**	**266,564**	**93,297**	**0**	**359,862**

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Description	Quantity	UOM	ContractCost	Contingency	Escalation	ProjectCost
(Note: UOM is the total combine lenght of 3 discharge lines.)						
			2,856.92			*3,856.84*
Intake and Exhaust Systems	**1.00**	**EA**	**2,857**	**1,000**	**0**	**3,857**
			10,500.45			*14,175.60*
42" Couplings Installment	**8.00**	**EA**	**84,004**	**29,401**	**0**	**113,405**
			2,825,659.86			*3,814,640.81*
Electrical	**1.00**	**EA**	**2,825,660**	**988,981**	**0**	**3,814,641**
			604,456.35			*816,016.07*
Main Pump Motors & Pumps (Note: Incl.)	**4.00**	**EA**	**2,417,825**	**846,239**	**0**	**3,264,064**
			48,708.64			*65,756.66*
Transformers	**1.00**	**EA**	**48,709**	**17,048**	**0**	**65,757**
			28,070.92			*37,895.74*
Motor Control Center	**4.00**	**EA**	**112,284**	**39,299**	**0**	**151,583**
			10,263.67			*13,855.96*
Switchgear and Buswork	**1.00**	**EA**	**10,264**	**3,592**	**0**	**13,856**
			3,554.88			*4,799.09*
Capacitor Banks	**8.00**	**EA**	**28,439**	**9,954**	**0**	**38,393**
			306.99			*414.43*
350 MCM Service Conductor, 3 Runs and Neutral	**675.00**	**FT**	**207,217**	**72,526**	**0**	**279,743**
			922.42			*1,245.27*
Heater, Electric Space, Fan Powered, 5kW	**1.00**	**EA**	**922**	**323**	**0**	**1,245**
			53,191.26			*71,808.20*
Associated General Items	**1.00**	**EA**	**53,191**	**18,617**	**0**	**71,808**
			53,191.26			*71,808.20*
Site Work	**1.00**	**EA**	**53,191**	**18,617**	**0**	**71,808**
			61.49			*83.02*
Chain Link Fence	**865.00**	**LF**	**53,191**	**18,617**	**0**	**71,808**
			2,863,529.07			*3,579,411.33*
Planning, Engineering and Design	**1.00**	**EA**	**2,863,529**	**715,882**	**0**	**3,579,411**
			916,329.30			*1,145,411.63*
Construction Management	**1.00**	**EA**	**916,329**	**229,082**	**0**	**1,145,412**

Labor ID: EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.3

Appendix F

Real Estate Plan

APPENDIX

DRAFT
REAL ESTATE PLAN

BIG SUNFLOWER RIVER WATERSHED STUDY

QUIVER RIVER PROJECT

TALLAHATCHIE AND SUNFLOWER COUNTIES, MISSISSIPPI

DRAFT
REAL ESTATE PLAN

BIG SUNFLOWER RIVER WATERSHED STUDY
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DRAFT REAL ESTATE PLAN

Big Sunflower River Watershed Study
QUIVER RIVER PROJECT
TALLAHATCHIE AND SUNFLOWER COUNTIES, MISSISSIPPI

DATE: December 3, 2015

1. PROJECT PURPOSE AND AUTHORIZATION

The Mississippi River Delta has lost over 80% of its bottomland hardwood wetlands. The Quiver River system has historically been a part of an interconnected watershed providing unity throughout the basin. Widespread stream modifications due to flood risk management projects have greatly impacted aquatic resources throughout the Lower Mississippi River Alluvial Valley (LMRAV). Streams within the Yazoo Basin exhibit degraded ecosystem functions, little or no riparian habitats, poor water quality, low in-stream cover, low dissolved oxygen and increased temperatures during low flows, increased turbidity during high flows, reduced habitat complexity and reduced aquatic species richness and diversity.

Agriculture is the basis of the area economy. This agrarian based economy has contributed significantly to declining ground water levels in the alluvial aquifer. Aquifer depletion will contribute significantly to reduced food security in the future. Further, aquifer depletion will continue to increase and thus lead to more surface water loss in the basin.

This project has an environmental enhancement component and a water supply component. This project will reestablish water levels throughout the year to restore pools and riffles that support aquatic vegetation and fish and other species and restore riparian vegetation, principally bottomland hardwood. This multipurpose plan for irrigation will transfer water from the Tallahatchie River to the Quiver River by cutting outlets and creating weirs in New Cassidy and Black Bayous and excavating the transfer channel over a total of 41,700 linear feet. The project entails the construction of a pump station as well as reforestation of the Quiver River banklines. The project will also include nonstructural measures that do not require any real estate acquisition.

This Real Estate Plan (REP) is submitted as a preliminary plan which outlines the real estate interests required for the access to and construction of the proposed Project. The information contained herein is tentative in nature for planning purposes only. At the time the REP was prepared, the Project Delivery Team (PDT) had just reached the Tentatively Selected Plan (TSP) milestone, and feasibility level analysis was just beginning. Footprint maps which identify locations of access, staging, borrow and other project features are preliminary. The information contained within this REP is based on assumptions made by the PDT and estimated acreages of project features. This REP does not fully conform to the requirements of Chapter 12 (ER 405-1-12). Following agency decision regarding the selected plan, the PDT will begin feasibility level design. Once feasibility level analysis is complete, the REP will be revised to conform to Chapter 12 and will be an Appendix to the final Feasibility Report.

Project Authorization
Resolved by the Committee on Public Works of the United States Senate, That the Chief of Engineers. U.S. Army, is hereby requested to review the report on the Mississippi River and Tributaries Project contained in House Document No. 308, 88th Congress, 2nd Session, and other

reports with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time with reference to providing a plan for the development, utilization and conservation of water related land resources of the Yazoo Basin, including the backwater areas of the Mississippi and Yazoo Rivers. Such study should include appropriate considerations of the needs for flood protection, wise use of flood plain lands, bank stabilization, navigation facilities, regional water supply and waste water management facilities systems, general recreation facilities, enhancement and control of water quality, enhancement and conservation of fish and wildlife and other measures for the protection and enhancement of the environment. The study area is in Mississippi House of Representatives District #2 – Rep. Bennie Thompson; Senators Cochran and Wicker.

Figure 1 below shows the Big Sunflower River Watershed Study Area. The Quiver River originates in Tallahatchie County and meanders over 60 miles south before it's confluence with the Big Sunflower River, just north of U.S. Highway 82 in Sunflower County, Mississippi.

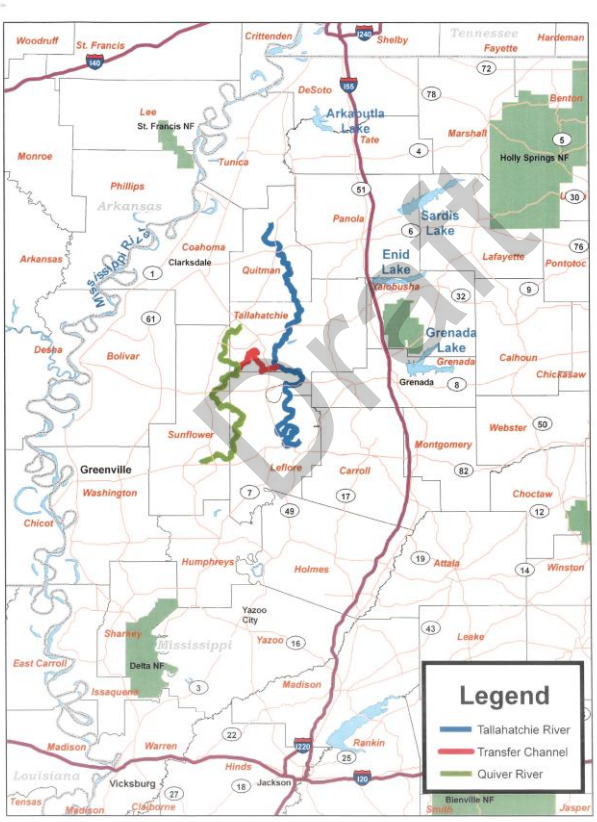


Figure 1 Big Sunflower River Watershed Study

Figure 2 below shows the Project Transfer Flows from Tallahatchie River proposed in this project.

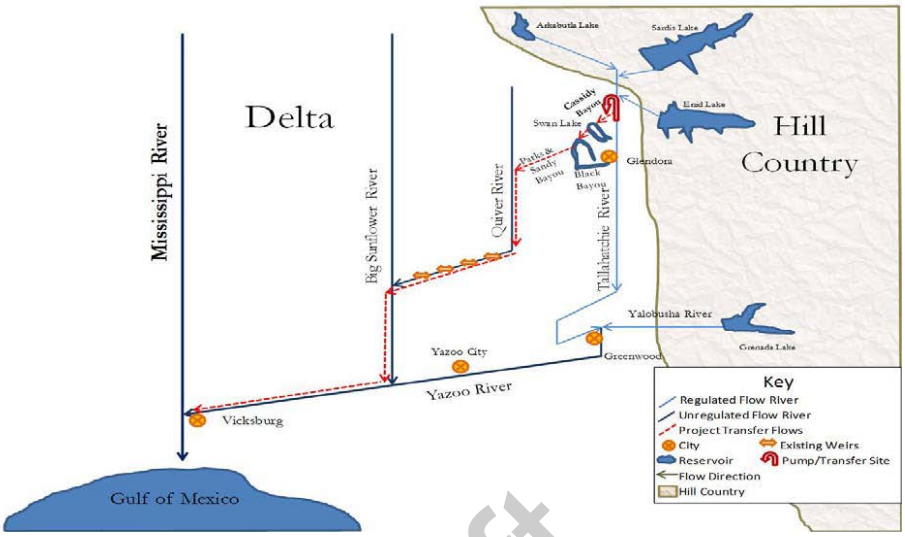


Figure 2 Project Transfer Flows from Tallahatchie River

2. LOCATION AND DESCRIPTION OF THE LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, AND DISPOSAL AREAS (LERRD'S) REQUIRED FOR THE PROJECT

The Quiver River is part of the Big Sunflower River and Yazoo River watersheds, originating in west-central Tallahatchie County and meandering more than 60 miles south through Tallahatchie, Sunflower and Leflore Counties.

