US Army Corps
of Engineers
Nashville District

DRAFT

ENVIRONMENTAL ASSESSMENT
SUPPLEMENT 3

CENTER HILL DAM SEEPAGE REHABILITATION PROJECT

MAJOR REHABILITATION EVALUATION REPORT
PREVIOUSLY APPROVED AND REVISED PLANS

PROPOSED ROLLER COMPACTED CONCRETE (RCC) BERM AND MEASURES

CENTER HILL DAM AND LAKE
DEKALB COUNTY, TENNESSEE

October 18, 2013

Contents

Acronyms and Abbreviations

APE	Area of Potential Effects
APC	Air Pollution Control
ARAP	Aquatic Resources Alteration Permit
ATR	Agency Technical Review
BMPs	Best Management Practices
CAA	Clean Air Act
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CERLA	Comprehensive Environmental Response, Compensation, and Liability
csf	Cubic feet per second
Corps	Corps of Engineers (Nashville District)
CWA	Clean Water Act
dbh	Diameter at Breast Height
EA	Environmental Assessment
Elevation	Feet above mean sea level
EPA	Environmental Protection Agency
EO	Executive Order
ESA	Endangered Species Act
‘	Feet
FCA	Flood Control Act
FWCA	Fish and Wildlife Coordination Act
HTRW	Hazardous, Toxic, and Radiological Waste
“	Inch
LRN	Lakes and Rivers Division, Nashville District
MRER	Major Rehabilitation Evaluation Report
msl	Above mean sea level
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PDT	Project Delivery Team
Project	Center Hill Dam and Lake Project
oz	Ounces
RCRA	Resource Conservation and Recovery Act
RM	River Mile
RCC Berm	Roller Compacted Concrete Reinforcing Berm
SHPO	State Historic Preservation Office
TDEC	Tennessee Department of Environment and Conservation
T&E Species	Threatened and Endangered species
THC	Tennessee Historic Commission
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USACE	U.S. Army Corps of Engineers

USFWS	U.S. Fish and Wildlife Service (Cookeville, Tennessee)
USGS	U.S. Geological Survey
TDOR	Tennessee Division of Remediation
TDWR	Tennessee Division of Water Resources
WQC	Water quality certification

1. PURPOSE AND NEED FOR ACTION

1.1. AUTHORIZATION

This Environmental Assessment, Supplement 3 (EA) is conducted under the original authority of the Center Hill Dam and Lake Project (Project). The Project was authorized by the Flood Control Act of 1938 (Public Law (PL) 761, 75th Congress, 3rd Session) and the Rivers and Harbors Act of 1946 (PL 525, 79th Congress, 2nd Session). Authorized Project purposes include flood control (PL 75-761), hydropower (PL 79-525), recreation (PL 78-534), conservation of fish and wildlife resources (PL 85-624), water quality (PL 92-500) and water supply (PL 78-534 and PL 85-500). Dam closure was started on November 27, 1948 and completed in December 1949. Center Hill Dam is located at mile 26.6 on the Caney Fork River in DeKalb County, Tennessee. Project location and impact footprints are shown in Figure 1.

This EA is being prepared is in accordance with the National Environmental Policy Act (NEPA) of 1969; Council for Environmental Quality (CEQ) regulations (40 CFR, 1500-1508); U.S. Army Corps of Engineers (Corps), Policy and Procedures for Implementing NEPA, ER 200-2-2, 1988; and Corps' Policy for Implementation and Integrated Application of the U.S. Army Corps of Engineers (USACE) Environmental Operating Principles (EOP) and Doctrine, ER 200-1-5.

1.2. PURPOSE AND NEED

The purpose and need for federal action is to reduce the risk of dam failure at Center Hill Dam. The Project has a long history of seepage problems since construction in the 1940's. Seepage problems through the karst limestone have developed because clay-filled joints in the rock and large solution features (caves) are eroding. Despite past grouting work, seepage has increased. Erosion jeopardizes the main and saddle dam embankments, the main dam left groin, and the integrity of the left rim resulting in a high potential for dam failure. Center Hill Dam is currently rated in the Corps' Dam Safety Action Classification as DSAC I, which is categorized as "Urgent and Compelling". The combination of life or economic consequences with probability of failure is extremely high. The risk for dam failure would exist until the seepage problems are addressed. Provision for safety and continued monitoring for future seepage problems as part of on-going dam safety is also within the scope of this EA.

The Corps has implemented a seepage repair and rehabilitation plan approved in the 2006 Major Rehabilitation Evaluation Final Report (MRER) to impede seepage at the Project. The plan was implemented and construction began in 2008. Since 2008, revisions to some of the Project features have been recommended due to changes in the Corps rehabilitation policy from a reliability-based evaluation procedure to risk-based evaluation procedure (Section 1.5.1 Reliability-Based and Risk-Based Dam

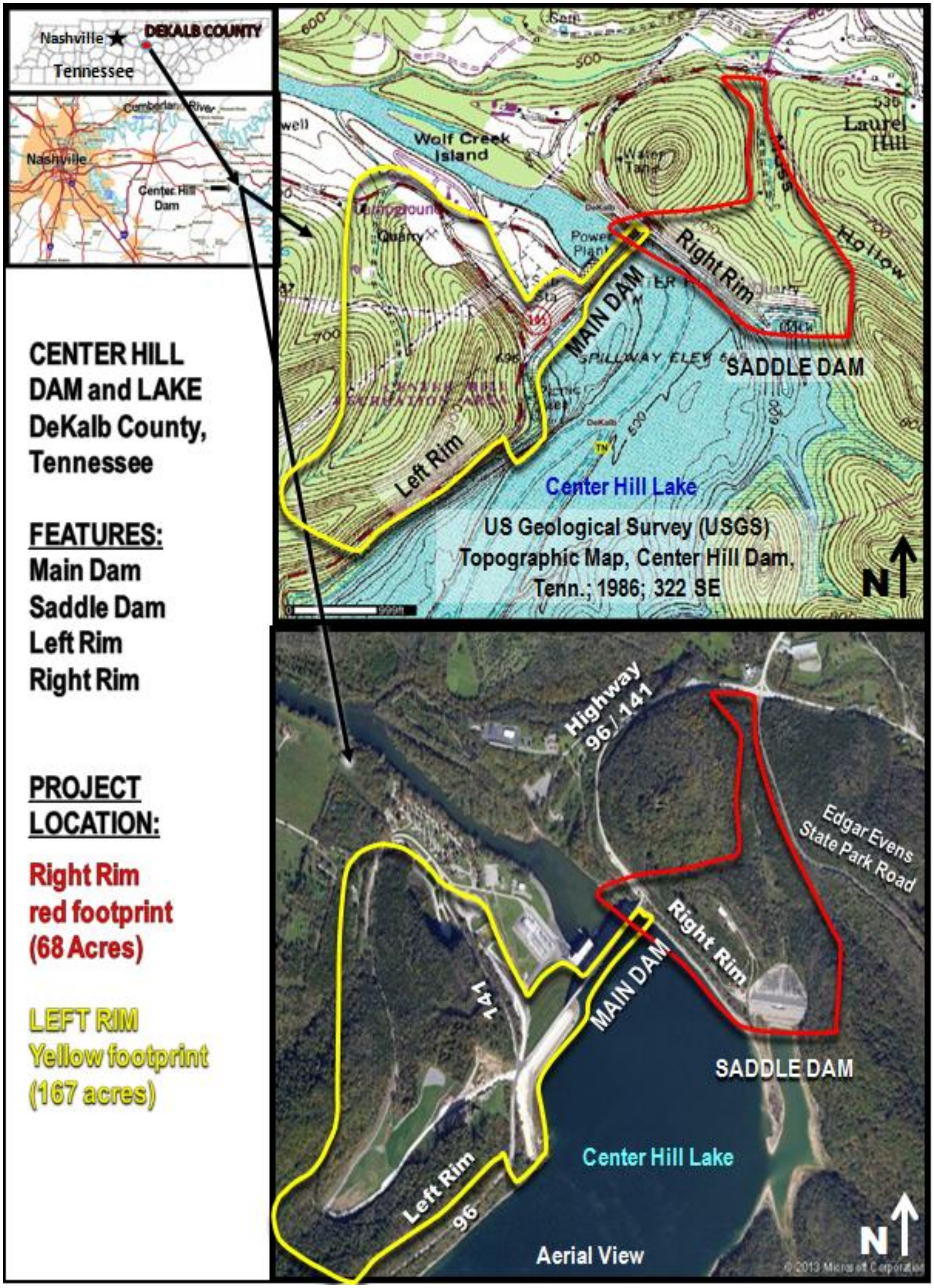

Figure 1. Vicinity Map and Project Boundaries.

Safety Guidance). The Corps has further refined data and design to achieve risk-based criteria. Recommended revisions have been documented in a draft 2013 MRER supplement and are considered in this EA. A summary of previously approved and revised (proposed) plan features are listed in Table 1 and shown in Figure 2.

Table 1. Project Features, Approved and Revised MRER Plans and Measures.

Project Feature	NO ACTION Previously Approved Plan 2006 MRER	PROPOSED ACTION Revised Plan Draft Revised 2013 MRER Supplement *	General Rationale	Environmental Assessment (EA) or Environmental Impact Statement (EIS)
Main Dam Embankment	Grout Curtain and Barrier Wall	Grout Curtain Constructed *Barrier Wall currently under construction*	No Revisions	2006 EA Supplement 1
Main Dam Embankment Left Groin	Grout Curtain	Grout Curtain Constructed	No Revisions	2008 EA Supplement 2
Left Rim	Complete Grout Curtain; Plug Left Rim Cave and Downstream Sinkholes	Partial Grout Curtain Constructed; No Cave and Sinkhole Plugging; Measure** 1, 2, 3, and 4	No Significant Life Loss or Credible Dam Failure Mode identified in RA; Seepage is a Water Loss Issue	2005 EA 2006 EA Supplement 1 2008 EA Supplement 2 2013 EA Supplement 3
Right Rim and Abutment	Install Grout Curtain Plug Upper and Lower Leaks	No Grout Curtain No Plugging of Upper and Lower Leaks; Measure 5	No Significant Credible Dam Failure Mode identified in RA; Seepage is a Water Loss Issue	2005 EA 2006 EA Supplement 1 2013 EA Supplement 3
Saddle Dam Embankment	Grout Curtains, Barrier Wall, and Coffer Dam	Roller Compacted Concrete Berm (RCC Berm)	RCC Berm more reliable and most effective long-term solution; Addresses all dam failure modes; cost effective	2005 EA 2006 EA Supplement 1 2013 EA Supplement 3
Entire Project Grouting	Periodic Maintenance and Operation Grouting	No Periodic Maintenance and Operation Grouting	No longer deemed necessary	2005 EA 2006 EA Supplement 1 2013 EA Supplement 3
Station Generator Replacement	New/Replace Generator to discharge 200 cubic feet per second (cfs) minimum flow	Rehabilitated Generator discharges 200 cfs minimum flow	No Revisions meets 200 cfs minimum flow	2005 EA 2006 EA Supplement 1
Cumberland River Basin Interim Operating Plan (IOP)	2008 EIS IOP Interim Pool Restrictions at Center Hill Dam; Interim Range 618'-630'; Incremental Pool Raise to Normal Range 623.5'-648'	No Change	IOP and Planned Incremental Pool Raise	2008 EIS 2013 EA Supplement 3

1.3. PROPOSED FEDERAL ACTION

The NEPA alternatives approved in the 2006 MRER plan form the project baseline. Since 2006, new information has resulted in revisions to the 2006 plan. Revisions include changes to Project features and a new proposed rolled compacted concrete berm (RCC Berm) alternative at the saddle dam, not described in previous EAs. The federal action is to evaluate revisions to the 2006 approved plan and consider the new RCC Berm alternative.

Figure 2. Project Features, Previously Approved and Revised MRER Plan.

1.4. SUMMARY OF PROJECT CHANGES

New information and changes in dam safety philosophy often alter construction plans after decision documents are completed. Table 1 summarizes project features, approved 2006 MRER plan, proposed revisions in the draft 2013 MRER supplement, the reason for revisions, and coverage under a NEPA document. Revisions and measures are highlighted in a blue font in Table 1, and addressed in this EA. Additional detail for each feature and measure is provided in the following sections.

The draft 2013 MRER supplement includes a baseline Risk Assessment (RA) that identified credible dam failure modes associated with each project feature. The RA findings revealed that construction of the previously approved barrier wall and grout curtain at the saddle dam would not reduce failure risk below the tolerable limit threshold. The new proposed RCC Berm alternative meets the tolerable limit threshold and is being evaluated in this EA.

1.5. NEPA AND DAM SAFETY GUIDANCE

1.5.1. RELIABILITY-BASED AND RISK-BASED DAM SAFETY GUIDANCE

When the Project began in 2005, dam safety guidance dictated a reliability-based evaluation procedure that addressed seepage throughout the project, including water loss as documented in the 2006 MRER. It was believed that continued, uncontrolled seepage and water loss created the potential for partial loss of the reservoir and/or dam failure. The goal was to stop seepage through the dam features (main and saddle dams, abutments and groin), and to stop water loss through the right and left rims, cave, upper and lower leaks and downstream sinkholes (Figure 2). Investigations determined that Center Hill Lake is the primary source of the water loss. Grouting the dam features would stop seepage. Water loss would be stopped by grouting the left and right rims, and plugging the cave, upper and lower leaks and downstream sinkholes to prevent water from flowing through them. Plugging would also prevent supplemental surface water from entering the cave and downstream sinkholes.

With the establishment of the Corps' Risk Management Center in 2009, and Corps-wide planning efforts for risk management, a risk assessment (RA) of Center Hill Dam was conducted in 2011. The goal of risk-based evaluation procedures was to focus on modes of dam failure. The RA concluded that the left rim cave, upper and lower leaks, and downstream sinkholes did not pose credible dam failure risks and therefore it was not necessary to plug them to prevent water loss.