The recommended plan (Alternative 6) requires construction of a pump station and channel which will allow flow of water from the Tallahatchie River to Quiver River through New Cassidy Bayou. This will allow for 100 cfs pump flow year round and up to 400 cfs for irrigation during summer season as long as channel has 100 cfs available. Outlet weirs would be installed on New Cassidy and Black Bayous in Tallahatchie County. Project includes 41,700 feet and 249,200 cyd of transfer channel excavation.

Real estate interests will be acquired for access, the pump station, new disposal sites, channel weir locations, construction areas, and planting areas. All property is agricultural land.

The following will be acquired in the Cassidy Bayou area (5 owners):

Perpetual Road Easement for access to site (5.77 acres)
Perpetual Channel Easement (includes Channel, Weir & Disposal Areas) (54.25 acres)
Fee (Proposed Pump Site) (11.73 acres)

The following will be acquired in the Black Bayou area (2 owners):

Perpetual Road Easement for access to site (4.02 acres)

Perpetual Channel Improvement Easement (includes Area for Weir) (22.70 acres)

Quiver River excavation will be on private water bottoms and a channel easement will be acquired, as well as a temporary work area easement for the disposal of the excavated materials. The location of these excavation and disposal areas has not been identified yet.

The project will reforest riparian stream banks with native bottom land hardwood species within 25 feet of both bank tops at several locations within Tallahatchie and Leflore Counties. Possible areas of reforestation are Cassidy Bayou, Fish Lake Outlet, Black Bayou, Sandy Bayou, Parks Bayou, Quiver River and Big Sunflower River. Actual locations have not been identified at this time. The District proposes the acquisition of a Bank Protection and Reforestation Easement. This subject will be addressed further in final REP.

3. NON-FEDERAL SPONSOR-OWNED LERRD'S

The Yazoo-Mississippi Delta (YMD) Joint Water Management District is the Non-Federal Sponsor (NFS). The sponsor does not own any lands needed for the project.

YMD Joint Water Management District is aware of the cost sharing requirements for potential project implementation and has signed a Letter of Intent, expressing strong support and willingness to continue as the NFS through construction and OMRR&R if the project is authorized and funded.

The cost of the NER (100cfs) plan will be cost shared at a 65% Federal and 35% NFS. Per ER 1105-2-100, Chapter 3.b.3, the NFS must pay all cost allocated to water supply purposes. Therefore, any cost above the 100CFS pump (NER) will be 100% funded by the NFS. In addition, the NFS will be responsible for acquisition of all lands, easements and rights of ways.

4. STANDARD ESTATES

Below is the language of the Standard Estates to be acquired. The land use in this project area is agricultural.

FEE

The fee simple title to (the land described in ____Schedule A) (Tracts Nos.___,___and___), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

ROAD EASEMENT

A (perpetual [exclusive] [non-exclusive] and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B);

subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY WORK AREA EASEMENT
A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

CHANNEL IMPROVEMENT EASEMENT
A perpetual and assignable right and easement to construct, operate, and maintain channel improvement works on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for the purposes as authorized by the Act of Congress approved_____, including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate: dredge, cut away, and remove any or all of said land and to place thereon dredge or spoil material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements far public roads and highways, public utilities, railroads and pipelines.

BANK PROTECTION & REFORESTATION EASEMENT (Non-Material Deviation Approval – See Exhibit D)
A perpetual and assignable easement and right-of-way in, on, over and across the land hereinafter described for the location, construction, operation, maintenance, alteration, repair, rehabilitation and replacement of a bank protection works, and for the planting of hardwood trees of native species of the project area for the protection of the bank against erosion and the enhancement of the habitats; together with the continuing right to trim, cut, fell, remove and dispose therefrom all trees, underbrush, obstructions, and other vegetation;; and to place thereon dredged, excavated or other fill material, to shape and grade said land to desired slopes and contour, and to prevent erosion by structural and vegetative methods and to do any other work necessary and incident to the project; together with the right of ingress and egress for such work; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired, but specifically prohibiting the landowner from cutting or removing any vegetation planted as a component of this project; subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines.

5. EXISTING FEDERAL PROJECT(S) WITHIN THE PROJECT AREA

There is only one Federal Project located in the immediate vicinity of LERRDs identified for acquisition for Quiver River; it is the Mississippi River & Tributaries, Yazoo Basin, Yazoo Headwater Project, Mississippi.

6. FEDERALLY-OWNED LANDS WITHIN (LERRD'S FOR) THE PROJECT

Within the fee limits shown for the northern pump site there is approximately 0.84 acre of LERRD that was acquired by the Corps in 2009. This land was acquired as Tract No. 2311E-1 for the Upper Yazoo Project (UYP) Item 7-C Channel Improvement Project, which is a component of the Federal Project listed above. The interest acquired is perpetual channel improvement easement which would be an encumbrance on the fee area.

On the southern weir site there is approximately 3.81 acres of LERRD acquired by the Corps in 1941. This area was acquired as Tract No. 105-1 for the Tallahatchie River Channel Improvement Lower Glendora Cut-Off (also part of the Federal Project above). The interest acquired is also perpetual channel improvement easement. The interest proposed to be acquired for the weir is also perpetual channel improvement easement. Therefore this area would be considered as previously acquired and no acquisition of the area would be necessary.

7. NAVIGATIONAL SERVITUDE

The navigation servitude is the "dominant right of the Government under the Commerce Clause of the U.S. Constitution to use, control and regulate the navigable waters of the United States and the submerged lands there under for various commerce-related purposed including navigation and flood control. In tidal areas, the servitude extends to all lands below the mean high water mark. In non-tidal areas, the servitude extends to all lands within the bed and banks of a navigable stream that lie below the ordinary high water mark."

In Mississippi, the State may (with some restrictions) pass title of beds and banks of navigable streams to private landowners, but the public retains the right to use the navigable waters for commerce, fishing and boating under the Public Trust Doctrine.

The Mississippi Code (51-1-1) defines Navigable Waters as all rivers, creeks and bayous in this State twenty-five miles in length, that have sufficient dept and width of water for thirty consecutive days in the year for floating a steamboat carrying a capacity of two hundred bales of cotton are declared navigable waters.

Mississippi follows the common law rule that riparian owners own the beds of navigable waters to the center of the stream, but navigable freshwaters have been historically available to the public for a variety of reasons.

Since these bayous and rivers within this project area are dry, we can assume for this study's purposes that we will need to purchase lands from seven landowners. The navigational servitude will not be invoked.

8. PROJECT MAPS

See Exhibit A.

9. INDUCED FLOODING

The construction of this Project will not induce flooding.

10. BASELINE COST ESTIMATES/CHART OF ACCOUNTS (COAs)

The total estimated real estate costs for this Project are $488,750. Below is a synopsis of the real estate costs:

Land Payments	$352,500
PL 91-646 Assistance Payment	$ 00
Acquisition Costs	$136,250
Total	$488,750

Acquisition costs include the costs of negotiations, appraisal, mapping, title search, condemnation, and processing the Non-Federal Sponsor's credit package. The real estate cost estimate includes a contingency. Estimated land payments are based on a cost estimate reviewed and approved at the District level with a date of value of September 23, 2015. A Baseline Cost Estimate of Accounts is included in Exhibit B.

11. RELOCATION ASSISTANCE BENEFITS

This Project does not displace residential, commercial, industrial, or habitable structures within Project boundaries; therefore, the provisions under Title II of Public Law 91-646, as amended, are not applicable.

12. TIMBER/MINERAL/ROW CROP ACTIVITY

Any timber value present is included in the overall appraised value of the land. The Government will not acquire mineral rights to the property. Project impacts agricultural lands, but it is assumed that the owner will be allowed to harvest crops prior to project construction.

13. PROJECT SPONSOR / NFS CAPABILITY ASSESSMENT

The Non-Federal Sponsor (NFS) will acquire all LERRDs for this Project. The NFS has condemnation authority, but does not have quick take authority. During the feasibility phase, discussions will take place between Real Estate, the NFS and Office of Counsel to determine how to manage condemnations. The NFS was advised of the Uniform Relocations Act requirements and requirements for documenting expenses for credit. The NFS's staff requires training regarding the requirements of PL91-646. That training will occur once the project is authorized by Congress, prior to initiating acquisition. The NFS is considered fully capable of meeting its

responsibilities of LER acquisition. A copy of the NFS's capability assessment is contained in Exhibit C.

14. ZONING IN LIEU OF ACQUISITION

Zoning ordinances will not be enacted to facilitate the acquisition of real estate interests in connection with this Project.

15. ACQUISITION SCHEDULE

The following Acquisition Schedule displays the tasks and durations required for acquisition of access to the Tallahatchie River, Black Bayou, Cassidy Bayou, Quiver River, channels, weir sites, pump site disposal areas, stream banks and restoration area. In the event that a title search reveals more than seven (7) impacted landowners, the Acquisition Schedule set forth below will need to be revised. (Construction of the Project is anticipated to take two years.) Below is an estimated 21- month Acquisition Schedule assuming that condemnation could be necessary for one ownership.

1) Non-Federal Sponsor Will Obtain Mapping	1 month
2) Non-Federal Sponsor Will Obtain Title Information	2 months
3) Non-Federal Sponsor Will Obtain Appraisals	2 months
(Can be concurrent with title)	
4) Non-Federal Sponsor Will Negotiate Acquisition	3 - 4 months
5) Closing	2 months
6) Condemnation (if necessary)	12 months
7) Issuance of Right-of-Entry by NFS	1 month

16. FACILITY/UTILITY RELOCATIONS

There are no facility/utility relocations associated with this project.

17. ENVIRONMENTAL CONSIDERATIONS

Environmental investigations are not complete. Environmental studies will be completed prior to preparation of the final Feasibility Report.

18. LANDOWNER CONCERNS

The Non-Federal Sponsor does not expect opposition from the landowners of the Quiver River Project. The Acquisition Schedule includes time for condemnation in order to provide a worst-case scenario for planning purposes.

19. NON-FEDERAL SPONSOR NOTIFICATION OF RISKS

Prior to completion of the final REP and final Feasibility Report, the Non-Federal Sponsor will be provided a letter outlining the risks of initiating acquisition activities prior to project authorization and design completion.

20. OTHER RELEVANT REAL ESTATE ISSUES

None

The completed Checklist is attached to the REP as Exhibit E.

PREPARED BY:

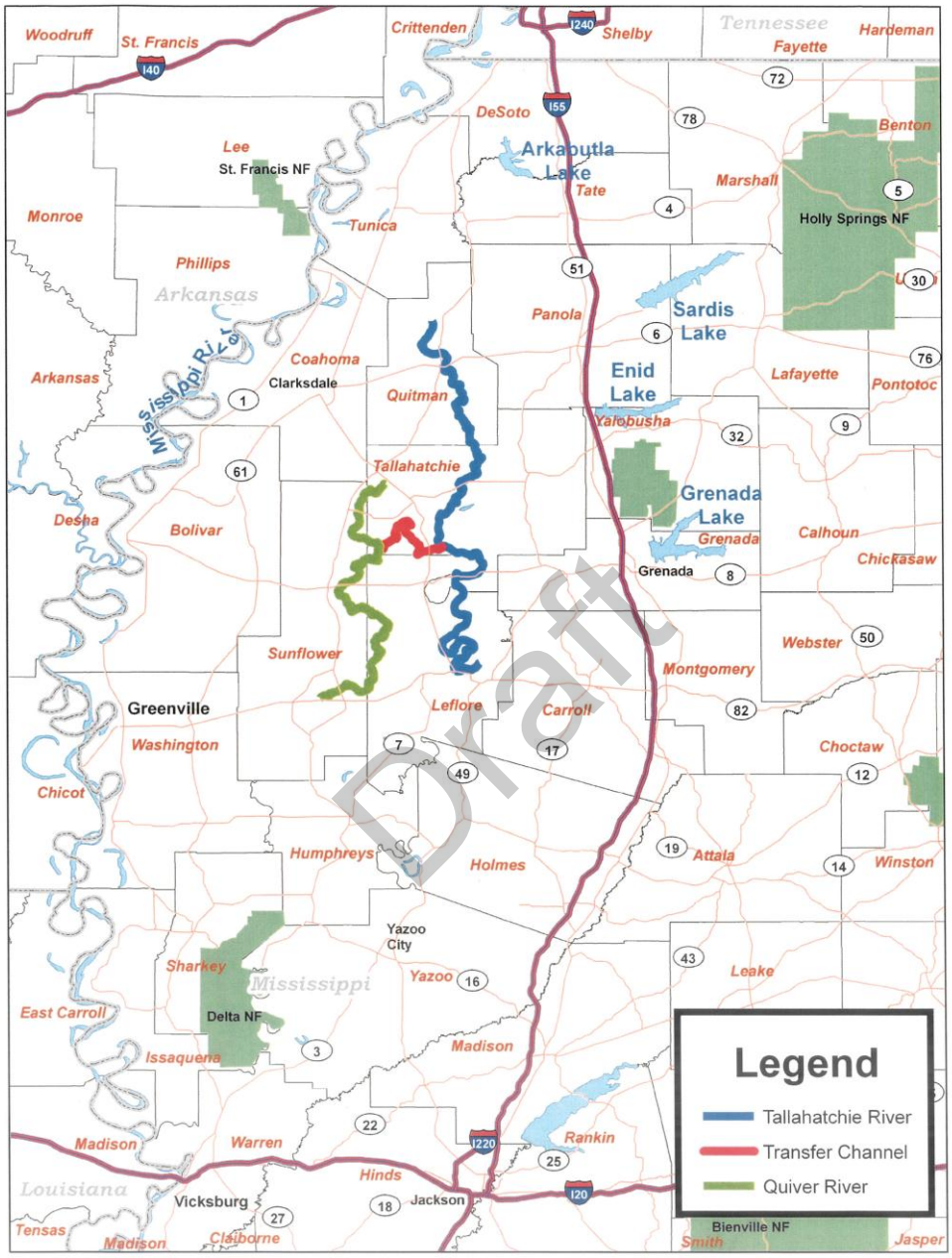
_____
Pamela M. Fischer
Realty Specialist

REVIEWED AND RECOMMENDED BY:

_____
Judith Y. Gutierrez
Chief, Planning and Appraisal

DATED: December 3, 2015

EXHIBIT A – MAPS



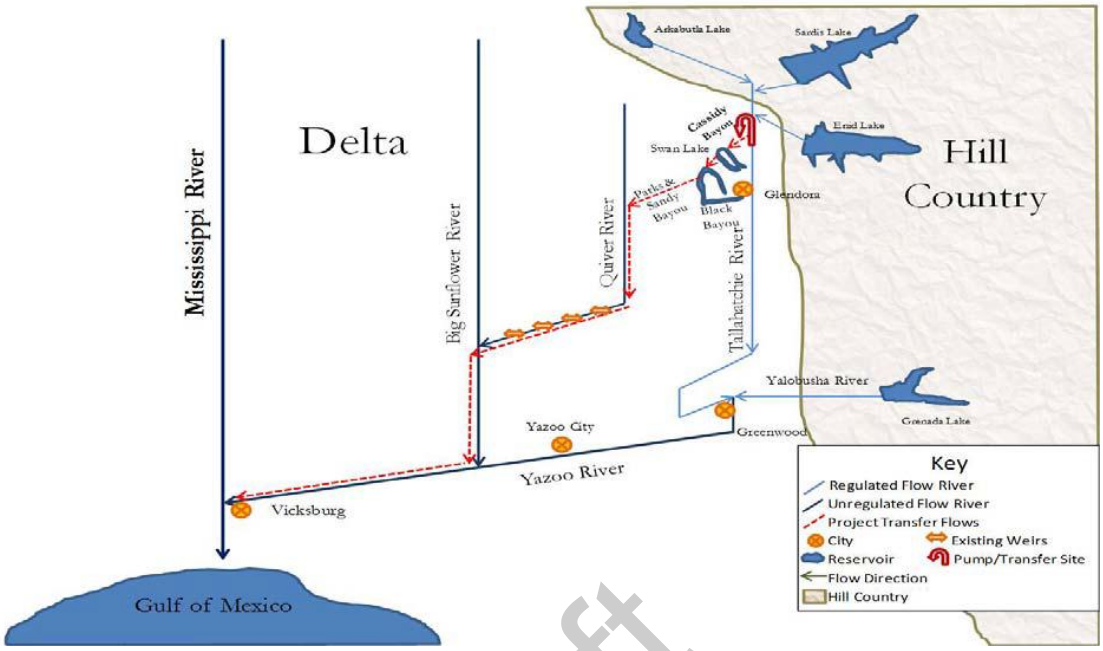

Delta
Hill Country
Mississippi River
Big Sunflower River
Quiver River
Tallahatchie River
Yalobusha River
Parks & Sandy Bayou
Black Bayou
Cassidy Bayou
Swan Lake
Glendora
Greenwood
Yazoo City
Yazoo River
Vicksburg
Gulf of Mexico
Arkabutla Lake
Sardis Lake
Enid Lake
Grenada Lake
Key
Regulated Flow River
Unregulated Flow River
Project Transfer Flows
City
Existing Weirs
Reservoir
Pump/Transfer Site
Flow Direction
Hill Country

EXHIBIT B
CHART OF ACCOUNTS

CEMVN-RE-E
REAL ESTATE DIVISION

Big Sunflower River Watershed Study
Quiver River Project
Exhibit B - CHART OF ACCOUNTS

						AMOUNT	CONTINGENCY	PROJECT COST
							ROUNDED	489,000
	TOTAL PROJECT COSTS					391,000	97,750	488,750
01	LANDS AND DAMAGES		CONTINGENCY	PROJECT COST	391,000		97,750	488,750
01B	ACQUISITIONS							
01B10	BY GOVERNMENT	0	0	0				
01B20	BY NON-FEDERAL SPONSOR (NFS)	51,000	12,750	63,750				
01B30	BY GOVT ON BEHALF OF LS	0	0	0				
01B40	REVIEW OF LS	27,000	6,750	33,750				
01C	CONDEMNATIONS							
01C10	BY GOVERNMENT	0	0	0				
01C20	BY LS	10,000	2,500	12,500				
01C30	BY GOVT ON BEHALF OF LS	0	0	0				
01C40	REVIEW OF LS	0	0	0				
01E	APPRAISAL							
01E10	BY GOVT (IN HOUSE)	0	0	0				
01E20	BY GOVT (CONTRACT)	0	0	0				
01E30	BY LS	14,000	3,500	17,500				
01E40	BY GOVT ON BEHALF OF LS	0	0	0				
01E50	REVIEW OF LS	7,000	1,750	8,750				
01F	PL 91-646 ASSISTANCE							
01F10	BY GOVERNMENT	0	0	0				
01F20	BY LS	0	0	0				
01F30	BY GOVT ON BEHALF OF LS	0	0	0				
01F40	REVIEW OF LS	0	0	0				
01G	TEMPORARY PERMITS/LICENSES/RIGHTS-OF-ENTRY							
01G10	BY GOVERNMENT	0	0	0				
01G20	BY LS	0	0	0				
01G30	BY GOVT ON BEHALF OF LS	0	0	0				
01G40	REVIEW OF LS	0	0	0				
01G50	OTHER	0	0	0				
01G60	DAMAGE CLAIMS	0	0	0				
01N00	FACILITY/UTILITY RELOCATIONS (Subordination Agreement)							