The change from a reliability-based, to risk-based evaluation procedures affected the selection of alternatives in the original EA and subsequent supplements. All the EAs addressed seepage. However, the original EA and Supplements 1 and 2 included alternatives to stop water loss by plugging the left rim cave, upper and lower leaks, and downstream sinkholes. These solution features do not affect dam safety. An abundance of new data gathered since 2006, the EA, and the draft revised 2013 MRER plan supplement document the risk-based analyses that bring the evaluation of the Project in line with current Corps dam safety guidance.

1.5.2. SUMMARY OF NEPA DOCUMENTS

In July 2005, an EA was completed and a Finding of No Significant Impact (FONSI) signed on July 17, 2005. The selected alternative was to install supplemental grout curtains following the established 1949 and 1993 grout lines into the left and right rims and into the lakeside of the saddle dam embankment. The alternative included plugging the left rim cave, upper and lower leaks, and downstream sinkholes to prevent water loss (Table 2 and Figure 2). Maintenance grouting for the whole project was anticipated to occur every 15-20 years.

In April 2006, EA Supplement 1 was completed and a FONSI signed on May 19, 2006. In addition to the selected alternative in the 2005 EA, an additional alternative was to install grout curtains and barrier walls would be installed into the main and saddle dam earthen embankments. A grout curtain would be installed into the concrete dam. Work platforms would be built on the main dam embankment and adjoining recreation area. The work platforms provided stable and flat work surfaces for large grouting equipment. A temporary cofferdam would be built in the lake upstream of the saddle dam to facilitate barrier wall construction (Table 2 and Figure 2).

In January 2008, EA Supplement 2 was completed and a FONSI signed on January 17, 2008. In addition to previous selected alternatives (EA and EA Supplement 1), the selected alternative was to excavate and construct a work platform through the left rim on top of the established 1949 and 1993 grout lines; and install a grout curtain and work platform on the left groin downstream of the main dam. A soil/rock berm would be installed at the entrance of the left rim cut platform to prevent unauthorized access and block the visibility of the left rim cut (Table 2 and Figure 2).

In November 2007, an Environmental Impact Statement (EIS) addressing Center Hill Lake operations was completed and a Record of Decision (ROD) signed on February 13, 2008. The selected alternative was to operate the lake under an interim operating pool (IOP) between elevations 618 feet (‘) and 630’ (Table 1). This alternative lowered the normal crest of the summer pool (648’) by approximately 18’. After inflow events, the lake levels were lowered as quickly as possible to target elevation 630’ to reduce hydraulic pressure on the main and saddle dams. This alternative preserved the fall and winter pool between 623.5’-630’. The lower IOP was a temporary measure. The pool would be incrementally raised as determined by dam safety guidelines when sufficient seepage repairs were completed to safely return the lake to normal operations (623.5’-648’).

In 2012, a new seepage repair alternative was identified for the saddle dam. The proposed engineering and safety preferred alternative is the RCC Berm. A draft EA Supplement 3, and unsigned FONSI describing the new RCC Berm alternative was circulated for public, agency, and internal review on August 27, 2012. Comments were considered and incorporated into the draft document. During the EA review period, project features listed in the previously approved 2006 MRER plan underwent revisions that are outlined in the draft 2013 MRER plan supplement (Table 1). Some of the revised project features include measures to address left rim stabilization, sinkhole repairs, dam safety clearing, spring culvert and weir repairs, and upper and lower leak weir repairs. Revised project feature in the 2013 draft revised MRER plan supplement are considered in this EA.

Alternatives considered and selected from previous NEPA documents are summarized in Table 2. All previously selected (including alternatives not implemented) and proposed alternatives and measures are shown in Table 2. These previous NEPA documents are incorporated by reference and can be viewed at the Nashville District Office-Room A-449, 801 Broadway Street, Nashville, Tennessee 37202-1070.

2. DESCRIPTION OF ALTERNATIVES

Alternatives are based on project features in the previously approved 2006 MRER plan and draft revised 2013 MRER plan supplement. Features that have not been revised are not further discussed in this EA (Table 1). For the purposes of this EA, two broad plans are being considered: A) No Action (previously approved 2006 MRER plan) and B) Proposed Action (draft revised 2013 MRER plan supplement). A decision would be made on each individual project feature and not necessarily on the whole broad plan since each feature is independent of all the other features.

A. The No Action Alternative in this EA is to implement the previously approved 2006 MRER plan with no revisions to alternatives under the Left Rim, Right Rim and Abutment, Saddle Dam Embankment, and Entire Project Features. A “pure” No Action alternative as required under NEPA (where no federal action or work would be done) has already been evaluated in the 2006 EA Supplement 1 (Table 2) and is incorporated by reference. This is the without project condition for the Saddle Dam Embankment Project Feature (no grout curtains, barrier wall, and cofferdam) in the draft revised 2013 MRER plan supplement.

B. The Proposed Action Alternative is to implement the draft revised 2013 MRER plan supplement with revisions to alternatives under the Left Rim, Right Rim and Abutment, Saddle Dam Embankment, and Entire Project Features. The Proposed Action would also implement measures to address ground surface safety and continued monitoring for future seepage problems as part of the on-going dam safety program. These measures are: 1) Left Rim Cut Stabilization, 2) Sinkhole Repairs, 3) Dam Safety Clearing, 4) Spring Culvert and Weir Repairs, and 5) Upper and Lower Leak Weir Repairs. Measures are added to provide clear NEPA coverage. These measures are independent of all other measures and can be implemented independently.

Table 3 format allows comparison of the No Action (Previously Approved 2006 MRER Plan) and Proposed Action (Revised Draft 2013 MRER Plan) for alternatives under each project feature including the new proposed RCC Berm alternative and measures.

Table 2. EA, EA Supplement, and EIS Alternatives.

EA/EIS	Alternatives
2005 EA Original **Selected** **Alternative 2**	1. No Action – Existing operations would continue and no construction or rehabilitation work would take place. **2. Grout Left and Right rims with conventional cement grout** **Left Rim:** **a. Route 1 – Follow the established grout line over the left rim hill.** (Route 2 – Follow existing access road adjacent Highway 96 – new grout line not further considered.) **b. Plug cave and downstream sinkholes (not implemented)** **c. Use all existing haul/access roads and existing disposal and parking areas.** **d. Access roads would be widened and trees would be cut.** **e. Periodic maintenance grouting for the entire project** **Right Rim:** **a. Route 1 – Follow right rim haul road across saddle dam (not implemented).** (Route 2 – Follow a new route over the Right Rim hill (new grout line not further considered). **b. Plug Upper and Lower Leaks downstream of main dam (not implemented)** **c. Use all existing haul/access roads and existing disposal and staging areas.** **d. The haul road to the top of the saddle dam would be widened and trees would be cut.** **e. Repair/rehabilitate Station Service Generator** 3. Lower the Lake Level 4. Remove the Dam
2006 EA Supplement 1 **Selected** **Alternative 3**	1. No Action – Existing operations would continue and no construction or rehabilitation work would take place. 2. Original EA, Selected Alternative 2 **3. Original EA, Selected Alternative 2 plus:** **Install barrier walls into main embankment, and saddle dam embankment (not implemented).** **a. Grouting the concrete dam (not implemented).** **b. Construct a work platform on the main dam.** **c. Construction of a work platform at Recreation area and permanent removal of 1 acre of trees.** (A work platform option upstream of the recreation area not further considered due to distance.) **d. On site grout plant in existing staging area adjacent the saddle dam.** **e. Construct a temporary cofferdam on the lake side of the saddle dam (not implemented).** **f. Rehabilitate the Station Service Generator (SSG) to produce 200 cfs.**
2008 EA Supplement 2 Left Rim Only **Selected** **Alternative 3**	1. No Action – Current Plan – 2006 EA, Supplement 1, Alternative 3. 2. Install a new left rim grout line along Highway 96. **3. Cut the left rim hillside up to 120 feet deep along the established grout line.** **a. Construct a work platform and grout plant in the left rim and cut trees.** **b. Grade excavated material downhill in left rim and cut trees.** **c. Dispose excavated material adjacent left groin and construct a work platform** **d. On-site grout plants in staging and open areas.** **e. Use existing disposal sites, work platforms, parking areas, and open areas.** **f. Construct a soil/rock berm at left rim cut entrance.** **g. Install an Orifice Gate to produce 200 cfs; SSG would serve as a backup**
2007 EIS Lake Operations **Selected** **Alternative 5**	1. No Action, Lake EL 648'-623.5' 6. Lake EL 625'-623.5' 2. Lake EL 645'-623.5' 7. Lake EL 625'-618' 3. Existing Condition - Lake EL 640'/623.5' 8. Lake EL 622' 4. Environmentally Preferred – Lake EL 635'-623'. 9. Emergency Drawdown, Lake EL 618.0-496.0 **5. Safety & Engineering Preferred – Interim Operating Pool (IOP) 630.0'-618.0';** **incrementally raise pool; return to Normal Operations (623.5—648-) when safe**
2013 EA Supplement 3 Right Rim **Selected** **Alternatives**	1. No Action – No Revisions to Features in the 2006 MRER Plan (Table 1) **2. Left Rim - No plugging cave and sinkholes; Measures: left rim stabilization; sinkhole repairs; dam safety clearing; spring culvert and weir repairs** **3. Right Rim and Abutment – No grout curtain; no concrete dam grouting; no plugging upper and lower leaks; Measure : upper and lower weir repairs** **4. Saddle Dam Embankment** **a. RCC Berm With Fill** **b. RCC Berm Without Fill** **c. RCC Berm With Fuse Gates** **5. Entire Project – No maintenance grouting**

Table 3. No Action and Proposed Action and Measures.

Project Feature	**No Action** **Previously Approved 2006 MRER Plan**	**Proposed Action** **Revised Draft 2013 MRER Plan**
Left Rim	Complete Grout Curtain; Plug Left Rim Cave and Downstream Sinkholes	Partial Grout Curtain Constructed; No Plugging of Left Rim Cave and Downstream Sinkholes Measures: 1–Left Rim Stabilization; 2–Sinkhole Repairs; 3–Dam Safety Clearing 4–Spring Culvert and Weir Repairs
Right Rim and Abutment	Install Grout Curtain Plug Upper and Lower Leaks	No Grout Curtain No Plugging of Upper and Lower Leaks; Measure: 5–Upper and Lower Leak Weir Repairs
Saddle Dam Embankment	Grout Curtains, Barrier Wall and Coffer Dam	Roller Compacted Concrete Berm (RCC Berm)
Entire Project	Periodic Maintenance and Operation Grouting	No Periodic Maintenance and Operation Grouting

2.1. LEFT RIM

2.1.1. CAVE AND SINKHOLES

A deep left rim cave is located about 900 linear feet from the Highway 96/141 intersection. A gap of about 310 feet of ungrouted rock remains at the cave location. The downstream and new sinkholes are hydrologically-connected downhill of the grout curtain (Figure 3).

NO ACTION

The No Action alternative would plug the cave and downstream sinkholes to stop water loss. Plugging the cave would complete the left rim grout curtain (Table 3).

PROPOSED ACTION

The proposed action is to not plug the cave and downstream or new sinkholes to stop lake water loss (Figures 2 and 3). The perception is that plugging the cave and Downstream sinkholes could cause hydraulic pressure on other portions of the left rim. Plugging the flow through the cave could potentially lead to more deleterious groundwater flows nearer to or beneath the main embankment dam. Plugging the downstream and new sinkholes could potentially lead to a more rapid development of sinkholes than what have already developed.

Since 2010, the development of numerous new sinkholes (Figure 3) and collapsing ground surface has prompted consideration of the measure to repair (not plug) the sinkholes and to stabilize the ground surface to allow safe access on the left rim.

Sinkholes would be repaired in accordance with standard Tennessee Department of Transportation (TDOT) design (Figure 4). Water flow within the sinkholes would not be

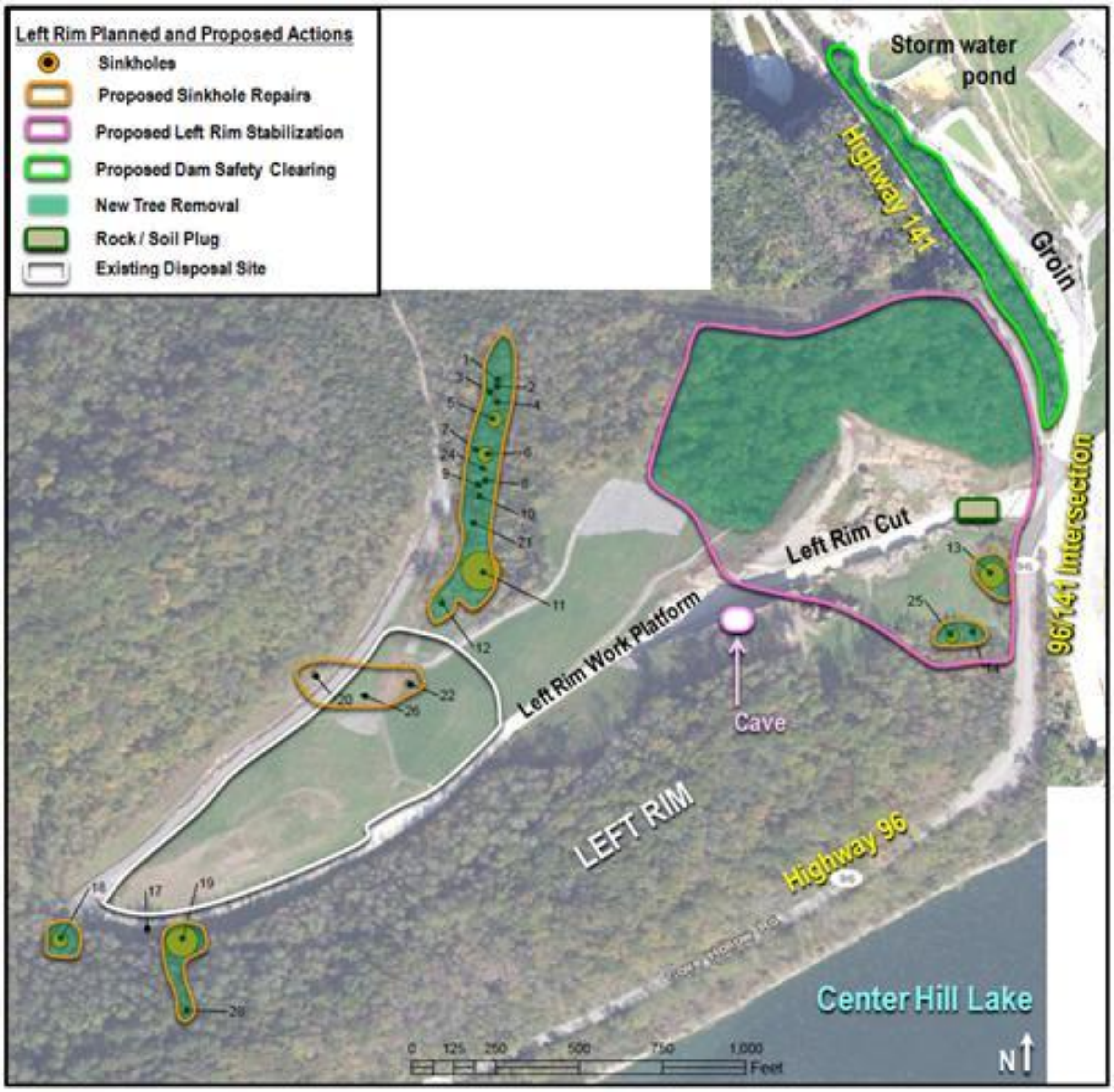

Figure 3. Left Rim Cave, Sinkholes, Planned and Proposed Actions.