CEMVN-RE-E
REAL ESTATE DIVISION

Big Sunflower River Watershed Study
Quiver River Project
Exhibit B - CHART OF ACCOUNTS

01R	**REAL ESTATE PAYMENTS**							
01R1	**LAND PAYMENTS**							
01R1A	BY GOVERNMENT	0	0	0				
01R1B	BY LS	282,000	70,500	352,500				
01R1C	BY GOVT ON BEHALF OF LS	0	0	0				
01R1D	REVIEW OF LS	0	0	0				
01R2	**PL 91-646 ASSISTANCE PAYMENTS**							
01R2A	BY GOVERNMENT	0	0	0				
01R2B	BY LS	0	0	0				
01R2C	BY GOVT ON BEHALF OF LS	0	0	0				
01R2D	REVIEW OF LS	0	0	0				
01R3	**DAMAGE PAYMENTS**							
01R3A	BY GOVERNMENT	0	0	0				
01R3B	BY LS	0	0	0				
01R3C	BY GOVT ON BEHALF OF LS	0	0	0				
01R3D	REVIEW OF LS	0	0	0				
01R9	**OTHER**	0	0	0				
01T	**LERRD CREDITING**							
01T20	ADMINISTRATIVE COSTS (By Gov't and L.S.)	0	0	0				

EXHIBIT C
Big Sunflower River Watershed Study
Quiver River Project
Tallahatchie and Sunflower Counties, Mississippi
Assessment of Non-Federal Sponsor's
Real Estate Acquisition Capability
(Yazoo-Mississippi Delta (YMD) Joint Water Management District)

I. Legal Authority:
a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?

Yes, the Non-Federal sponsor, the YMD Joint Water Management District, has legal authority to acquire and hold title to real property for project purposes.
The YMD Joint Water Management District is a joint water management district created under Title 51, Chapter 8 of the Mississippi Code. Under Miss. Code Ann. § 51-8-31, subsection (b), any district created pursuant to Chapter 8 has the power "to acquire by purchase, gift, devise, lease or any other mode of acquisition, and to hold or dispose of, real and personal property of every kind within or without the district."
In light of the statutory language provided above, the YMD Joint Water Management District is fully capable of acquiring and holding real property for this project's purposes.
b. Does the sponsor have the power of eminent domain for this project?

Yes, YMD Joint Water Management District has the power of eminent domain that can be used for this project. Article VI of YMD Joint Water Management District's Charter is entitled "Eminent Domain." This Article provides that the YMD Joint Water Management District's Board of Commissioners possess the eminent domain powers provided by Miss. Code Ann. § 11-27-1, which reads as follows:
"Any person or corporation having the right to condemn private property for public use shall exercise that right as provided in this chapter, except as elsewhere specifically provided under the laws of the state of Mississippi."
Article VI also provides that the YMD Joint Water Management District's Board of Commissioners has powers of eminent domain under "other applicable state laws." The Article further states that the eminent domain power shall be exercised "only when public necessity and convenience so require, for the following specified purposes: acquiring land or other property for temporary or permanent easements or rights-of-way, and for construction, maintenance, repair, improvement or extension of facilities or special water supply or pollution abatement projects."
The YMD Joint Water Management District is a joint water management district created under Title 51, Chapter 8 of the Mississippi Code. Miss. Code Ann. § 51-8-33 authorizes the exercise of eminent domain by joint water management districts. The Mississippi [2]

Attorney General clarified that the eminent domain power under § 51-8-33 pertains to the powers set forth in Miss. Code Ann. §§ 11-27-1 through 11-27-51. See A.G. Op. #2000-0635, Applewhite, October 27, 2000. Those Sections outline the procedures necessary to allow for an eminent domain taking, including filing a complaint, determining the land's value, and providing just compensation.

In consideration of the authority above, the YMD Joint Water Management District possesses the eminent domain power necessary for use in this project, as the purpose and goals of this project are parallel to those set forth under Article VI of the YMD Joint Water Management District Charter.

c. Does the sponsor have "quick take authority for this project?

No, YMD does not possess "quick-take" authority that can be used for this project. In general, Mississippi allows certain organizations to expedite the process under its "quick take", or right to immediate possession statutes found in Miss. Code Ann. §§ 11-27-81 through 11-27-91. However, it appears that water management districts, like the YMD Joint Water Management District, are restricted from using these "quick take" powers. The Mississippi Attorney General has opined that water management districts were not one of the specifically enumerated entities allowed to exercise "quick take" eminent domain powers, and therefore they do not possess the ability to exercise "quick-take" eminent domain. See A.G. Op. #2000-0635, Applewhite, October 27, 2000.

Further, it does not appear that the counties comprising the YMD Joint Water Management District will be able to exercise their "quick-take" eminent domain powers on behalf of the YMD Joint Water Management District. In the Attorney General Opinion mentioned in the previous paragraph, the Mississippi Attorney General first agreed that the county or municipal members are authorized to exercise "quick take" eminent domain. However, the Attorney General went on to opine that allowing a member to exercise its "quick take" powers on behalf of an entity without such powers would "circumvent the intent of § 11-27-81." See A.G. Op. #2000-0635, Applewhite, October 27, 2000.

In light of the authorities outlined above, the YMD Joint Water Management District, in addition to its member counties, will not be able to exercise "quick-take" eminent domain powers in connection with this project.

d. Are any of the land/interests in land required for the project located outside the sponsor's political boundary?

No, none of the lands and/or interests in land required for this project are located outside of the YMD Joint Water Management District's political boundary. Under Article III of its Charter, the YMD Joint Water Management District covers the "geological unit known as the Yazoo-Mississippi River Alluvial and Deltaic Plain," which includes all or parts of the following Mississippi counties: Bolivar, Carroll, Coahoma, DeSoto, Holmes, Humphreys, Issaquena, Leflore, Panola, Quitman, Sharkey, Sunflower, Tallahatchie, Tate, Tunica, Warren, Washington, and Yazoo. [3]

The Quiver River originates in west-central Tallahatchie County and meanders south through parts of Leflore, Sunflower, and Tallahatchie Counties. The Tallahatchie River runs through portions of Leflore, Quitman, and Tallahatchie Counties. The majority of the transfer channel proposed for this project is contained in Tallahatchie County. Each of the counties contemplated above fall within the YMD Joint Water Management district and each have a presence on the YMD Joint Water Management District's Board of Commissioners.

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?

Yes, as referenced in Sections 5 and 6 of the Real Estate Plans, there are small areas of land and/or interests in land located within the project area that the YMD Joint Water Management District cannot condemn.

The first area is located within the fee limits listed for the northern pump site. This area is comprised of approximately 0.84 acres of federally-owned land that was acquired by the Corps of Engineers in 2009 as Tract No. 2311E-1 for the Upper Yazoo Project Item 7-C Channel Improvement Project. This is a component of the federally-run Mississippi River & Tributaries, Yazoo Basin, Yazoo Headwater, Mississippi project. The interest acquired is a perpetual channel improvement easement, which would be an encumbrance on the fee area.

The second area is located on the southern weir site. The area is comprised of approximately 3.81 acres acquired by the Corps of Engineers in 1941 as Tract No. 105-1 for the Tallahatchie River Channel Improvement Lower Glendora Cut-Off, which is also a component of the federally-run project mentioned in the previous paragraph. The interest acquired is a perpetual channel improvement easement, as is the interest proposed to be acquired for the weir. Therefore, this area would be considered as previously acquired and no acquisition of the area would be necessary.

As outlined in Section I, subsection b of this Exhibit, the YMD Joint Water Management District has eminent domain power that allow it to condemn private property for public use under Miss. Code Ann. §§ 11-27-1 through 11-27-51. However, this power only extends to private lands, and not the federally-acquired property discussed above. Therefore, the YMD Joint Water Management District cannot condemn those portions of property discussed above, in accordance with this project.

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended?

Yes, the sponsor requests training for in-house staff to become familiar with the real estate requirements of Federal projects. [4]

b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training?

No, the sponsor is willing to work with the USACE to develop a reasonable plan to receive such training in a timely manner to meet project goals and timelines.

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

Yes, in-house counsel for the YMD Joint Water Management District has sufficient real estate acquisition experience to meet the YMD Joint Water Management District's responsibilities associated with this project. In-house counsel for the YMD Joint Water Management District has been a licensed attorney in the State of Mississippi for almost forty (40) years. Counsel has had experience with real estate acquisition and will be able to provide the necessary skill, guidance, and legal expertise to accomplish any real estate acquisition tasks that this project may require.

d. **Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the projected schedule**?

Yes, the YMD Joint Water Management District's projected in-house staffing is at a level that is sufficient considering its other workload and the schedule of this project. This project is one of the YMD Joint Water Management District's main goals, and the YMD Joint Water Management District will ensure that it maintains a sufficient level of in-house staff for the duration of the project.

e. Can the sponsor obtain contractor support, if required in a timely fashion?

Yes, if required, the YMD Joint Water Management District can obtain contractor support in a timely fashion. Under Miss. Code Ann. § 51-8-31(c), the YMD Joint Water Management District has the power to "make and enter into contracts, conveyances, mortgages, deed of trust, bonds, leases or contracts for financial advisory services." Additionally, the YMD Joint Water Management District has been a functioning agency for nearly twenty-five (25) years, affording it numerous contracting contacts that may be useful to this project. In light of this information above, the YMD Joint Water Management District has both the power and the contacts to obtain contractor support in a timely fashion, if required to do so by this project.

f. Will the sponsor likely request USACE assistance in acquiring real estate?

No, the YMD Joint Water Management District will not likely request USACE assistance in acquiring real estate.

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

Yes, the YMD Joint Water Management District's staff will be located within a reasonable proximity to the project site. The offices of the YMD Joint Water [5]

Management District are located off of Stoneville Road in Stoneville, Mississippi. These offices are also located in the northeastern portion of Washington County, Mississippi.

The Stoneville office is located within approximately eighty (80) miles of the Tallahatchie River and approximately forty (40) miles of the Quiver River. This location, in addition to the fact that the YMD Joint Water Management District staff live in locations close to both rivers, place the YMD Joint Water Management District in a reasonable proximity to the location of the transfer channel contemplated by this project.

b. Has the sponsor approved the project/real estate schedule/milestones?

Yes, the sponsor approves of the tentative acquisition schedule as described in Section 15 of the Draft Real Estate Plan for the Quiver River Project. YMD will work with the USACE to develop a finalized acquisition schedule at the appropriate time.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?

Yes, the YMD Joint Water Management District has performed satisfactorily on a previous USACE project, The Coldwater River Watershed Project (2003). YMD has also performed satisfactorily by working and coordinating the USACE on the Feasibility Study for the Quiver River Project.

b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable.

YMD anticipates being fully capable of performing the duties and requirements as the local sponsor in order to meet project goals and timelines.

V. Coordination:

a. Has this assessment been coordinated with the sponsor?

Yes, YMD has discussed and coordinated with the USACE to properly address the questions in this assessment.

b. **Does the sponsor concur with this assessment?**

Yes, the sponsor concurs with this assessment.

Prepared by:	Agreed:	Approved by:
Pamela Fisher Realty Specialist	Dean Pennington Sponsor	Judith Y. Gutierrez Chief, Planning & Appraisal

EXHIBIT D
BANK PROTECTION AND REFORESTATION EASEMENT

BANK PROTECTION & REFORESTATION EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across the land hereinafter described for the location, construction, operation, maintenance, alteration, repair, rehabilitation and replacement of a bank protection works, and for the planting of hardwood trees of native species of the project area for the protection of the bank against erosion and the enhancement of the habitats; together with the continuing right to trim, cut, fell, remove and dispose therefrom all trees, underbrush, obstructions, and other vegetation;; and to place thereon dredged, excavated or other fill material, to shape and grade said land to desired slopes and contour, and to prevent erosion by structural and vegetative methods and to do any other work necessary and incident to the project; together with the right of ingress and egress for such work; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired, but specifically prohibiting the landowner from cutting or removing any vegetation planted as a component of this project; subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines.

In accordance with paragraph 12-10 c. of ER 405-1-12, the District Chief of Real Estate may approve a non-standard estate if it serves the intended project purpose, substantially conforms with and does not materially deviate from a corresponding standard estate, and does not increase the costs or potential liability of the Government. The foregoing estate complies with those requirements as it achieves the project purpose in as narrow a manner as practical, does not increase the cost or potential liability of the Government, and is a minor modification of the standard Bank Protection Easement, replacing the words "placement of stone, riprap and other materials" with the words "planting of hardwood trees of native species of the project area" and adding the words "for the enhancement of the habitats" and "specifically prohibiting the landowner from cutting or removing any vegetation planted as a component of this project." This is considered a non-material deviation to the standard estate.

Reviewed by:

CHENNAULT.CARL.K.1230845081
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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CHENNAULT.CARL.K.1230845081
Date: 2015.12.04 14:50:22 -06'00'

Ken Chennault
Assistant District Counsel
Vicksburg District

Approved by:

WOOD.ROBERT.S.1230838182
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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=WOOD.ROBERT.S.1230838182
Date: 2015.12.07 10:36:31 -06'00'

Robert Wood
Chief, Real Estate Region South Division

EXHIBIT E

Quality Control Plan Checklist

ER 405-1-12, Section 12-16, Real Estate Handbook, 1 May 1998

A Real Estate Plan (REP) is prepared in support of a decision document for full-Federal or cost shared specifically authorized or continuing authority projects. It identifies and describes lands, easements and rights-of-way (LER) required for the construction, operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of a proposed project including requirements for mitigation, relocations, borrow material, and dredged or excavated material disposal. It also identifies and describes facility/utility relocations, LER value, and the acquisition process. The REP does not just cover LER to be acquired by the Non-Federal Sponsor (NFS) or Government. The report covers all LER needed for the project, including LER already owned by the NFS, Federal Government, other public entities, or subject to the navigation servitude.

The REP must contain a detailed discussion of the following 20 topics, as set out in Section 12-16 of the ER, including sufficient description of the rationale supporting each conclusion presented. If a topic is not applicable to the project, this should be stated in the REP. The pages of a REP should be numbered.

PROJECT Big Sunflower River Watershed Study, Quiver River Project

REPORT TITLE Draft Feasibility Study

Date of Report December 3, 2015 **Date of REP** December 3, 2015

1. **Purpose of the REP** √

a. Describe the purpose of the REP in relation to the project document that it supports.
b. Describe the project for the Real Estate reviewer.
c. Describe any previous REPs for the project.

2. **Describe LER** √

a. Account for all lands, easements, and rights-of-way underlying and required for the construction, OMRR&R of the project, including mitigation, relocations, borrow material and dredged or excavated material disposal, whether or not it will need to be acquired or will be credited to the NFS.
b. Provide description of total LER required for each project purpose and feature.
c. Include LER already owned by the Government, the NFS and within the navigation servitude.
d. Show acreage, estates, number of tracts and ownerships, and estimated value.
e. Break down total acreage into fee and the various types and durations of easements.
f. Break down acreage by Government, NFS, other public entity, and private ownership, and lands within the navigation servitude.

3. **NFS-Owned LER** √

a. Describe NFS-owned acreage and interest and whether or not it is sufficient and available for project requirements.
b. Discuss any crediting issues and describe NFS views on such issues.

4. Include any proposed **Non-Standard/Standard Estates** √

a. Use Standard Estates where possible.
b. Non-standard estates must be approved by HQ to assure they meet DOJ standards for use in condemnations.
c. Provide justification for use of the proposed non-standard estates.

d. Request approval of the non-standard estates as part of document approval.

e. If the document is to be approved at MSC level, the District must seek approval of the non-standard estate by separate request to HQ. This should be stated in the REP.

f. Exception to HQ approval is District Chiefs of RE approval of non-standard estate if it serves intended project purposed, substantially conforms with and does not materially deviate from the standard estates found in the RE Handbook, and does not increase cost or potential liability to the Government. A copy of this approval should be included in the REP. (See Section 12-10c. of RE 405-1-12)

g. Although estates are discussed generally in topic 2, it is a good idea to also state in this section which standard estates are to be acquired and attach a copy as an appendix. The duration of any temporary estates should be stated.

5. **Existing Federal Projects** √

a. Discuss whether there is any existing Federal project that lies fully of partially within LER required for the project.

b. Describe the existing project, all previously-provided interests that are to be included in the current project, and identify the sponsor.

c. Interest in land provided as an item of local cooperation for a previous Federal project is not eligible for credit.

d. Additional interest in the same land is eligible for credit.

6. **Federally-Owned Lands** √

a. Discuss whether there is any Federally-owned land included within the LER required for the project.

b. Describe the acreage and interest owned by the Government.

c. Provide description of the views of the local agency representatives toward use of the land for the project and issues raised by the requirement for this land.

7. **Navigation Servitude** √

a. Identify LER required for the project that lies below the Ordinary High Water Mark, or Mean High Water Mark, as the case may be, of a navigable watercourse.

b. Discuss whether navigation servitude is available

c. Will it be exercised for project purposes? Discuss why or why not.

d. Lands over which the navigation servitude is exercised are not to be acquired nor eligible for credit for a Federal navigation or flood control project or other project to which a navigation nexus can be shown.

e. See paragraph 12-7 of ER 405-1-12.

8. **Map** √

a. An aid to understanding

b. Clearly depicting project area and tracts required, including existing LER, LER to be acquired, and lands within the navigation servitude.

c. Depicts significant utilities and facilities to be relocated, any known or potential HTRW lands.

9. **Induced Flooding** can create a requirement for real estate acquisition √

a. Discuss whether there will be flooding induced by the construction and OMRR&R of the project.

b. If reasonably anticipated, describe nature, extent and whether additional acquisition of LER must or should occur.

c. Physical Takings Analysis (separate from the REP) must be done if significant induced flooding anticipated considering depth, frequency, duration, and extent of induced flooding.

. d. Summarize findings of Takings Analysis in REP. Does it rise to the level of a taking for which just compensation is owed?

10. **Baseline Cost Estimate** as described in paragraph 12-18 √

a. Provides information for the project cost estimates.

b. Gross Appraisal includes the fair market value of all lands required for project construction and OMRR&R.

c. PL 91-646 costs

d. Incidental acquisition costs

e. Incremental real estate costs discussed/supported.

f. Is Gross Appraisal current? Does Gross Appraisal need to be updated due to changes in project LER requirements or time since report was prepared?

11. **Relocation Assistance Benefits** Anticipated √

a. Number of persons, farms, and businesses to be displaced and estimated cost of moving and reestablishment.

b. Availability of replacement housing for owners/tenants

c. Need for Last Resort Housing benefits

d. Real Estate closing costs

e. See current 49 CFR Part 24

12. **Mineral Activity** √

a. Description of present or anticipated mineral activity in vicinity that may affect construction, OMRR&R of project.

b. Recommendation, including rationale, regarding acquisition of mineral rights or interest, including oil or gas.

c. Discuss other surface or subsurface interests/timber harvesting activity

d. Discuss effect of outstanding 3rd party mineral interests.

e. Does estate properly address mineral rights in relation to the project?