impeded. Surface water would be allowed to enter the sinkholes. Excavated rock from on site construction or quarried rock would be used in the repairs. Use of onsite rock creates a beneficial re-use of rock needing disposal from construction. Repairs would retard sinkhole collapses and make the surface terrain safer for ground inspections. Many sinkholes are developing in forested areas.

Trees and soil are collapsing into the sinkholes as they develop. Sinkhole repair would require approximately 2 acres of temporary tree removal to access the sinkholes and stabilize the ground surrounding the sinkholes (Figure 3). Trees would be expected to grow back via natural succession.

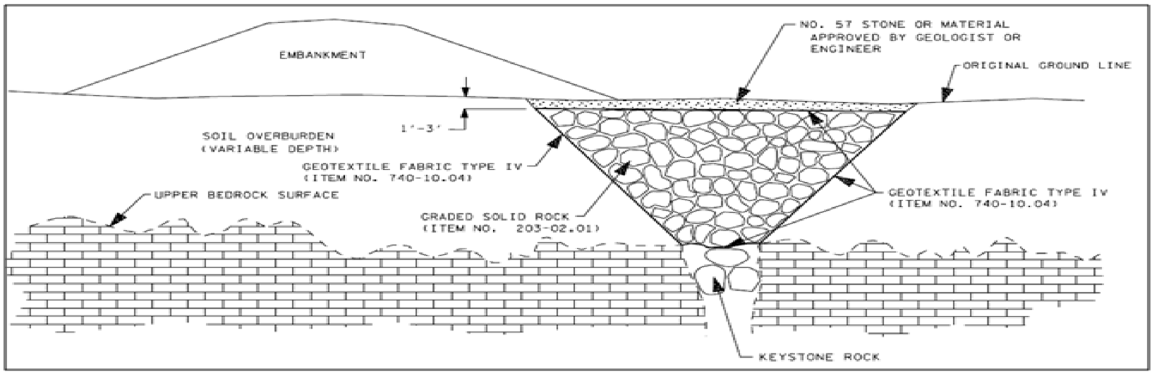

Figure 4. Standard State Sinkhole Treatment.

2.1.2. LEFT RIM CUT STABILIZATION

The left rim cut was constructed on top of the established 1949 and 1993 grout lines (EA Supplement 2, Table 2). Excavation removed approximately 120' of overburden to shorten drilling depth and the amount of grout needed for the grout curtain. The work platform was built on the cut to provide a stable and gently sloped work surface for large grouting equipment. On completion, a soil/rock berm was to be placed at the cut entrance (Highway 96/141 intersection) to reduce visibility and prevent unauthorized access (Figures 3 and Figure 5).

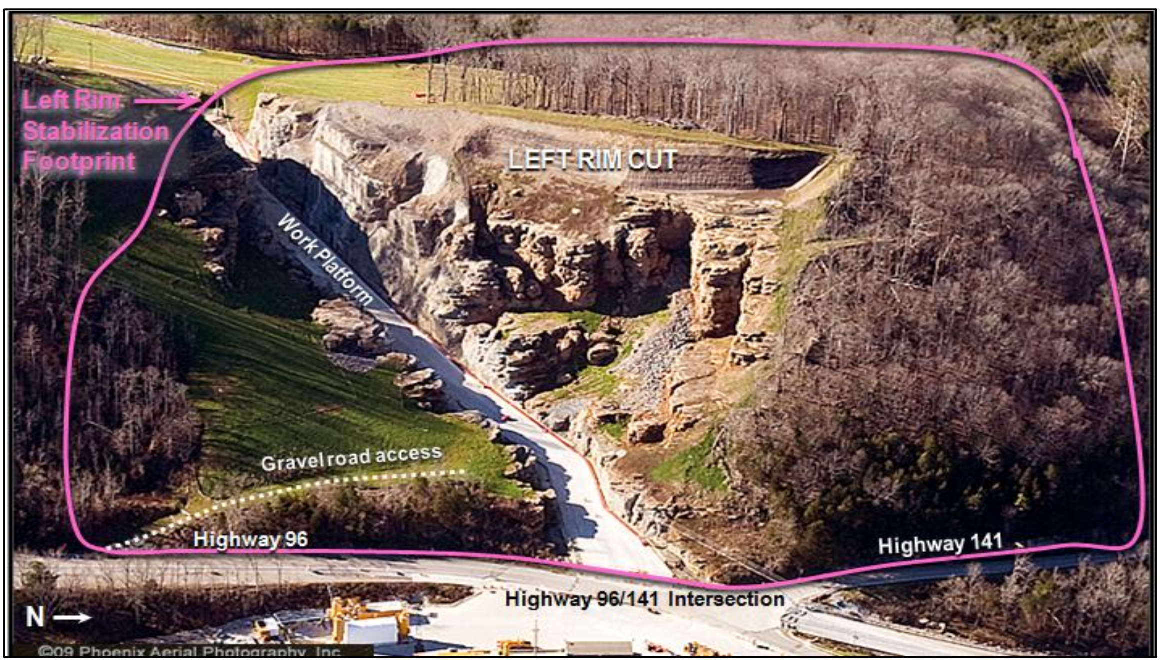

Figure 5. Left Rim Cut and Stabilization Footprint at the Highway 96/141 Intersection.

Shortly after completion in 2010, large storms washed mud, rock, and tree limbs into the Highway 96/141 intersection. An investigation revealed that storm water was washing out clay filled cavities in the rock resulting in sporadic rock falls and erosion. The instability of the cut sides is so serious a safety threat that this section has been quarantined and remains a long term public safety hazard. To protect surface waters, storm water is captured in a storm water treatment pond located below the groin (Figure 5). The approved rock/soil berm cannot be installed until it is safe and erosion of the cut slopes ceases.

NO ACTION

The No Action plan is to do no additional excavation to stabilize the left rim cut and address concentrated storm water flows. A soil/rock berm would be placed at the cut entrance regardless of the cut's existing condition and potential of breaching the soil/rock berm. Storm water would continue to be routed to an existing storm water pond below the groin that will require maintenance as long as the pond is in use (Figure 2).

PROPOSED ACTION

The proposed action is to stabilize the left rim cut to reduce erosion and rock falls. Stabilization work would require temporary tree removal of up to 11 acres. The amount of trees cut would depend on the severity of the hillside instability once construction is initiated. Micro-blasts and/or ram-hoeing the weathered rock to level the limestone spires and outcrops would be required. The broken rock would be sloped back to prevent erosion. To achieve a stable slope, grading may result in partial burial of the work platform. If additional fill is needed to stabilize the hillside, excavated soil and rock from on site construction activities would be used. Storm water would be directed to sheet flow over the stabilized area, follow its original flow path under Highway 141 to the groin, or flow in a roadside adjacent Highway 141 in a ditch that drains into the quarry. The storm water pond would be removed and no further maintenance would be required. The hillside would be stabilized with warm season grasses and native tree seedlings and allowed to follow natural succession to develop into forest. When the cut is stabilized, the soil/rock berm would be installed at the lowest point near the Highway.

2.1.3. DAM SAFETY CLEARING

The left groin hillside downstream of the main dam embankment contains approximately 2 acres of woods. This area is sandwiched between the groin and Highway 141 (Figure 3). Adequate dam safety inspections between the hillside and the groin cannot be performed in the wooded area. Engineering Regulation (ER) 1110-2-1156 Engineering and Design, Safety of Dams, Policy and Procedures, establishes requirements for vegetation management for dams, abutments, and associated structures (groins). Ground around these structures is to be maintained as open grassed areas to facilitate ground inspections for wet spots, depressions, sinkholes, seeps and hill slope failures.

NO ACTION

The No Action alternative is to do nothing. No trees would be removed. This area would not meet dam safety regulations.

PROPOSED ACTION

The proposed action is to permanently remove approximately 2 acres of trees from the area between the groin and Highway 141 to facilitate required dam safety inspections (Figure 3). The cleared area would be maintained in grass. Piezometers would be installed to monitor seepage. To replace lost forest habitat, 2 acres would be planted with tree seedlings in an onsite disposal area. Disposal areas have remained open space due to reuse. Converting disposal acreage to forest acreage ensures replacement of lost forest.

2.1.4. SPRING CULVERT AND WEIR REPAIR

Picnic and Quarry Springs flow through a culvert under Highway 141 and Campground Road (Figure 6). Gravel filled in the first culvert and impeded the flow. A second culvert was installed several years ago. The outlet of the second culvert appears to be undermined by water flowing around and under this culvert as it exits downstream Campground road. The second culvert appears to be undersized. During high flows, backwater floods both springs and threatens to flood Highway 141.

Figure 6. Spring Culvert and Weir Locations.

Picnic and Quarry Springs were once monitored for seepage as part of on-going dam safety monitoring. Their weirs were damaged from overtopping during several high flow events.

NO ACTION

The No Action plan would not replace the spring culvert or repair the weirs.

PROPOSED ACTION

The proposed action is to replace the spring culvert and repair 3 weirs. No trees would be removed. Minimal shrub removal and bank stabilization would be necessary to repair the weirs at the weir locations. Repairs are necessary to measure seepage as part of the on-going dam safety Picnic and Quarry Springs flow monitoring.

2.2. RIGHT RIM AND ABUTMENT

Right rim grouting along the access road to the saddle dam was planned to impede seepage toward the saddle dam and diminish flow in the upper and lower leaks. Grouting beneath the concrete dam was planned to reinforce the existing 70-year old original grout curtain, and to seal seepage paths in the dam foundation. Grouting into the right abutment of the concrete dam was planned to stop or slow seepage the upper and lower leaks (Figure 2).

2.2.1. UPPER AND LOWER LEAKS

The upper leak results from a weakened bedding plane that produces about 3-4 cfs. The lower leak originates from a once dry cave. Since 1959, the lower leak flow had been increasing. Seepage eroded soil filled solution features and currently the lower leak produces about 40 cfs. The cave was explored in 2001. It is approximately 140' long. The opening is about 6' wide and tapers to less than 5' with little available air space. Both leaks were once measured by weir boxes as part of on-going dam safety seepage monitoring. The weirs were damaged by overtopping and falling rocks (Figure 7). In their current condition, there is no way to obtain accurate flow measurements. Geotechnical investigations found that the upper and lower leaks did not pose a risk of failure to the dam since the leaks are within rock and/or concrete for their entire length. The RA concluded that seepage in the right rim, right abutment, and from the upper and lower leaks resulted in no credible dam failure modes. The seepage is a water loss issue.

NO ACTION

The No Action alternative is to install grout curtains into the right rim access road and concrete dam, and right abutment. The upper and lower leaks would be plugged to prevent water loss.

PROPOSED ACTION

No grouting would be done on the right rim along the access road to the saddle dam, under the concrete main dam foundation, or in the right abutment. The upper and lower leaks would not be plugged to prevent water loss. The broken upper leak and lower leak concrete weirs would be repaired so the seepage flows can be measured and monitored as part of the on-going dam safety program. Weir repairs would not alter water quality or quantity as the upper and lower leaks would continue to flow unimpeded. Shrubs and grasses would be removed to facilitate weir repairs. The vegetation is sparse. Removal would have little effect on the visual appearance of the tailwater area (Figure 7)

MITIGATION

Planned grouting and plugging the upper and lower leaks was anticipated to cut off a substantial volume of water entering the Caney Fork River tailwater. Seepage and the leaks provide constant flow that supports the tailwater trout fishery when the dam is not generating. If the leaks were plugged, the trout fishery would likely be impacted by the reduced flow. To mitigate for this loss, the station service generator (SSG) was

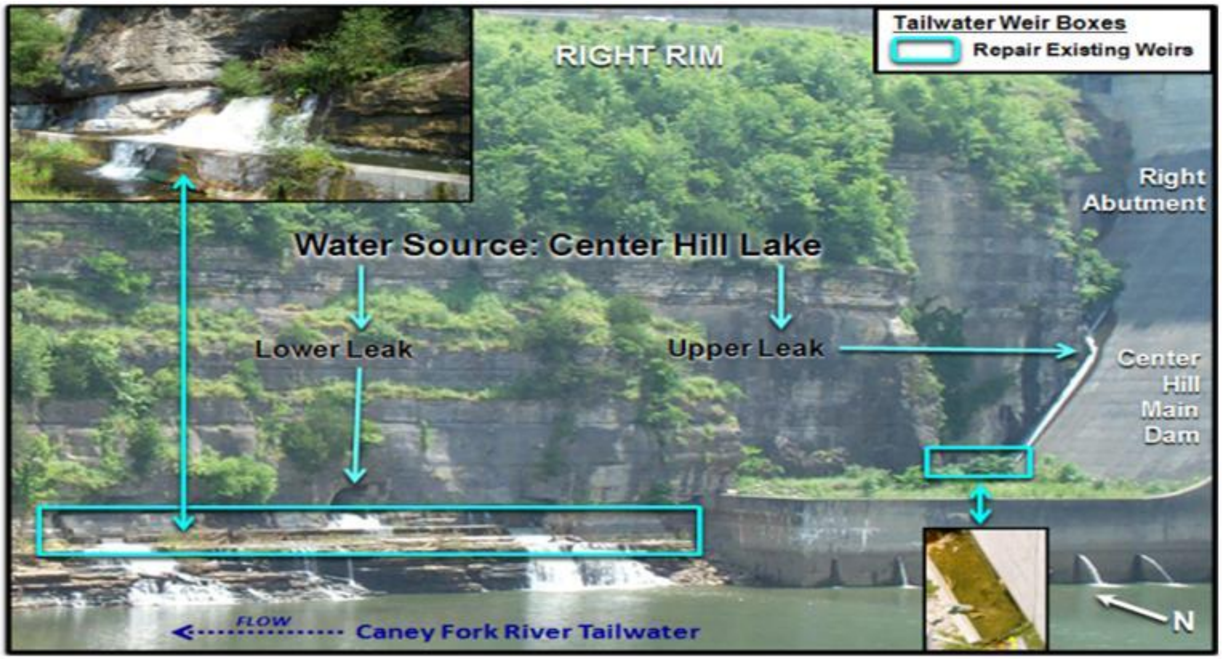

Figure 7. Upper and Lower Leaks and Weir Locations.

rehabilitated to provide approximately 200 cfs of minimal flow. In February of 2008, the IOP (618'-630') was implemented. The perception was that a lower pool would reduce the amount of cold, oxygenated water storage in the lake. In anticipation of possible reduction of dissolved oxygen in the tailwater, an orifice gate was installed in the sluice gate within the dam. The orifice gate reliably provides 250 cfs of cold, oxygenated water into the tailwater. Under the Proposed Action, the leaks would continue to flow. The SSG and orifice gate enhance water quality and quantity in the tailwater when flow is needed.

2.3. SADDLE DAM EMBANKMENT

The saddle dam is located about 1,500' east of the main dam on the north side of the lake (Figures 1 and 2). The saddle dam is an earthen embankment constructed of high quality, well-compacted clay. It is 125' high and 770' long. The top width is 35' and the base width is 600'.

In 1996, the saddle dam was retrofitted to serve as an emergency spillway to pass a probable maximum flood (PMF). The PMF is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. A PMF is equivalent to a 130,000 year return period event.

The top 40' of the saddle dam was excavated to elevation 658'. A concrete slab was constructed over the crest. Concrete panels (20' x 20' x 1.5') were placed on the downstream face and the abutments of the dam. Clean, white sand was placed as a leveling course" beneath the concrete panels. The purpose of the panels was to protect the earthen embankment during a PMF.

An erodible fuse plug was constructed on top of the concrete capped saddle dam. The crest of the fuse plug was constructed to elevation 692.4' with a pilot channel that initiates erosion at a pool elevation of 691.5. The fuse plug is designed to erode down to the top of the concrete capped saddle dam (658') when it operates. A shallow sheet pile wall and riprap protect the upstream face of the fuse plug from wave action (Figure 8). Water reaches the upstream face of the fuse plug when the pool exceeds elevation 658'.

Figure 8. Saddle Dam and Design Features.

There are numerous large rock faults, solution features, bedding planes, and fractures within, upstream, and downstream the saddle dam foundation. Boring investigations have confirmed several seepage paths flowing under the saddle dam. A noticeable amount of leveling sand has been discharging out of the panel drains for years (Figure 9). Sand loss affects the durability of the concrete panels. The pressure of flood water cascading onto weakened panels increased the probability of panel loss during a PMF. Once the panels are lost, the underlying earthen saddle dam embankment would erode resulting in collapse of the saddle dam. If the saddle dam remains in place after the fuse plug erodes, the lake would drain until it was at the top elevation of the saddle dam (658). If the saddle dam collapse and erodes, the lake would probably drain to the bottom of the saddle dam and valley floor at 570'. The significance of elevation is shown in Figure 10 and Table 3.

Center Hill Lake is operated within congressionally authorized elevations. The power pool and seasonal elevations (fall, winter, spring, and summer) operate between 618' and 648'. Seasonal elevations follow and fluctuate within the power marketing zone (guide curve). Under normal operations, the pool would follow the guide curve to a top elevation of 648'. The IOP (EIS selected range 618'-630') maintains the pool to a top

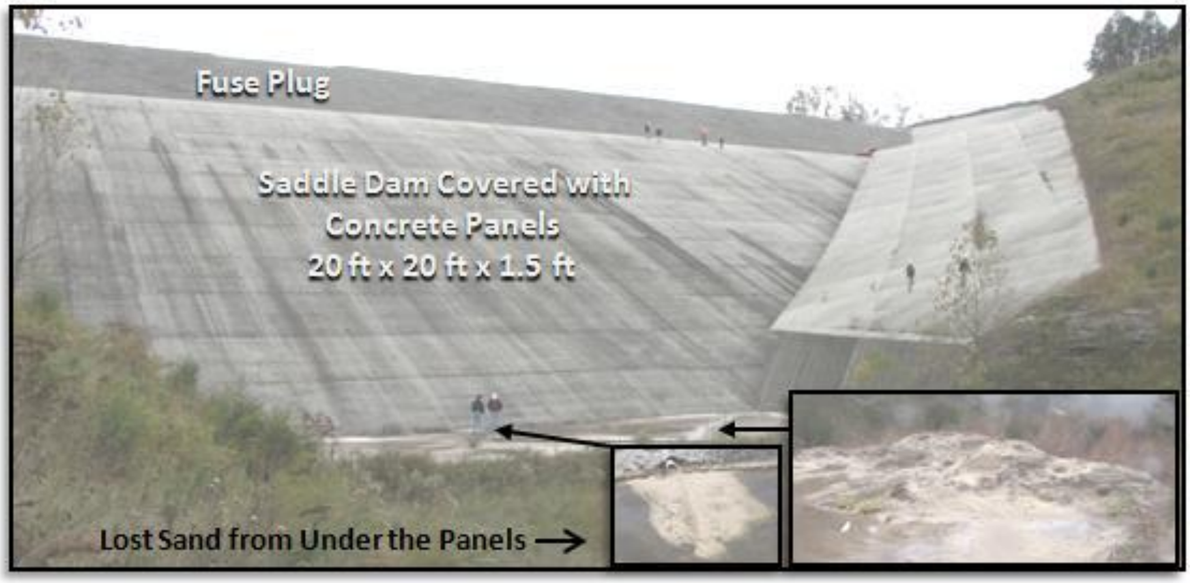

Figure 9. Saddle Dam – Concrete Panels and Loss of Leveling Sand.

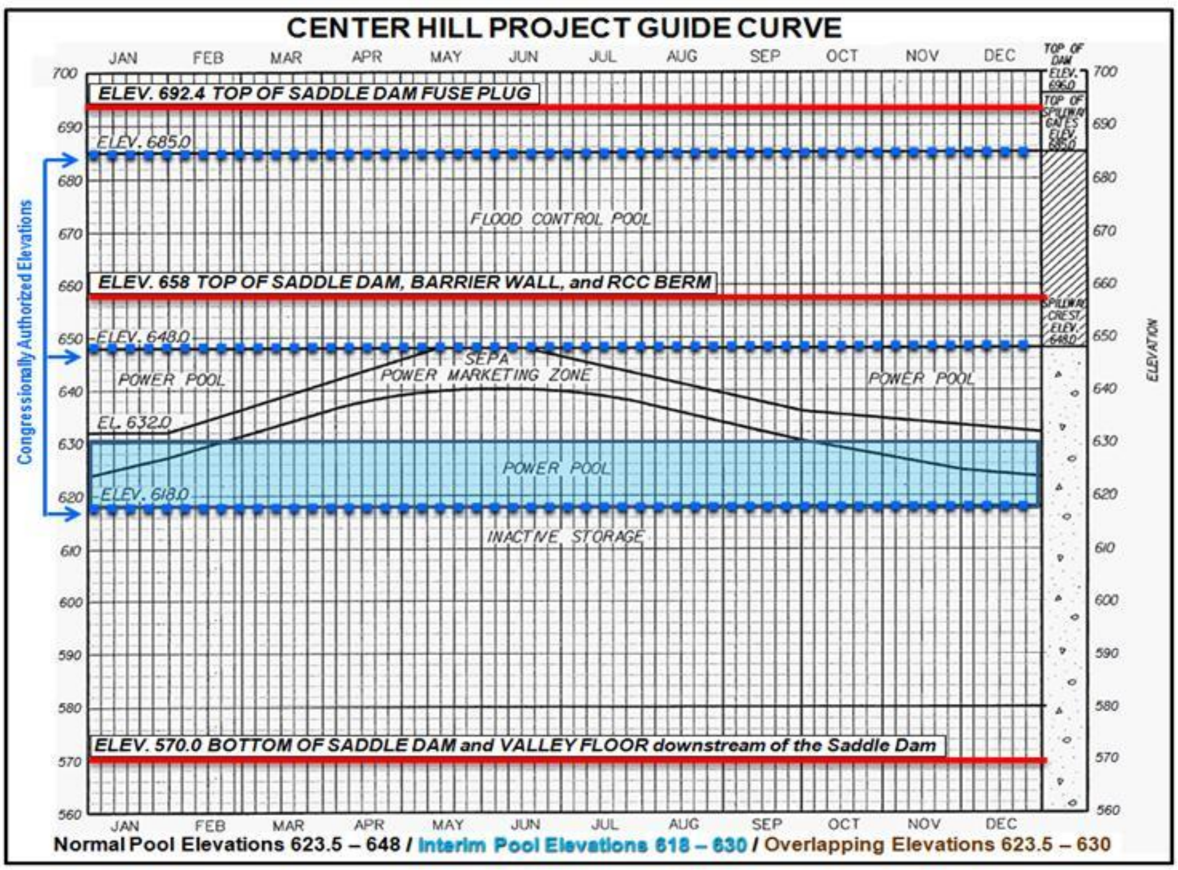

Figure 10. Center Hill Lake Guide Curve and Key Pool Elevations.

elevation of 630'. Figure 10 shows the relationship of the saddle dam and pool elevations. The solid red lines in Figure 10 show: 1) the top of the saddle dam fuse plug, 2) the top of the saddle dam, and the previously approved grout curtain and barrier wall and proposed RCC Berm alternatives, and 3) the bottom of the saddle dam and valley floor. Table 3 shows the lake's surface area and volume remaining at specific elevations. Should the saddle dam fail, approximately 66% of the lake's surface area would be lost, and nearly 87% of the lake volume would be lost (Table 4).

Table 4. Center Hill Lake Surface Area, Volume and Elevations at the Main Dam.

Center Hill Pool Elevations (ft)	Physical Feature	Surface Area (Acres)	Lake Volume (Acre-Feet)
696.0	Top of Main Dam Embankment	NA	NA
692.4	Top of Saddle Dam Fuse Plug	NA	NA
691.5	Fuse Plug-Pilot Channel / Initiation of Fuse Plug Erosion	NA	NA
690.0	**Maximum Measured Storage Prior to Fuse Plug Erosion**	**23,740**	**2,209,000**
685.0	Top of Flood Control Pool	23,060	2,092,000
681.5	Flood of Record (May 1984)	22,570	2,012,500
658.0	**Top of RCC Berm, Barrier Wall, and Saddle Dam**	**19,530**	**1,518,000**
648.0	Average Summer Pool; Bottom of Spill Gates	18,220	1,330,000
630.0	Top of Interim Pool During Seepage Repairs	16,010	1,021,000
623.0	Low Point of SEPA Marketing Band in Winter	15,200	912,000
618.0	Top of Inactive/Conservation Pool	14,590	838,000
570.0	**Bottom of Saddle Dam and Valley Elevation**	**8,080**	**287,000**
540.0	Penstock openings to hydropower generators	4,150	103,000
496.0	Bottom of Main Dam Lowest Sluice Gate	680	5,970
470.0	River Bottom	0	0

2.3.1. NO ACTION: GROUT CURTAINS, BARRIER WALL, AND COFFER DAM

No Action would implement the previously approved plan alternative. A grout curtain, barrier wall, and cofferdam would be constructed on the upstream side of the saddle dam earthen embankment (Figure 11). The continuous concrete barrier wall would be approximately 780' long, 2' wide and about 118' deep from elevations 658' and 540'.

Grout curtains would be constructed on each side of the barrier wall (Figure 12). A coffer dam would be built on the lakeside of the saddle dam to protect grout curtain and barrier wall construction from a rising lake pool during flood events. The IOP reduces the risk of flood events. The thickness and height of the coffer dam to withstand floods was not designed but it was anticipated that at least 150,000 CY of fill would be placed into Center Hill Lake to build the coffer dam. The coffer dam would be removed on project completion. The RA revealed that the barrier wall leaves the saddle dam vulnerable to overtopping and does not meet dam safety guidelines for tolerable risk.