13**. NFS Assessment** √

a. Assessment of legal and professional capability and experience to acquire and provide LER for construction, OMRR&R of the Project.

b. Condemnation authority

c. Quick-take capability

d. NFS advised of URA requirements

e. NFS advised of requirements for documenting expenses for credit.

f. If proposed that Government will acquire project LER on behalf of NFS, fully explain the reasons for the Government performing work.

g. A copy of the signed and dated Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability (Appendix 12-E) is attached to the REP.

14. **Zoning** in Lieu of Acquisition √

a. Discuss type and intended purpose

b. Determine whether the proposed zoning proposal would amount to a taking for which compensation will be due.

15**. Schedule** √

a. Reasonable and detailed Schedule of land acquisition milestones, including LER certification.

b. Dates mutually agreed upon by Real Estate, PM, and NFS. _____

16. **Facility or Utility Relocations** √

a. Describe the relocations, identity of owners, purpose of facilities/utilities, whether owners have compensable real property interest.

b. A synopsis of the findings of the Preliminary Attorney's Investigation and Report of Compensable Interest is included in the REP as well as statements required by Sections 12-17c.(5) and (6).

c. Erroneous determinations can affect the accuracy of the project cost estimate and can confuse Congressional authorization.

d. Eligibility for substitute facility

1. Project impact

2. Compensable interest
3. Public utility or facility
4. Duty to replace
5. Fair market value too difficult to determine or its application would result in an injustice to the landowner or the public.

e. See Sections 12-8, 12-17, and 12-22 of ER 405-1-12.

17. **HTRW** and Other Environmental Considerations √

a. Discussion the impacts on the Real Estate acquisition process and LER value estimate due to known or suspected presence of contaminants.

b. Status of District's investigation of contaminants.

c. Are contaminants regulated under CERCLA, other statues, or State law?

d. Is clean-up or other response required of non-CERCLA regulated material?

e. If cost share, who is responsible for performing and paying cost of work?

f. Status of NEPA and NHPA compliances

g. See ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects.

18. **Landowner Attitude** √

a. Is there support, apathy, or opposition toward the project?

b. Discuss any landowner concerns on issues such as condemnation, willing seller provisions, estates, acreages, etc.?

19. A statement that the **NFS has been notified in writing about the risks of acquiring LER before the execution of the PPA**. √ If not applicable, so state. _____

20. **Other Relevant Real Estate Issues**. Anything material to the understanding of the RE aspects of the project. _____

A copy of the completed Checklist is attached to the REP √
(Draft REPs must contain a draft checklist and draft Technical Review Guide)

I have prepared and thoroughly reviewed the REP and all information, as required by Section 12-16 of ER 405-1-12, is contained in the Plan.

Pamela Frink December 3, 2015

_____ _____
Preparer Date

A copy of the Real Estate Internal Technical Review Guide for Civil Works Decision Documents is attached and signed by me as the Reviewer

Judith Y. Gutiérrez December 3, 2015

_____ _____
RE Internal Technical Reviewer Date

The REP has been signed and dated by the Preparer and the District Chief of Real Estate. √

Appendix G

404(b)1 Water Quality Analysis

QUIVER RIVER RESTORATION PROJECT
Section 404(b)(1) Evaluation

The following short form 404(b)(1) evaluation follows the format designed by the Office of the Chief of Engineers. As a measure to avoid unnecessary paperwork and to streamline regulation procedures while fulfilling the spirit and intent of environmental statues, the US Army Corps of Engineers, New Orleans District (CEMVN) is using this format for all proposed project elements requiring a 404(b)(1) evaluation, but involving no adverse significant impacts.

PROJECT DESCRIPTION. The Quiver River lies in the Delta region of northwestern Mississippi. Historically, the Quiver River was a low gradient, meandering river with riparian corridors, instream cover and enough year-round flow to provide habitat for a variety of mussel and fish species. Water withdrawals, primarily for irrigation, now limit stream flow in the late summer and early fall and have degraded aquatic habitat quality and quantity. Loss of instream cover and riparian vegetation also impact habitat quality. Twenty-four mussel species are found in the river now, but over 40 species may have historically occurred in the river. Forty-three fish species now occur in the Quiver River, but up to 80 may have occurred.

Groundwater provided base flow in the streams during low water periods (Speer et al. 1964). Water withdrawals for irrigation deplete water in the Quiver River and the alluvial aquifer. Aquifer depletion is the primary reason for the loss of perennial flow in delta streams during periods of the year with no precipitation. Depletion of the alluvial aquifer threatens the economic viability of agriculture in the area.

Loss of riparian vegetation, especially bottomland hardwoods, has also degraded the aquatic habitat. Between 1950 and 1976, approximately one-third of the lower Mississippi alluvial valley's bottomland forests were cleared for agriculture and by the 1980's less than 20% of the original forested wetlands remained (Klimas 1988, Stanturf et al. 2000, Gardiner et al. 2005, King et al. 2006).

The main purpose of the study is to restore aquatic habitat to the Quiver River and consider compatible opportunities to provide agricultural water supply.

The main goals of the project are to restore the degraded aquatic and riparian ecological processes in the Quiver River, Cassidy, Black, Parks and Sandy Bayous, and Swan Lake; provide a more reliable water source for agriculture and aquaculture; and improve the reliability of the alluvial aquifer to be a long-term source for regional water supply.

In order to meet the goals, several objectives were set up by the PDT. Restore fish and mussel habitat in the Quiver River. Increase average wetted perimeter in the Quiver River connector channels. Restore bottomland hardwood habitat in the floodplain. Provide reliable water supply for agriculture.

The Tentatively Selected Plan (TSP) is the locally preferred plan (LPP) - Alternative 5, which is a multipurpose NER/Water Supply plan (NER 100 cfs and up to 400 cfs for irrigation). Alternative 5 maximizes ecosystem restoration benefits compared to costs and is consistent with the Federal objectives. This alternative also allows the non-Federal sponsor to provide a reliable water source of irrigation and reduce further depletion from the alluvial aquifer. Alternative five would transfer 400 cfs of water from the Tallahatchie River to the Quiver River. For those landowners willing to participate in reforestation efforts, it would also plant trees on approximately 100 acres. The Mississippi Department of Environmental Quality committed to regulate the extraction of surface water out of Quiver River to ensure a 100 cfs minimum ecological flow.

This alternative would build a pumping station on the Tallahatchie River approximately 2 miles north of Sharkey, MS. The station would have the capacity to pump 400 cfs from the Tallahatchie River. The station would house two 100 cfs pumps and one 200 cfs pump so that it can deliver 300 cfs for irrigation and ecological purposes, but only 100 cfs when it is only needed to maintain the minimum flow. A 1,500 foot long channel would be excavated (63,000 cubic yards) to connect the pump station to Cassidy Bayou. Water would flow from Cassidy Bayou into Swan Lake. Water would flow from Swan Lake to Black Bayou, then to Sandy Bayou and then Parks Bayou, and finally into the Quiver River approximately 2.5 miles northeast of Brooks, MS. This alternative will require new weirs in Cassidy and Black Bayou so that water can reach the required water surface elevation without flowing back into the Tallahatchie. At Black Bayou 2.5 acres will be cleared to construct the weir and 1.7 acres will be cleared at the Cassidy Bayou site.

In Parks and Sandy Bayous, some channel blockages and sediment deposits will have to be removed to allow 300 cfs to pass. This will include up to 38,600 ft and 191,700 cy of channel work.

For any landowner willing to participate in reforestation, they will have the opportunity to replant bottomland hardwoods on any area cleared for construction and along the streambanks in areas where conservation easements are acquired; 100 acres of tree planting is anticipated.

The pumping station would be operated to ensure 100 cfs is maintained in the Quiver River. Water transfer to meet the ecological minimum flows are most likely in September and October, but some may also be needed in August and November. During October, nearly all of the 100 cfs will be needed to maintain the minimum flow. Irrigation season generally extends from May to August and water can be withdrawn from the system as long as the 100 cfs minimum flow is maintained. Operation of the pump is not likely from December through April when the extra water is not needed for irrigation or ecological flows. It is assumed the pump cannot be regulated to deliver increments less than 100 cfs.

The following programs would also be available: USDA agencies would work with landowners to implement projects that would benefit habitat in the area and provide

some aquifer protection. The Farm Service Agency (FSA) manages the Farmable Wetlands Program. The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. By restoring farmable wetlands, FWP improves groundwater quality, helps trap and break down pollutants, prevents soil erosion, reduces downstream flood damage, and provides habitat for water birds and other wildlife. FSA administers the Conservation Reserve Program (CRP). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. The Natural Resources Conservation Service (NRCS) administers the Agricultural Conservation Easement Program (ACEP). Agricultural Land Easements prevent conversion of productive working lands to non-agricultural uses and protect the long-term viability of the nation's food supply. Agricultural land easements provide additional public benefits, including environmental quality, historic preservation, wildlife habitat and protection of open space. Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, filter sediments and chemicals to improve water quality, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities. NRCS also manages the Healthy Forests Reserve Program (HFRP). Land enrolled in HFRP easements must restore, enhance or measurably increase the recovery of threatened or endangered species, improve biological diversity or increase carbon storage.

The construction of the channel cross overs is based on a dragline excavating from the top bank and casting the material into a spoil bank running parallel to the channel. The material in the spoil bank is to be spread and shaped by dozers. The construction of the weirs consist of stone with a sheet pile cut-off. It is assumed that the water would be diverted around or through the site so that the construct can be in the dry. The sheet piling is to be driven by pile driving equipment (crane, pile hammer, and etc.). A hydraulic excavator and front-end loader is to place the stone for each weir.