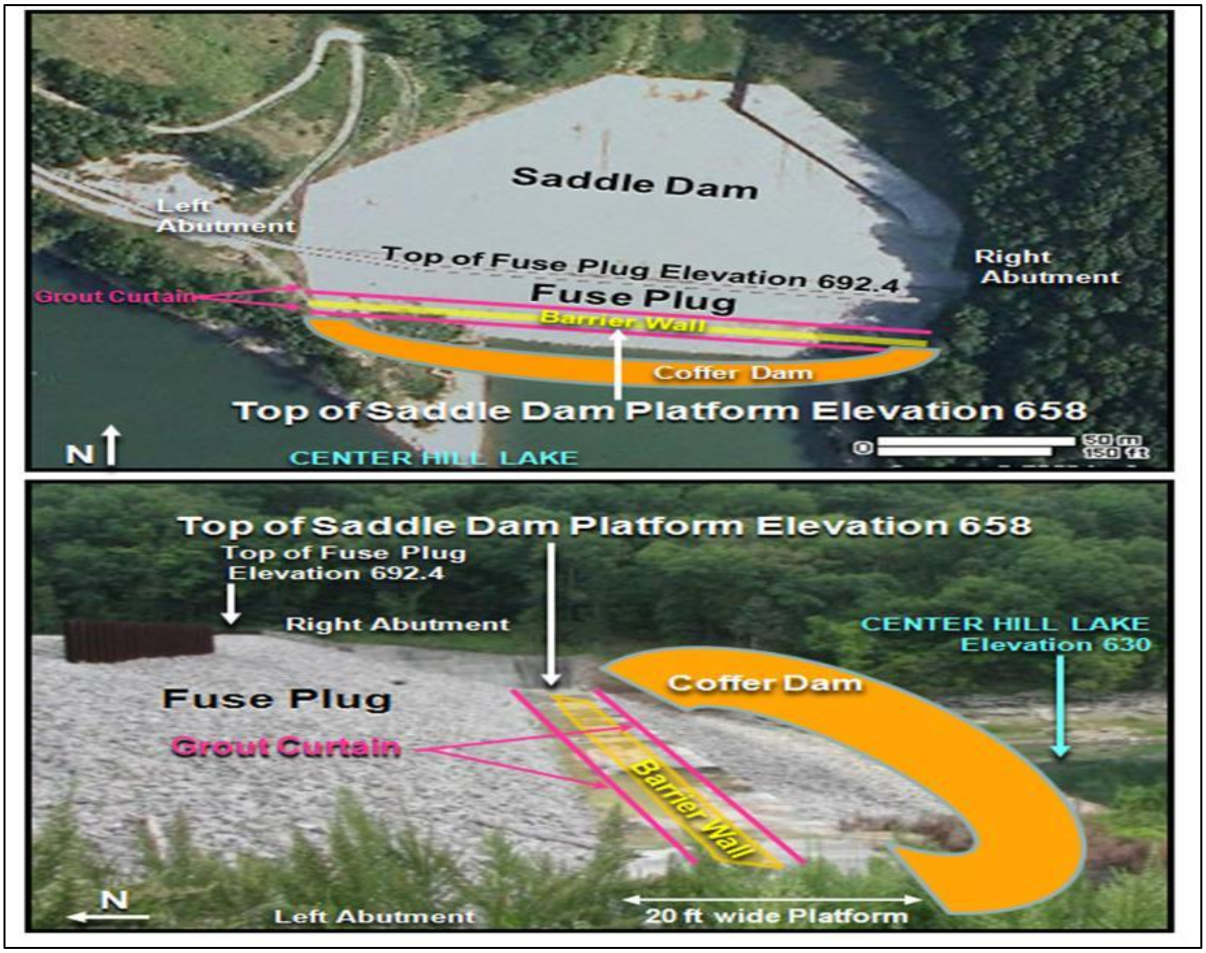

Figure 11. Previously Approved Saddle Dam Plan – Grout Curtains, Barrier Wall, and Coffer Dam.

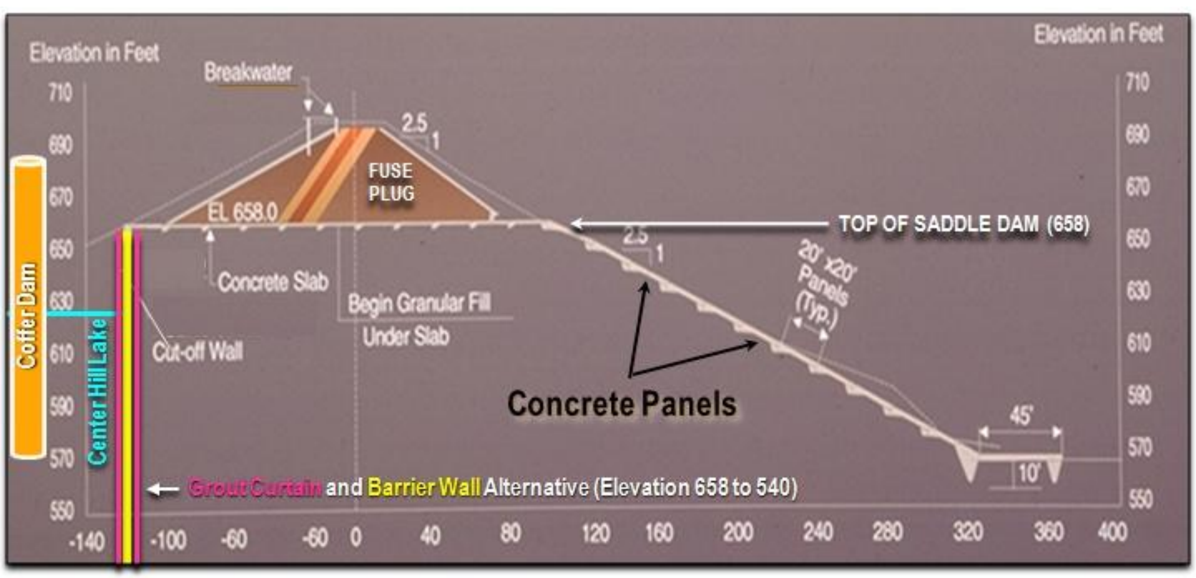

Figure 12. Cross-section of the Saddle Dam, Grout Curtains, Barrier Wall, and Coffer Dam.

downstream physical features (rock faults, solution features, in-filled joints, open or bedding plane partings, fractures, and overhangs) that could concentrate seepage at the saddle dam foundation contact between bedrock and soil. Concentrated seepage in any of these features could scour the walls or ceilings of the open spaces, initiating erosion if flow velocities were sufficient. A grout curtain could temporarily block these openings in bedrock, and a barrier wall would eliminate any direct upstream-to-downstream seepage paths. Therefore, all the failure modes originally identified during a PMF associated with soil/bedrock contacts became insignificant when the condition of a fully constructed barrier wall was considered. However, current exploratory drillings have verified seepage flowing through the hillsides and around the saddle dam abutments. Under this condition, seepage would circumvent the barrier wall, connect to physical features under the saddle dam, and erode the saddle dam earthen embankment even with a barrier wall.

The project delivery team (PDT) and non-government advisors noted in 2009 that the cost of constructing a barrier wall at the saddle dam was large and that an RCC Berm might be a cost-competitive alternative that also provides more robust technical and dam safety-related advantages that are discussed in more detail under the proposed RCC Berm Alternative.

Saddle Dam Failure Mode 2 – Overtopping and Loss of Concrete Panels: The second saddle dam failure mode postulated by the RA addressed the concrete-lined panels on the downstream of the saddle dam (Figures 8 and 9). As designed, should a flood occur that is greater than elevation 691.5 (fuse plug pilot channel), water would begin to erode the fuse plug pilot-channel and discharge over the concrete panels. In the potential failure mode, the hydraulic force of flood waters over the concrete plates underlined with voids could dislodge panels and thereby potentially erode the earthen embankment resulting in a saddle dam collapse and loss of most of the lake (Table 2), even with the barrier wall in place. Given the loss of structural integrity of the concrete panel cover, the RA identified overtopping of the saddle dam as a credible mode of dam failure.

2.3.2. RCC BERM WITHOUT FILL

This alternative would reduce risk significantly more than the saddle dam grout curtains, barrier wall, and coffer dam No Action alternative. It would preserve the lake to elevation 658’. No fill would reduce construction cost. None of the excavated soil and rock from the RCC Berm construction would be re-used. All excavated material would require more on or off site disposal. Without fill placed on top of the saddle dam concrete panels, uplift pressure from seepage flowing under the concrete panels would not be addressed. Water would pool in the open space between the saddle dam and RCC Berm. A culvert would have to be built through the RCC Berm to drain the water. The culvert would have to be gated and maintained to ensure operation. Uplift pressure would weaken the saddle dam and make it more vulnerable to premature failure at lake elevations less than the probable maximum flood (PMF) elevation of 691.4’ when the fuse plug pilot channel is suppose to erode. Under these conditions, an RCC Berm without fill is not as robust and reliable as a Berm with fill and is therefore not further considered in this EA.

2.3.3. RCC BERM WITH FUSE GATES

This alternative would reduce risk significantly more than the saddle dam grout curtains, barrier wall, and coffer dam No Action alternative. It would preserve the lake to elevation 658'. None of the excavated soil and rock from the RCC Berm construction would be re-used. All excavated material would require on or off site disposal. Water would pool in the open space between the saddle dam and the RCC Berm. A culvert would have to be built through the RCC Berm to drain the water. The culvert would have to be gated and maintained to ensure operation. Fuse gates are 30'tall metal tipping-buckets that would rest on top of the RCC Berm. The fuse gates would essentially replace the function of the saddle dam fuse plug. This replacement would only be needed if the fuse plug operates during a PMF. It is the opinion of the engineering team that the fuse gates only provide redundancy and reduce saddle dam rehabilitation costs after the fuse plug operates. They are not worth the additional expense and are no longer considered the best option. A post-PMF event is beyond the scope of this EA. Such a catastrophic event would require a new EA or EIS to address restoring Center Hill Lake flood pool storage (648'-685'). Based on this scenario, this alternative has been eliminated from further consideration in this EA. Even with fuse gates, the fuse plug would still function as designed. The RCC Berm would still preserve Center Hill Lake to 658'.

2.3.4. PROPOSED ACTION: RCC BERM WITH FILL

This alternative would reduce risk significantly more than the saddle dam grout curtains, barrier wall, and coffer dam No Action alternative. It would preserve the lake to elevation 658'. Fill would increase construction cost. No water would pool in the open space between the saddle dam and RCC Berm. A culvert would not be required, which would reduce operating cost. Excavated soil and rock from the RCC Berm construction would be re-used. Other sources include excavated material from the main dam, left rim cut stabilization measure, and rock from commercial quarries. Placing fill on top of the saddle dam concrete panels is an engineering decision to address uplift pressure from seepage flowing under the concrete panels. Fill would counteract uplift pressure to preserve saddle dam stability and make it less vulnerable to premature failure. The RCC Berm with fill provides the most reliability at the most reasonable cost and reduces risk below the tolerable limit threshold. This alternative is the dam safety and engineering preferred Proposed Action alternative and is considered in detail in this EA.

The proposed alternative is to construct an RCC Berm with fill downstream of the saddle dam embankment. This alternative has not been discussed in previous NEPA documents. The footprint for the proposed RCC Berm covers approximately 68 acres and is shown in Figure 1 (Red Boundary), and its location on the Project is shown in Figure 2. A conceptual design of the RCC Berm is shown in Figure 13.

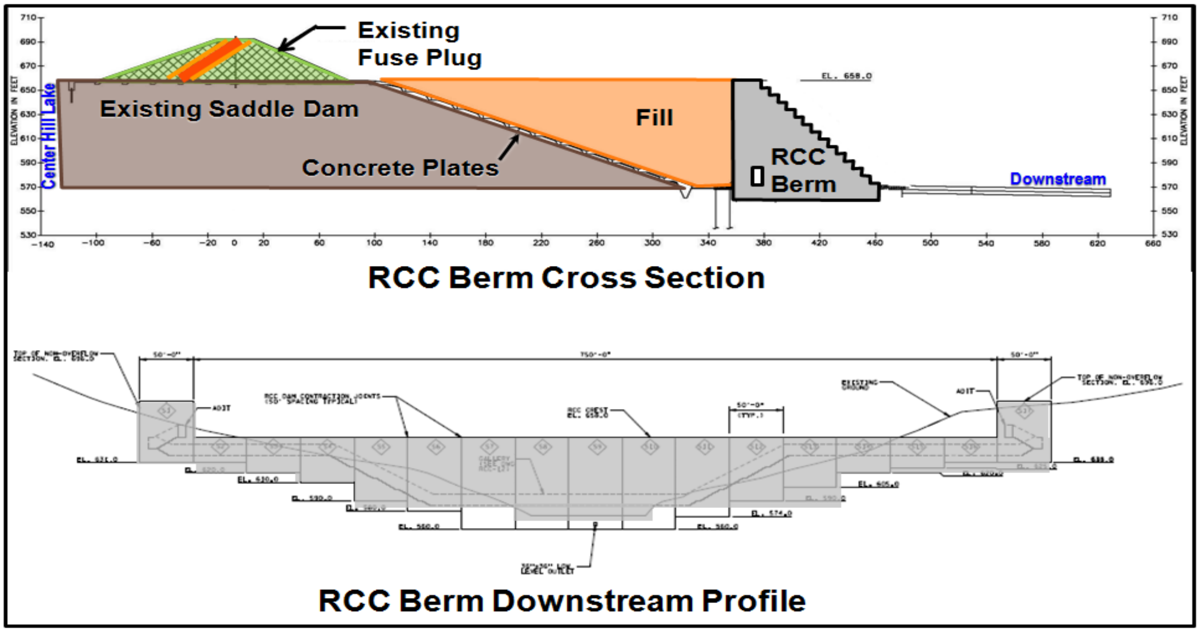

Figure 13. Revised Saddle Dam Plan – RCC Berm.

The PDT and non-government advisors identified the proposed RCC Berm as an alternative that provided technical and dam safety-related advantages. The RCC Berm met dam safety guidelines for tolerable risk and was more reliable, robust, easier to build and inspect, and was less costly than the No Action alternative. As a result, the PDT studied the feasibility of constructing an RCC reinforcing berm downstream of the existing saddle embankment to act as a barrier in the event of a catastrophic failure of the saddle dam. A solid RCC Berm would be resistant to seepage effects (piping erosion) and overtopping. A saddle dam failure with this alternative in place would preserve the lake at elevation 658 (Table 3).

<u>Anticipated RCC Berm Construction Activities:</u> In the conceptual design (Figure 13), the RCC Berm would be approximately 100’ tall from its base, and 900’ long. The base would be approximately 160’ wide. Two 50’ concrete aprons would extend upstream, downstream, and along the sides of the base of the RCC Berm. The top crest would be about 35’ wide at elevation 658’ – the same elevation as the saddle dam. An estimated 100’ buffer would encircle the saddle dam, RCC Berm, and concrete apron to maintain clear access to the structures and facilitate dam safety inspections. The RCC Berm’s foundation design would include excavation of all weathered rock, micro-blasting, and appropriate treatment of karst features (grouting, dental concrete and concrete blanket) discovered in the footprint of the berm and abutment areas. These construction activities would treat the foundation against seepage. Blasting would be limited and vibrations controlled to attenuate within 1000’ of the blast site. A grout blanket would be placed upstream and downstream the RCC Berm’s centerline. Rock and soil would be excavated from the hillsides and used in road construction, disposed of in a laydown and aggregate storage area below the saddle dam, in existing onsite disposal areas, onsite construction activities, or in state and Corps approved disposal facilities.

The RCC Berm would be a solid concrete structure constructed with layers of compacted concrete with fill placed on top of the concrete plates between the saddle dam and the RCC Berm. Storm water from the RCC Berm and saddle dam would be conveyed to a swale (wet weather conveyance) and enter Moss Hollow Branch just as storm water currently flows off the saddle dam and enters Moss Hollow Branch.

Concrete batch plants may be located on site or off site. Onsite locations would be in previously disturbed locations. Existing off site, State permitted batch plants may also be used in coordination with or independent of onsite plants. Sand and gravel may be stockpiled on site in the laydown area on the valley floor below the saddle dam or in the existing saddle dam disposal area adjacent the top of the saddle dam. These materials may also be stored off-site at batch plants or in state permitted and Corps approved construction facilities.

An evaluation for locating concrete batch plants and associated aggregate materials on or off-site was conducted to support the 2006 EA, Supplement 1. This evaluation addressed impacts associated with on or off site facilities and to concrete production. The evaluation found that a customized concrete blend that met specific engineering requirements was not typically provided by commercial facilities. There were also time (45 minutes), aggregate type (reactivity with concrete), temperature (the aggregate needs be cold), and volume (the need for a dedicated plant) constraints that plants would need to meet. This evaluation is included in Appendix A and therefore is not further discussed in this EA.

Borrow material would come from natural soil and rock excavated on site from the left rim stabilization and/or stone removed from the main dam platform extension after barrier wall construction. Additional fill material may come from State permitted and Corps approved commercial sources. Rock, soil, cured concrete, and rock chips may be a source for access road improvements and fill for leveling laydown areas, or fill for the RCC Berm. If an off-site disposal site is used, the site would be a State and Corps approved permitted site. Any disposal that would be placed in another location, other than locations identified in this EA, would require further NEPA review by the Corps as well as any additional environmental compliance required based on the site conditions.

<u>Anticipated RCC Berm Impacts:</u> The proposed RCC Berm covers about 68 acres. Twenty-four acres is considered permanent (saddle dam, staging area and roads) and temporary open space (existing saddle dam disposal site and field and scrub brush). Forty-four acres is forest habitat. Construction activities would include up to 30 acres of tree removal (Table 5).

Roads around the existing saddle dam disposal site would be relocated to accommodate RCC Berm construction. Relocation would include tree removal. The right rim access road to the top of the saddle dam would be improved. Improvements would consist of installing a guard rail, removing selected trees, hardening the road surface, and scarifying the bluff to remove loose rock to reduce the risk of rock falling onto vehicles and equipment using the road.

Table 5. Right Rim – Existing Condition and Future Impacts.

Feature	Permanent Open (Acres)	Temporary Open (Acres)	Wetlands (Acres)	Intermittent Stream (Linear Feet)	Forest (Acres)
Right Rim (68 acre footprint)					
Saddle Dam	7				
Staging Area – Top of Saddle Dam	1				
Haul Road to Top of Saddle Dam and Radio Tower	1				
Haul Road to Bottom of Saddle Dam	1				
Corps Storage Building and Road	1				
Saddle Dam Disposal Area		7			
Scattered Pockets of Open Field/Scrub Brush		6			
Wetland Loss+			**(0.13)**		
Wetlands – Avoided			0.21		
Moss Hollow Branch – Permanent Crossing				**(50)**	
Moss Hollow Branch – Temporary Encapsulation*				**450**	
Moss Hollow Branch – Avoided				4,800	
Forest – Temporary Removal					**25**
Forest – Permanent Removal					**(5)**
Forest – Avoided					14
Right Rim Totals	**11**	**13**	**0.34**	**5,300**	**44**

+ Permanent Loss () Lost acres would be replaced in Temporary Open areas with tree seedling plantings.
*** Temporary Impact () Cut acres would be stabilized with warm season grasses and tree seedling plantings.**

Trees would be removed to construct the laydown and aggregate storage area in a level area in the valley below the saddle dam. The access road to the bottom of the saddle dam is approximately 3,000' long. The access entrance would be widened to provide a safe pullover and to minimize impact to the two-way traffic to and from Edgar Evins State Park (Park). Trees would be cut to widen the access road to accommodate large equipment. Pull-over lanes may be considered where the road narrows at some locations. Road improvements would include one stream crossing. Initially, a temporary stream crossing (15-30' wide) may be used. The bridge crossing may be up to 50' wide and would permanently cover Moss Hollow Branch. Up to 450' of Moss Hollow Branch would be temporarily covered or encapsulated to accommodate an equipment and aggregate storage area. To minimize stream impact, the stream substrate would not be disturbed. A bottomless culvert crossing or equivalent would protect the stream substrate.

A 0.13 acre wetland is located adjacent the road. The wetland cannot be avoided and would be filled and mitigated to accommodate road and laydown area construction. The total anticipated impacts (wetland, stream, and temporary and permanent forest loss) due to potential RCC Berm construction are shown in Figure 14 and listed in Table 4. More detail regarding environmental impacts is provided is Section 3 Environmental Consequences.

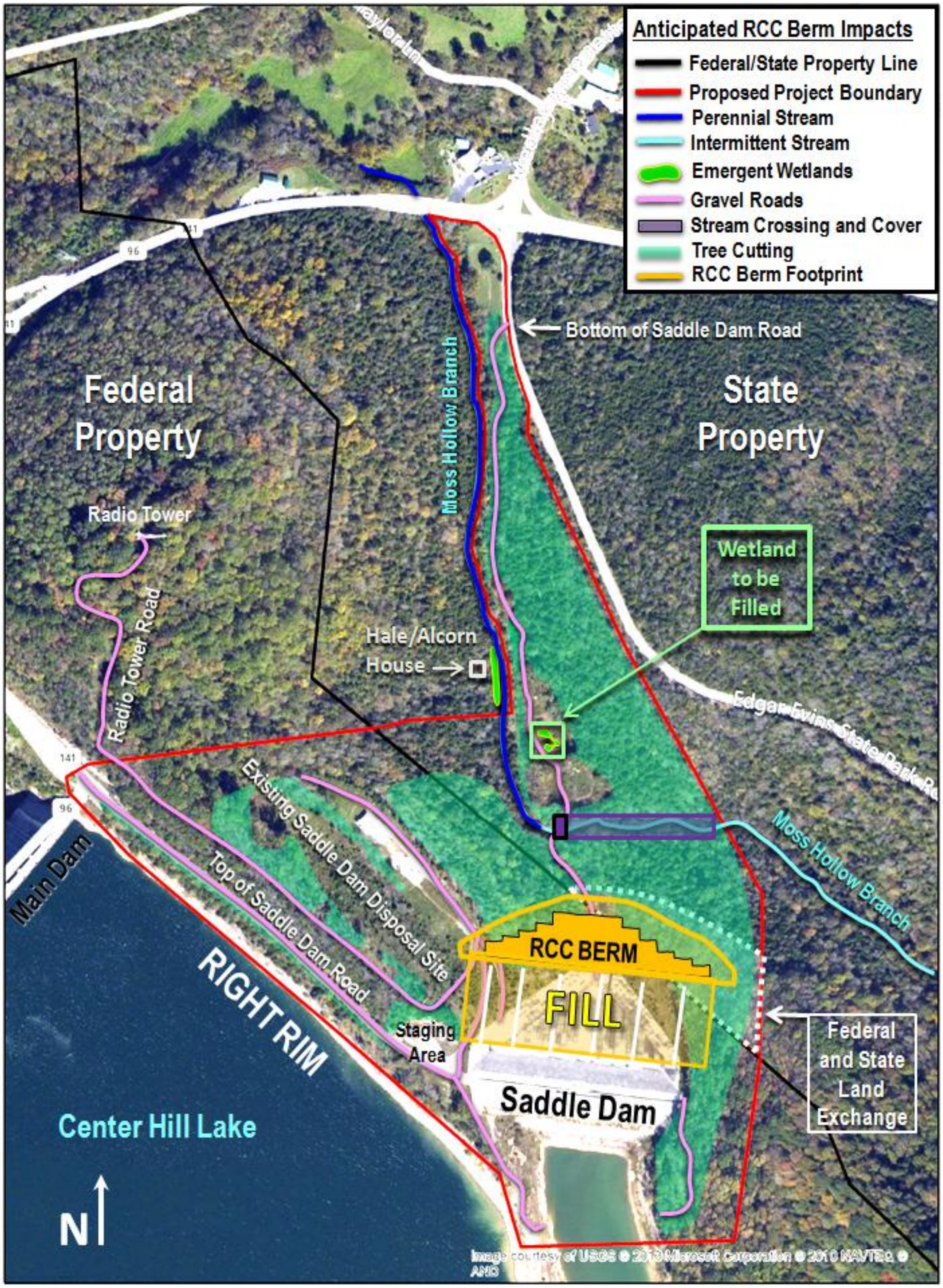

Figure 14. Total Anticipated Impacts – Right Rim – RCC Berm Construction.

2.4. ENTIRE PROJECT

NO ACTION

The No Action alternative would plan for periodic maintenance and operation grouting on 15-20 year interval for the entire project. Maintenance grouting would follow the existing grout curtain paths shown in Figure 2.

PROPOSED ACTION

Periodic maintenance and operation grouting would not be planned for the entire Project. The main and saddle dam embankments are the only features at the Project with credible seepage and piping failure modes. The main dam embankment would be protected from seepage and piping failure by grout curtains and a barrier wall. The RCC Berm would preserve the lake level to the top of the RCC Berm (658'). The RCC Berm is the only structure that may require future maintenance grouting. As a water bearing structure, uplift pressures will be lessened by maintenance grouting along the RCC Berm foundation and abutments.

2.5. INTERIM OPERATING PLAN AND PLANNED INCREMENTAL POOL RISE

Center Hill Lake operating pool alternatives were described in the 2007 November EIS (Table 1). The purpose of the EIS was to identify an IOP range that would reduce hydraulic pressure on the main and saddle dam foundations and have the least impact to project authorities and the environment. The No Action alternative (Alternative 1) was to maintain normal operating pool elevations following the established guide curve range between 623.5'-648' without regard to hydraulic pressure or dam safety. The Dam Safety and Engineering Preferred alternative (Alternative 5) was the selected IOP range. The Corps Water Management Branch would operate the pool between 618'-630' (Table 6). The selected IOP lowered the crest of the summer pool (top of the guide curve) by 18' but effectively preserved the winter pool (Figure 10). The selected IOP alternative became effective when the ROD was signed on February 13, 2008. The EIS identified the IOP as a temporarily measure. The pool would be incrementally raised as determined by dam safety guidelines and when a sufficient number of project features have been completed to safely return the lake to normal operations (623.5'-648'). Data collected from piezometers, uplift cells, inclinometers, monuments, and weirs would determine timing and range of incremental pool rise. The timing and range of the increments is unknown at this time, but may range from a few to several feet depending on how much each project feature contributes to dam failure risk reduction and increased dam safety.

Though not a separate section, the EIS considered the effects of climate variability which is driven by rainfall conditions (Table 6). Resource impacts were evaluated under different pool elevation alternatives and under dry (drought), typical (normal) and wet (flooding) seasonal rainfall patterns. Table 6 implies that when the pool was raised in 5' increments, impacts to project purposes would lessen. Table 6 also indicates that any amount of incremental pool raise higher than 630' would be anticipated to lessen impacts. The scope of impacts described in this section since 2007 are based on

Table 6. Selected IOP (Alternative 5) and Projected Impacts Based on Rainfall Conditions.