In general the pumping station consist of a concrete substructure supported on H-piles, a metal building superstructure housing electric pumps, misc. equipment and materials associated with pumps, and a riprap channel protection. It is assumed that a dewatering system (well points) is required. Dozers and an hydraulic excavator would be used to clear and grub the site. The hydraulic excavator with the assistance of a dozer is to excavate the channel and the site for the structure. The H-piles are to be driven by pile driving equipment (crane, pile hammer, and etc.). A crane is to be used to place the concrete, construct the metal building, and to install the pumps. A hydraulic excavator, dozer, front-end loader, rollers are used to place fill/backfill for the structure. The hydraulic excavator and front-end loader would place the riprap and filter stone for the riprap channel protection.

More detail regarding access and construction methods will be developed during the preparation of plans and specifications for the project.

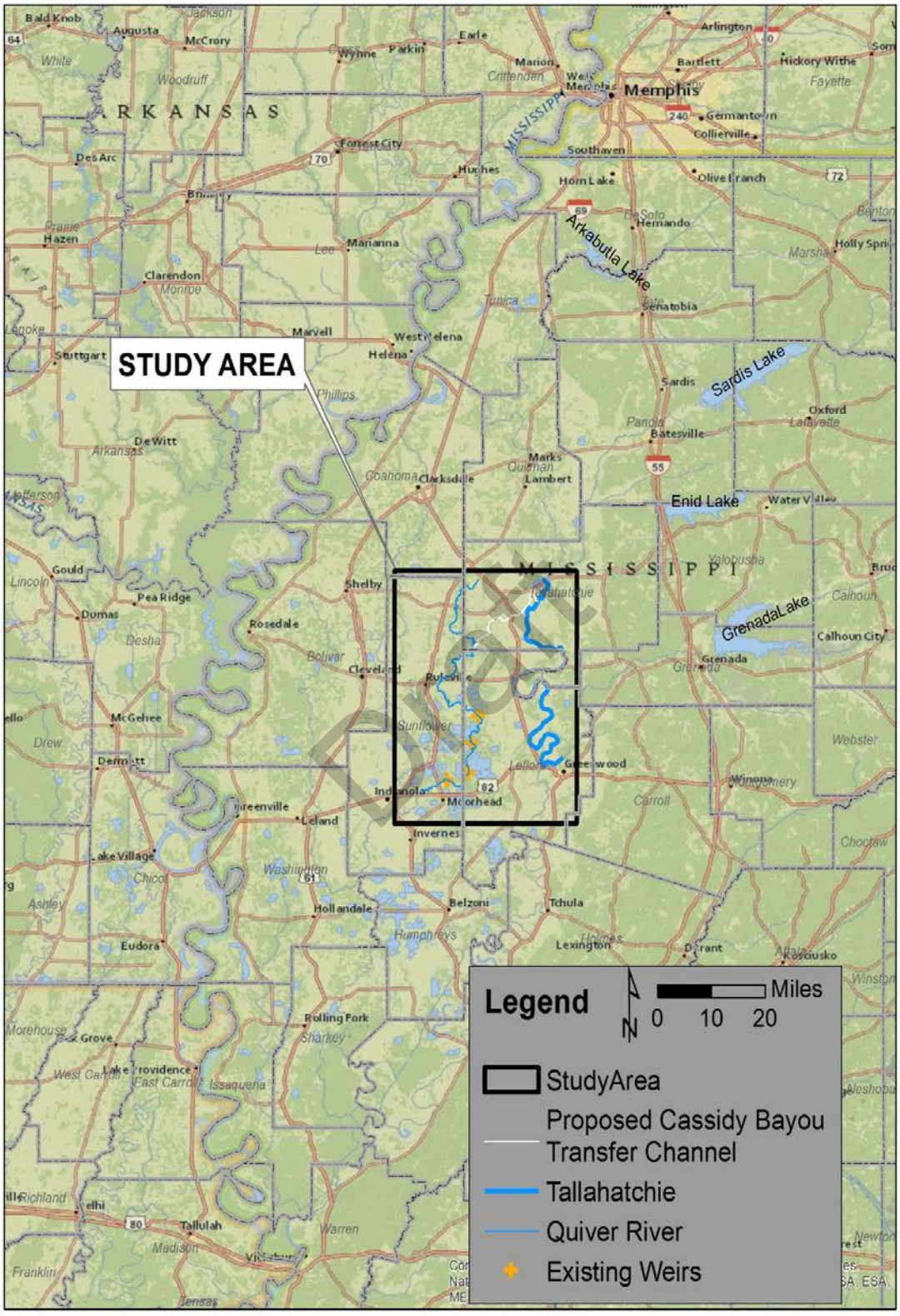

Figure 1. Map of the Study Area

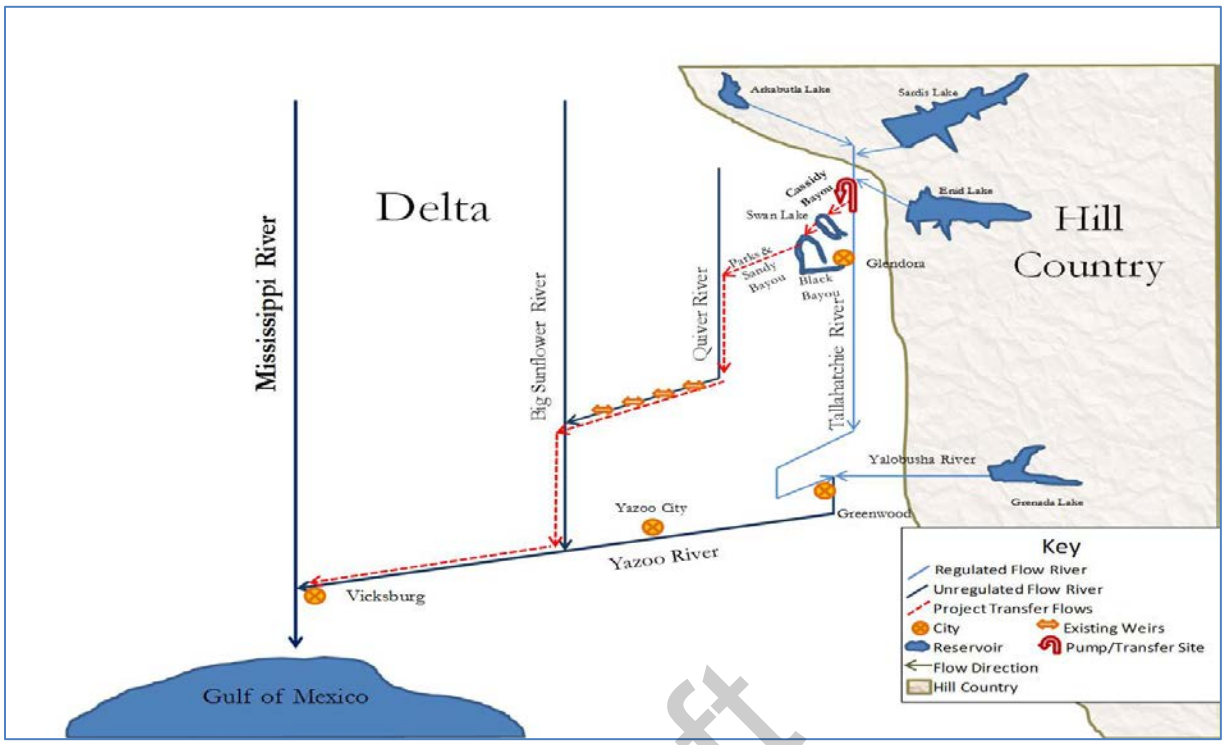

Figure 2. Map Displaying Project Goal: Transferring Conveyance from Tallahatchie River to the Quiver River (not to scale).

1. Review of Compliance (§230.10 (a)-(d)).	Preliminary[1]		Final[2]
A review of this project indicates that:			
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose (if no, see section 2 and information gathered for environmental assessment alternative);	YES	NO*	
b. The activity does not appear to: (1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act; (2) jeopardize the existence of Federally listed endangered or threatened species or their habitat; and (3) violate requirements of any Federally designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies);	YES	NO*	
c. The activity will not cause or contribute to significant degradation of waters of the United States including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values (if no,see section 2);	YES	NO*	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see section 5).	YES	NO*	

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant *
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
(1) Substrate impacts.		x	
(2) Suspended particulates/turbidity impacts.		x	
(3) Water column impacts.		x	
(4) Alteration of current patterns and water circulation.		x	
(5) Alteration of normal water fluctuations/ hydroperiod.		x	
(6) Alteration of salinity gradients.		x	
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
(1) Effect on threatened/endangered species and their habitat.		x	
(2) Effect on the aquatic food web.		x	
(3) Effect on other wildlife (mammals, birds, reptiles, and amphibians).		x	
c. Special Aquatic Sites (Subpart E).			
(1) Sanctuaries and refuges.		x	
(2) Wetlands.		x	
(3) Mud flats.	x		
(4) Vegetated shallows.		x	
(5) Coral reefs.	x		
(6) Riffle and pool complexes.	x		
d. Human Use Characteristics (Subpart F).			
(1) Effects on municipal and private water supplies.		x	
(2) Recreational and commercial fisheries impacts.		x	
(3) Effects on water-related recreation.		x	
(4) Esthetic impacts.		x	
(5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.		x	

Remarks

Subpart C – Physical and Chemical Characteristics of the Aquatic Ecosystem

a. *Substrate Impacts*: The project will not alter the substrate.

b. *Suspended Particulates/Turbidity Impacts*: There will be some short-term turbidity increases during construction, but no long term impacts.

c. Water Column Impacts: The project will not affect the water column.

d. *Alteration of Current Patterns and Water Circulation*: The project will restore and enhance flow to areas that historically had more flow, but are now degraded.

e. *Alteration of Normal Water Fluctuations/Hydroperiod:* The project will restore a more normal hydroperiod in the affected channels.

f. *Alteration of Salinity Gradients*: The project will not affect salinity gradients.