Alternative	Top Pool Elevation (ft)	Flood Damage Reduction			Hydropower			Navigation			Recreation			Fish and Wildlife			Water Quality			Water Supply		
		Year *			Year			Year			Year			Year			Year			Year		
		T	D	W	T	D	W	T	D	W	T	D	W	T	D	W	T	D	W	T	D	W
1	648/623.5 (No Action)	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
2	645/623.5	None	None	None	None	Minor	None	None	None	None	None	None	None	None	None	Minor	Minor	Minor	None	None	None	None
3	640/623.5	None	None	None	Moderate	Moderate	Minor	None	Minor	None	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Moderate	Minor	None	Minor	None
4	635/623.5	None	None	None	Moderate	Severe	Moderate	Minor	Minor	None	Minor	Minor	Minor	Moderate	Minor	Severe	Moderate	Moderate	Moderate	Minor	Minor	None
5	630/618	None	None	None	Severe	Severe	Moderate	Minor	Moderate	Minor	Moderate	Moderate	Moderate	Severe	Moderate	Severe	Severe	Severe	Moderate	Moderate	Moderate	Minor
6	625/623.5	Moderate	Moderate	Moderate	Severe	Severe	Severe	Moderate	Moderate	Moderate	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe
7	625/618	Moderate	Moderate	Moderate	Severe	Severe	Severe	Moderate	Moderate	Moderate	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe
8	622 (Flat-line)	Severe	Severe	Severe	Severe	Severe	Severe	Moderate	Moderate	Moderate	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Moderate	Severe	Severe	Severe
9	Emergency 618-496	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe

* Study Year; Rainfall Conditions: T – Typical D – Dry W – Wet

Negative Impact: None | Minor | Moderate | Severe

(Source: 2007 EIS)

findings from the April 2013 draft Corps IOP restrictions at Center Hill Dam (Corps 2013).

The Project Guide Curve for Center Hill Lake represents the primary guidance for operating pool elevations (Figure 10). Center Hill Lake is divided into distinct pools or layers based on three congressionally authorized elevations (EL 618', 648', and 685'). These pool elevations form operating boundaries for flood storage (648' – 685'), hydropower (618' – 648'), and conservation (river bottom 470' – 618') to serve project purposes throughout the year. Under normal operations, the project guide curve maintains the pool elevation range between 640' and 648' (mid-March – mid August), and tops out at elevation 648' for approximately 30 days (Mid-May – Mid-June) (Figure 15). The lake elevation in winter is generally maintained between elevations 623.5'-632'. Elevations are weather event driven and therefore are frequently variable during dry (2007, 2008, 2012) typical (2010) and wet (2009, 2011, 2013) years (Figures 15 and Figure 16). What can be seen is that most of the inflows occur in the first half of the year. Under normal operations, the inflows would have been stored and released within the project guide curve band in the last half of the year. Under the IOP, inflows are rapidly dropped to the target 630'. Significant extremes in terms of lake levels and project releases have been observed at Center Hill during the 2007-2013 periods when the pool restrictions have been in place.

The hydrographs (Figures 15 and 16) infer that the actual difference between interim and normal pool operations is the length of time the pool remains above 630 and the speed at which the lake is returned to elevation 630 following a rainfall event. As seen

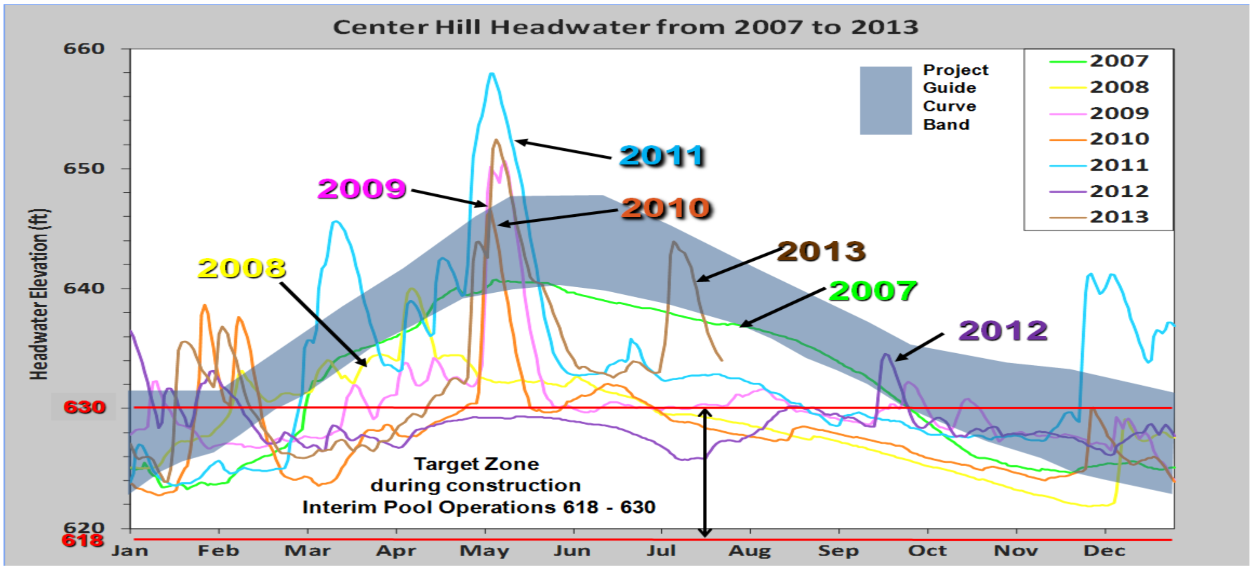

Figure 15. Center Hill Lake – Project Guide Curve and Yearly Hydrographs.

in Figures 15, the lake is dropped quickly to target interim pool elevation of 630 while normal pool operations would have preserved the early spring, summer, and early fall elevations within the project guide curve (Figure 16).

An evaluation of the annual hydrograph cycles since 2007 (Figure 15 and 16) showed that the pool typically exceeded 630'. Since 2007, the pool rose above elevation 630' approximately 43.2% of the time, and above 648' about 1.4% of the time. Center Hill Lake met or exceeded summer pool in 2009, 2010, 2011, and 2013 (Figure 16).

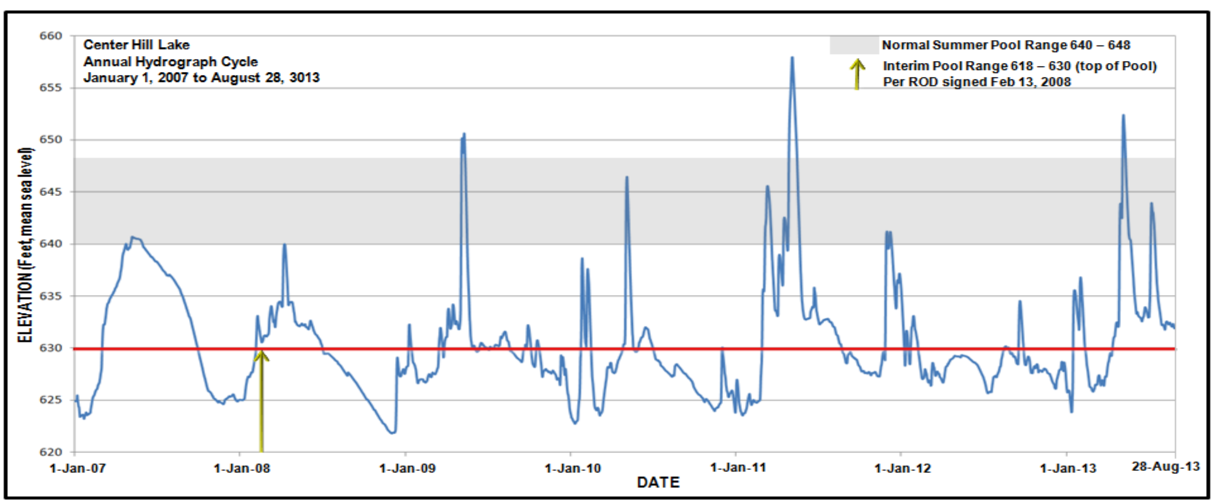

Figure 16. Annual Weather Driven Hydrograph.

The 2007 EIS addressed environmental impacts to project purposes and resources in detail and assumed the worst case scenario and anticipated that the greatest impacts would occur if the pool dropped closer to 618'. Returning to normal pool operations (status quo) was anticipated to have negligible impacts. This section serves to summarize climatic effects since 2007 and its impacts to date.

Flood Damage Reduction

The IOP for the Cumberland Basin reservoir system places a priority on evacuating storage at Center Hill Lake following high water events. This has the effect of increasing the flood risk downstream due to higher than normal releases from Center Hill Lake. Also, at the other flood control projects in the Cumberland Basin, water may be retained in the flood control pool for longer durations, thus reducing the volume of flood control storage available. Current USACE Dam Safety regulations recognize that flood damage reduction operations may be required concurrently with pool restrictions. Provisions are included that allow temporary variance from Interim Risk Reduction Measure pool restrictions to support flood damage reduction operations. Downstream impacts will always be a primary consideration when setting release schedules.

Hydropower

The hydropower pool extends from the top of the conservation pool elevation of 618' up to elevation 648' (Figure 10). The normal operation at Center Hill is to favor the top of the Southeastern Power Administration (SEPA) power marketing zone (synonymous with the project guide curve), targeting a June 1 elevation of 648'. The 2007 risk reduction measure for Center Hill Dam was to operate the project within a zone bounded by elevation 618' and elevation 630', thus targeting a June 1 elevation of 630'. This operation has reduced the volume of water in storage by about 309,000 acre-feet (62.8%), but does retain some operational flexibility to support project and downstream water management objectives.

The pool restriction at Center Hill Dam has resulted in significant impacts to hydropower interests. Power customers have seen reductions in the amount of hydropower available and the timing (value) of its availability. Generation has been pushed off peak when it is less valuable during periods when water levels at Center Hill are being lowered following significant rainfall. Pool lowering at Center Hill has resulted in increased spilling at main-stem plants when the resulting river flow exceeds the capacity of the hydropower units. Hydropower interests have also seen a seasonal impact where water is generally not available in the late summer and fall when it is extremely valuable, particularly from a peaking perspective, due to the lack of water in storage. As seen in Table 6, it was anticipated that this lack of water storage would be addressed through incremental pool rising at Center Hill. Excess inflows during periods of significant rainfall can be incrementally stored as opposed to their aggressive release according to the IOP. This would result in hydropower benefits in both the short-term (reduce generation pushed off peak) and long-term (availability in the summer and fall for peaking purposes). The time, duration, and amount of incremental pool raise will be determined by dam safety evaluations.

Navigation

Impacts to the Cumberland River navigation system are expected to remain at manageable levels by holding more water in the mainstem projects to maintain acceptable navigation conditions. However, a rapid drawdown at Center Hill, followed by severe reductions in discharge, creates abrupt river fluctuations that affect navigation conditions. The lock approaches to Cheatham and Old Hickory along with the main river channel through Nashville are critical areas for commercial navigation. A lower than normal Old Hickory pool elevation impacts recreational boating, but lowering has less of an impact to commercial navigation. When lowering Center Hill Lake a smooth transition is critical to avoiding navigation impacts downstream.

Recreation

The Nashville District has worked with Center Hill Lake marinas, fishermen, boaters, campers and day users to ensure continued recreation opportunities with the reduced pool levels. Mitigation measures included extending boat ramps in Center Hill Lake. Wading was noticeably reduced for tailwater fishermen when the pool was quickly pulled down to 630'. At higher incremental pools, more water could be held and not released as abruptly to provide more wading time in the tailwater.

Fish and Wildlife

The lake fishery was affected by the IOP. Cover (overhanging trees, undercut banks, tree roots, logs and stumps) was lost or exposed along the shore when the lake was abruptly drawn down. There is little that can be done to lessen the impact until the lake can be incrementally raised. A positive impact to the lake fisheries was anticipated in the 2007 EIS when the pool was incrementally raised and returned to normal operations. Vegetation was allowed to grow in the exposed shoreline with lower lake levels. The vegetation would be inundated during incremental raises and normal operations and would provide additional food and cover for the lake fishery.

Potential threats to the tailwater trout fishery were anticipated in the 2007 EIS. During extended periods of low flow and a lower lake, concerns were raised regarding water temperature and dissolved oxygen. Sluice gate discharges have been used to supply cold oxygenated water to the Caney Fork River below Center Hill Dam. However long-term use was considered risky since the cold water storage in the lake was markedly reduced under the IOP. Sluice releases can be effective up to a point, but once the cold water is gone there is nothing that can be done to protect the tailwater trout fishery. Mitigation included rehabilitation of the station house generator to supply up to approximately 200 cfs of water during low flow. An orifice gate was installed in the sluice gate to preserve cold water storage and to supply approximately 250 cfs of cold, well oxygenated water.

Water Quality

The IOP identified water quality as a high priority only behind flood control, dam safety, and water supply. Center Hill has faced cold water and dissolved oxygen challenges with a lower pool. However, the risk to the tailwater trout fishery has been minimal. Orifice gate, and service house generator (SSG) were mitigation measures for plugging the upper and low leaks, but plugging was not implemented. Sluice gate, orifice gate, and SSG releases have been viable enhancement measures to manage tailwater cold water and dissolved oxygen issues.

Water Supply

The greatest threat to water supplies was anticipated to occur during drought conditions when the power pool could drop to 618'. There are three water supply intakes on Center Hill and they are all located below the bottom of the power pool (deeper than 618'). With an IOP range between 618'-630' the water supply intakes have not been impacted. The Smith County Utility District has an intake in the Caney Fork River tailwater about 19 miles downstream from Center Hill Dam. With the seasonal storage provided by IOP there have been no quantity related issues with this utility. Center Hill routinely coordinates with staff at the water treatment plant when sluicing operations are initiated so they can anticipate changes in raw water quality and adjust their treatment accordingly.

Typical and wet years noticeably reduced impacts to hydropower, recreation, water supplies, the tailwater trout fishery, water quality, and downstream navigation. As documented in the 2007 EIS, anticipated impacts of a lower pool during drought conditions were mitigated. As seen in Figure 15, any amount of incremental pool rising, and an eventual return to status quo (normal operations 623.5'-648') is not expected to result in any further substantive impacts to project purposes and resources.