Subpart D - Biological Characteristics of the Aquatic Ecosystem (Subpart D).

a. *Effect on threatened/endangered species and their habitat:* Through the restoration of depth to the river and consistent flow events, mussel habitat quality will improve as there will be more habitat available for rabbitsfoot and sheepnose..

b. *Effect on the aquatic food web:* The project would result in a short-term loss to aquatic productivity until the dredging, weirs, and pumps are constructed. After construction, better stream flow, deeper pools, and increased wetted perimeter will provide better habitat and create more food sources for the aquatic fauna in the river. After the temporal lag from construction, the project would provide additional productivity to the local ecosystem.

c. *Effect on other wildlife (mammals, birds, reptiles, and amphibians):* The project would result in a short-term loss in productivity until the created habitat types become fully functional. After this temporal lag, the project would provide additional productivity to the local ecosystem, especially mussel habitat. The overall effect to wildlife would be beneficial.

Subpart E – Special Aquatic Sites

a. *Sanctuaries and refuges*: There are no sanctuaries or refuges in the project area.

c. *Wetlands:* The project will result in potential net gain of wetlands due to the increased wetted perimeter of the proposed project.

e. *Mud flats:* There are no mud flats present within the proposed project area.

g. *Vegetated shallows:* The project will result in an overall increase of vegetated shallows.

i. *Coral reefs*: None present within project area.

k. *Riffle and pool complexes:* The project will restore more normal flow to the Quiver River including riffle-pool complexes.

Subpart F – Human Use Characteristics

a. Effects on Municipal and Private Water Supplies: No affect. The surrounding Municipalities are on a much deeper aquifer than the surrounding farmers and surface pool of the Tallahatchie. This water intake would not be affected by the proposed actions.

b. Recreational and commercial fisheries impacts. The proposed action will improve habitat for recreational fisheries and may protect the water supply for commercial catfish farms in the area. The Quiver River is not likely to become a significant recreational fishery but localized use may increase.

c. Effects on water-related recreation. There is no significant recreational use in the project area.

d. Aesthetic impacts. There will be some minor aesthetic impacts during the construction process. Once complete, the proposed project should improve the visual characteristics of the surrounding area.

e. Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserve: None exist in the project area.

The Following Section will be completed during the feasibility level design phase.

3. Evaluation of Dredged or Fill Material (Subpart G).[3]

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material.

(1) Physical characteristics ..... _____
(2) Hydrography in relation to known or anticipated sources of contaminants ..... _____
(3) Results from previous testing of the material or similar material in the vicinity of the project ..... _____
(4) Known, significant sources of persistent pesticides from land runoff or percolation ..... _____
(5) Spill records for petroleum products or designated (Section 311 of CWA) hazardous substances ..... _____
(6) Other public records of significant introduction of contaminants from industries, municipalities, or other sources ..... _____
(7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities ..... _____
(8) Other sources (specify) ..... _____

230.61 – Considerations in Evaluating the Biological Availability of Possible Contaminants in Dredged or Fill Material:

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or the material meets the testing exclusion criteria.

YES NO*

The Following Section will be completed during the feasibility level design phase.

4. Disposal Site Delineation (§230.11(f)).

a. The following factors, as appropriate, have been considered in evaluating the disposal site.

(1) Depth of water at disposal site ..... _____
(2) Current velocity, direction, and variability at disposal site ..... _____
(3) Degree of turbulence ..... _____
(4) Water column stratification ..... _____
(5) Discharge vessel speed and direction ..... _____
(6) Rate of discharge ..... _____
(7) Dredged material characteristics (constituents, amount, and type of material, settling velocities) ..... _____

(8) Number of discharges per unit of time ..... ____

(9) Other factors affecting rates and patterns of mixing (specify) .....

An evaluation of the appropriate factors in 4(a) above indicates that the disposal site and/or size of mixing zone are acceptable: YES NO

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable.

YES NO*

The Following Section will be completed during the feasibility level design phase.

5. Actions to Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken, through application of the recommendations of §230.70-230.77 to ensure minimal adverse effects of the proposed discharge.

YES NO*

All appropriate and practicable steps have been taken, through application of the recommendations of 230.70 – 230.77 to ensure minimal adverse effects of the proposed discharge. Retention dikes will be utilized to minimize the escape of dredged material from the established disposal area.

The Following Section will be completed during the feasibility level design phase.

6. Factual Determination (§230.11).

A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:

a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5 above). YES NO*

b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5). YES NO*

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5) YES NO*

d. Contaminant availability (review sections 2a, 3, and 4). YES NO*

e. Aquatic ecosystem structure and function (review sections 2b and c, 3, and 5). YES NO*

f. Disposal site (review sections 2, 4, and 5). YES NO*

g. Cumulative impact on the aquatic ecosystem. YES NO*

h. Secondary impacts on the aquatic ecosystem. YES NO*

*A negative, significant, or unknown response indicates that the project may not be in compliance
with the Section 404(b)(1) Guidelines.

[1]Negative responses to three or more of the compliance criteria at this stage indicates that the
proposed projects may not be evaluated using this "short form procedure". Care should be used in
assessing pertinent portions of the technical information of items 2a-d, before completing the final
review of compliance.

[2]Negative responses to one of the compliance criteria at this stage indicates that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form" evaluation process is inappropriate.

[3]If the dredged or fill material cannot be excluded from individual testing, the "short form" evaluation process is inappropriate.

References considered in preparation of this document:

a. Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34 pages. Last Accessed May 2014.
b. Environmental Atlas of the Lake Pontchartrain Basin. 2002. USGS Open File Report 02-206. Internet URL: http://pubs.usgs.gov/of/2002/of02-206/intro/preface.html, last modified May, 2002. Last Accessed February 2014
c. U.S. Environmental Protection Agency (USEPA). Environmental Monitoring and Assessment Program. http://watersgeo.epa.gov/mwm/. Last accessed May 2014.

7. Evaluation Responsibility.

a. Biological input provided by: Jared Everitt

b. Engineering input provided by : Matthew Parrish

c. Evaluation reviewed by: Marsha Raus

_____	_____
Date	Signature

8. Findings.

The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines.

_____	_____
Date	Joan M. Exnicios Chief, Environmental Planning Branch

Appendix H

Draft Finding of No Significant Impact

DRAFT
FINDING OF NO SIGNIFICANT IMPACT
Big Sunflower River Watershed
(Quiver River), Mississippi

The U.S. Army Corps of Engineers (USACE), Vicksburg District (MVK), is proposing an ecosystem restoration project on the Quiver River in Tallahatchie, Leflore, and Sunflower Counties, MS. An integrated feasibility study and environmental assessment have been drafted to explore restoring the quality and sustainability of aquatic habitat and providing water for irrigation in the Quiver River.

The Quiver River is typical of streams in the Lower Mississippi River Alluvial Valley (LMRAV). Agriculture, irrigation, and flood risk management projects have degraded aquatic habitat. Past channelization and reduced instream flows in the Quiver River limit the amount of physical habitat present and cause decreased dissolved oxygen levels and higher water temperatures. Most streams within the Yazoo Basin have limited riparian vegetation, high nutrient concentrations, limited in-stream cover, low dissolved oxygen, high water temperatures, high turbidity, reduced habitat complexity, and low aquatic species richness and diversity. There are opportunities to restore a more historic flow regime, reestablish BLH riparian corridors, reduce sedimentation, lower nutrient concentrations, lower summer and fall water temperatures, and increase dissolved oxygen.

Management measures that could address the systemic aquatic degradation in the project area were identified in the feasibility study, and five alternatives were developed. The Tentatively Selected Plan would build a pumping station on the Tallahatchie River approximately 2 miles north of Sharkey, MS. The station would have the capacity to pump 400 cfs from the Tallahatchie River. A 1,500 foot long channel would be excavated (63,000 cubic yards) to connect the pump station to Cassidy Bayou. Water would flow from Cassidy Bayou into Swan Lake. Water would flow from Swan Lake to Black Bayou, then to Sandy Bayou and then Parks Bayou, and finally into the Quiver River approximately 2.5 miles northeast of Brooks, MS. The pumping station would be operated to ensure 100 cfs is maintained in the Quiver River. Water transfers to meet the project flow are most likely in September and October, but some may also be needed in August and November. Irrigation season generally extends from May to August and water can be withdrawn from the system as long as the 100 cfs project flow is maintained. Operation of the pump is not likely from December through April when the extra water is not needed for irrigation or ecological flows.

No federally listed threatened or endangered species are known to occur in the area; however, the proposed project is within range of pondberry (*Lindera melissifolia*), sheepnose mussel (*Plethobasus cyphyus*), and rabbitsfoot mussel (*Quadrula cylindrica cylindrica*). The project would likely have positive benefits for the mussels and coordination with the U.S. Fish and Wildlife Service is ongoing. A Draft 404(b)(1) evaluation has been completed; however, water quality certification would be coordinated with the Mississippi Department of Environmental Quality prior to project construction. A records search of the U.S. Environmental Protection Agency's EnviroMapper website and several site visits revealed no HTRW sites within the project area; therefore, it was concluded that the probability of encountering hazardous, toxic, and radioactive waste (HTRW) is low. If any HTRW is encountered during construction activities, the proper handling and disposal of these materials would be coordinated with the TDEC.

The construction sites would be surveyed for cultural resources prior to construction, and any significant sites would be avoided or mitigated. Coordination with the State Historic Preservation Officer is ongoing. If any cultural resources are encountered during proposed construction activities, construction would stop and the Vicksburg District Archaeologist would be contacted immediately.

Based on a review of the analysis performed in the environmental assessment and supporting documentation, I have determined the proposed action is not a major Federal action significantly affecting the quality of the human environment. Therefore, I have determined that an environmental impact statement is not required.

DRAFT

Date

Michael C. Derosier
Colonel, Corps of Engineers
District Engineer