3. AFFECTED ENVIRONMENT AND CONSEQUENCES

In this section, the existing resources are described and a comparison of the impacts of the No Action and Proposed Action plans is made. The No Action plan is the previously approved 2006 MRER plan. The Proposed Action is the draft 2013 MRER supplement that includes design changes and a new alternative for revised project features (Table 1). Only the revised project features are addressed in this section. It is again emphasized that each revised project feature is independent of another feature, so changes in an individual feature could be dropped or modified without affecting overall seepage and rehabilitation repairs.

3.1. GENERAL ENVIRONMENTAL CONDITIONS

Land use in and surrounding the Project is a mix of recreation, forest, meadows, lawns, and major transportation corridors. Recreational lands include the Corps campgrounds, beaches, and picnic areas, and forested lake lands surrounding the lake (approximately 21,000 acres), Edgar Evins State Park (Park) (approximately 6,000 acres), and Corps, Tennessee Wildlife Resources Agency (TWRA) and Park boat ramps. Interstate 40 and the Louisville and Nashville Railroad cross the Caney Fork River tailwater approximately 10 miles downstream of the main dam. State Highways 96 and 141 cross through the project and over Center Hill main dam. The forest and Center Hill Lake support an abundance of aquatic and terrestrial wildlife. The Caney Fork River tailwater supports a trout fishery. The land surrounding Center Hill main and saddle dam is primarily lawns, a campground, and forest. The public is not allowed within the footprints of the left and right rims (approximately 235 acres) due to construction, safety, or security reasons.

3.2. PREVIOUSLY COVERED RESOURCES

The original 2005 EA, 2006 EA Supplement 1, 2008 EA Supplement 2, and 2007 EIS provided descriptions of several environmental resources and these descriptions are unchanged from the previous documents. Since these documents are incorporated by reference, discussions of these unchanged resources are not duplicated in this EA. Only the right rim RCC footprint (68 acres) and affected areas on the left rim (approximately 20 acres) are discussed in this EA as the existing (baseline) condition; therefore, some of the sections overlap with descriptions from previous documents.

3.3. PHYSIOGRAPHY

Center Hill Reservoir is located within two physiographic provinces of Central Tennessee designated as the Central Basin and the Highland Rim. The Central Basin is a nearly elliptical area enclosed by the Highland Rim. The Central Basin was formed by erosion of the Nashville Dome, a low structural dome that makes up the structural and geographic center of the Basin. The dome represents the southern end of the Cincinnati Arch, an elongated area of up-warped rocks that extend into Tennessee. During the up-warping and doming, the rocks at the crest of the dome were stretched, resulting in the formation of joints.

The weakened carbonate rocks were readily subject to solution and erosion, resulting in a topographic basin that now occupies the top of the structural dome. The Basin is characterized by calcium carbonate sedimentary rocks of Ordovician age. These sedimentary rocks comprising the Central Basin include limestone, shale, dolomite, siltstone, sandstone, and claystone.

The Highland Rim is a ring-shaped hilly upland completely encircling the Central Basin. It stretches from the western margin of the Cumberland Plateau southward and westward as far as Kentucky Lake. Terrain is a level to rolling plateau with soil cover varying from 20 to 100 feet thick. Bedrock is flat-lying limestone of Mississippian origin. Numerous rock outcrops and sinkholes are present in this region. Sinkholes are formed by the collapse of underground cavities dissolved out of limestone by the flow or percolation of subsurface water streams and seepages. In areas where such sinks are common, the terrain is referred to as karst topography. The Center Hill seepage repair and rehabilitation project is located in karst topography (Corp 2005 and 2006a).

NO ACTION

There would be no grading and reshaping to topographic contours due to RCC Berm construction, sinkhole repairs, dam safety clearing, left rim stabilization, or disposal of soil and rock from onsite excavation activities. Construction of the saddle dam grout curtains, barrier wall, and cofferdam alternative would not affect physiography; however, physiography (continued development of sinkholes, solution voids and fractures) would affect this alternative. Without an RCC Berm, over time continued development of karst features surrounding the barrier wall would eventually connect to known karst features under and surrounding the saddle dam. With sufficient karst development, the saddle dam would be expected to fail similar to saddle dam failure Mode 1 (2.3 Saddle Dam Embankment).

Sinkholes, leaks, and the left rim cave would be plugged to stop water loss. Back pressure from plugging the flow in the left rim cave could potentially lead to more deleterious groundwater flows nearer to or beneath the main embankment dam. Back pressure from plugging the upper and lower leaks could redirect flow to the bluff or connecting concrete monoliths and affect their stability. Plugging the sinkholes would backup water in the solution features to likely create more collapsing sinkholes in the adjacent area.

Without stabilization, erosion of the left rim cut would continue for some time to produce rock slides and debris flows. Without tree clearing, karst development along the groin may be overlooked.

PROPOSED ACTION

Minor grading and reshaping of topographic contours would be required at the RCC Berm, repaired sinkholes, left rim cut stabilization, dam clearing, and onsite disposal areas. The contours would be blended into the surrounding ground surface to ensure stable hill slopes. Development of caves, leaks, and sinkholes in karst terrain is a natural process that provides a surface to groundwater connection. None of these features would be plugged. Water would flow in and through these features unimpeded.

The RCC Berm foundation would be excavated to competent rock and eliminate in-situ karst features. The RCC Berm is a solid concrete structure, impenetrable to, and unaffected by karst seepage paths that would continue to develop under and circumvent the saddle dam. Filling the space between the RCC Berm and saddle dam would provide hydraulic back pressure and counteract developing seepage pressure under the saddle dam concrete panels. Repaired sinkholes would retard ground surface collapse. Washed out clay from solution features and bedding planes would be seen and stabilized in the left rim cut stabilization and dam safety areas. In time the disturbed areas are expected to blend in with the surrounding terrain.

3.4. CLIMATE

The climate of the area is distinctly continental with moderate temperatures averaging about 60 degrees Fahrenheit and on occasion, exceeding 100 degrees or falling below zero Fahrenheit. The length of the average growing season is about 210 days, extending from early April to the end of October. Annual precipitation for the basin averages 48 and 56 inches (EPA Ecoregions, 2004). The Cumberland Basin has experienced a wide range of weather conditions over the period 2007-2013 while pool restrictions have been in place at Center Hill. Dry (drought) years occurred in 2007, 2008, and 2012. The more typical rainfall occurred in 2010. Significant impacts involving multiple project purposes and resources (flood damage reduction, hydropower, navigation, recreation, fish and wildlife, water quality, and water supply) were anticipated by the 2007 EIS and summarized under Section 2.5 Interim Operating

Pool (IOP). River and reservoir conditions were fairly stable and overall impacts were less than anticipated.

Climate has been highly variable in Middle Tennessee. Droughts do not pose a serious threat to any of the alternatives. However, extreme floods are a serious threat. Changing weather patterns could exacerbate and increase the frequency of droughts and floods in the region. A changing climate would have a varying effect on project features in both the approved and revised plan. The recent wet rainfall years (2009, 2011, and 2013; Figure 16) imply that climate change may be increasing the risk of severe flood events.

NO ACTION

Implementing the saddle dam seepage repairs (grout curtains, barrier wall, and cofferdam dam) during an extreme flood event would be risky and subject to dam failure. The cofferdam would need to be designed to a thickness and height to withstand flood events. Even with aggressive pool drawdowns, the pool rose to or near the top of the saddle dam (658') in 2009, 2011, and 2013 (Figures 15 and Figure 16). Overtopping of the cofferdam during barrier wall construction would likely simulate Failure Mode 2. Frequent high inflow events would increase hydraulic pressure on the saddle dam. Should seepage and piping circumvent the completed barrier wall and connect with solution features under the saddle dam, it is likely that a Failure Mode 1 would occur. Both failure modes would effectively drain the lake.

The left rim grout curtain would be completed by plugging the left rim cave to stop water loss. Downstream sinkholes would be plugged to stop water loss. More frequent and intense inflows influenced by climate change would increase the frequency of high pool events that increase hydraulic pressure to groundwater paths. Groundwater back pressure would be expected to hasten erosion in solution features and force the groundwater to reroute around the plugged cave and sinkholes. Groundwater back pressure and increased storm water runoff would likely aggravate new sinkhole development and collapses.

Grouting the right rim and abutment would be expected to reduce seepage paths even under high pool elevations. However, as with the left rim cave, grouting could increase internal rock pressures and cause the seepage to migrate elsewhere. However plugging the upper and lower leaks would likely have similar consequences as plugging the left rim cave. Back pressure may force bedding plane separation and a rerouting of flow through other, unseen and unmonitored solution features. Plugged leaks cannot be measured and monitored so it would not be possible to determine if seepage flow is changing over time.

The No Action alternative for the entire project would schedule maintenance grouting in 15-20 year intervals. Grout curtains for the entire project may be affected by hydraulic pressure from high pool events and groundwater pressure that would result in fractures, and washout of solution features. Periodic maintenance grouting of the whole project would fill new voids. However, seepage loss through grout curtains is considered a water loss and not a dam safety concern. Effective grout curtains may impede water flow and result in back water and unknown re-routing of seepage paths.

Under a No Action, no revisions to project features described in the revised plan would be implemented. The RCC Berm would not be constructed. Sinkholes would not be repaired and stabilized to convey ground and surface water and impede accelerated enlargement and collapse. The left rim cut would continue to destabilize and erode and the associated storm water pond would have to be maintained. Without tree removal in the dam safety clearing area, karst development along the groin may be hard to detect. Without a new Picnic Spring culvert under Highway 141 and Campground Road, long periods of backwater may inundate and drown the quarry wetland particularly during wet years. If the left rim Picnic and Quarry spring weirs; and the right rim upper and lower leak weirs are not repaired, then variable flow conditions that may be linked to changing climatic conditions cannot be monitored.

PROPOSED ACTION

The RCC Berm is the proposed new seepage repair alternative for the saddle dam in the draft revised plan. Climate extremes (droughts and floods) are expected to have little effect on this alternative. The RCC Berm is a massive concrete structure that would be securely embedded into competent bedrock and into the valley hillsides. The RCC Berm would be more operable and reliable in dealing with potential climate change. Seepage paths and solution features would be removed from the foundation's footprint. The RCC Berm's purpose is to contain a failed saddle dam, and then function as a saddle dam to maintain the lake to an elevation of 658'. The structure is designed to remain fixed in place and to withstand repeated over-topping events. To restore the flood pool from elevation 658' to 685' would require other construction alternatives to regain approximately 30' of storage space which would be evaluated under a different NEPA document.

The left rim grout curtain would remain ungrouted at the cave location. The cave would not be plugged. The groundwater would flow unimpeded. Flow fluctuates with the lake and is most noticeable when the pool is greater than 635'. The flow through the cave exits at Picnic Springs. In wet years and high flood pool, flow through the cave would be expected to increase. The cave is not a dam safety concern. Flow is only a water loss.

The left rim cut would be stabilized to arrest erosion and reduce rock falls. Severe storms intensify hillside erosion, rock falls, and storm water runoff. The storm water flow pattern would be redesigned to eliminate the need for the left rim cut storm water pond (Figure 2). Sinkholes would be repaired to retard rapid collapse and enlargement. Sinkhole development generally intensifies with severe storm events. Subsurface flows usually erode soil from beneath and surface water erodes the top soil. Some of the sinkholes are linked to the lake. Water can be seen flowing in the sinkholes when the lake is within the flood pool. Repairs would follow a standard State TDOT sinkhole treatment (Figure 4). The repairs would not impede subsurface water within, or surface water to a sinkhole. Trees would be removed from the left groin in the dam safety clearing to allow monitoring of ground changes that may, or may not be related to climatic events such as drought (dried, cracked ground surfaces) or severe storms (muddy flows and hill slope slides). The spring culvert would be replaced. Storm events already results in inundation of the Picnic and Quarry Springs for a short period of time. Severe storms are likely to result in road flooding and long periods of inundation to the springs and quarry wetland until the culvert capacity can be restored. Spring weir repairs would allow flow monitoring to determine the extent spring flows are influenced by storm and flood pool events.

The right rim and abutment would not be grouted. High pool events may result in increased seepage through the right rim and abutment; however the seepage paths are known and can be monitored. The upper and lower leaks would not be plugged. Variable high pool events may increase the leaks. Flow may be constrained regardless of high pool event as both leaks are encased in rock for their entire length. The upper and lower leak weirs would be repaired. Discharge could be measured and monitored to identify any links between climate condition and changing flow volumes.

Periodic maintenance grouting of the entire project is no longer deemed necessary. A reanalysis showed that only the main and saddle dam embankments had credible seepage and piping failure modes. None of the other grout curtains are associated with a dam failure mode. Resulting seepage may increase or decrease with varying rainfall conditions, but the flow is considered a water loss issue.

3.5. FEDERAL AND STATE PROPERTY EXCHANGE

The U.S. Government (Corps) is proposing a land exchange on lands under the control of the Corps and the State of Tennessee, Edgar Evins State Park (Park). The proposed exchange involves two parcels, each consisting of 3.47 acres (Figure 17). The land exchange is necessary so that the entire RCC Berm and associated dam safety inspection area would be constructed on federal property (Figure 14). The land the State is proposing to transfer to the Corps is forested. The land the Corps is proposing to transfer to the State is currently leased to the State as part of the Park and includes the Park's visitor center, observation tower, and road entrance. The State Park expresses positive support for the land exchange as they would own the Park facilities. The remaining Park land located within the proposed impact footprint would remain in Park ownership. A temporary work area easement (TWAE) would be acquired to access park land within the RCC Berm footprint. Resource impacts on Park property are included in this EA. The Corps would seek permanent easement for the saddle dam and RCC Berm access road and will be responsible for road construction, maintenance, and repair. The road is 15' wide and 3,000' long from its entrance to the base of the saddle dam. It is anticipated that no changes to the existing activities on the parcel of land that would be deeded to the Park are planned. It would be maintained in its current condition. Unforeseen future impacts to the proposed parcel deeded from the Corps to the Park would be the Park's responsibility to address and are not further considered in this EA.

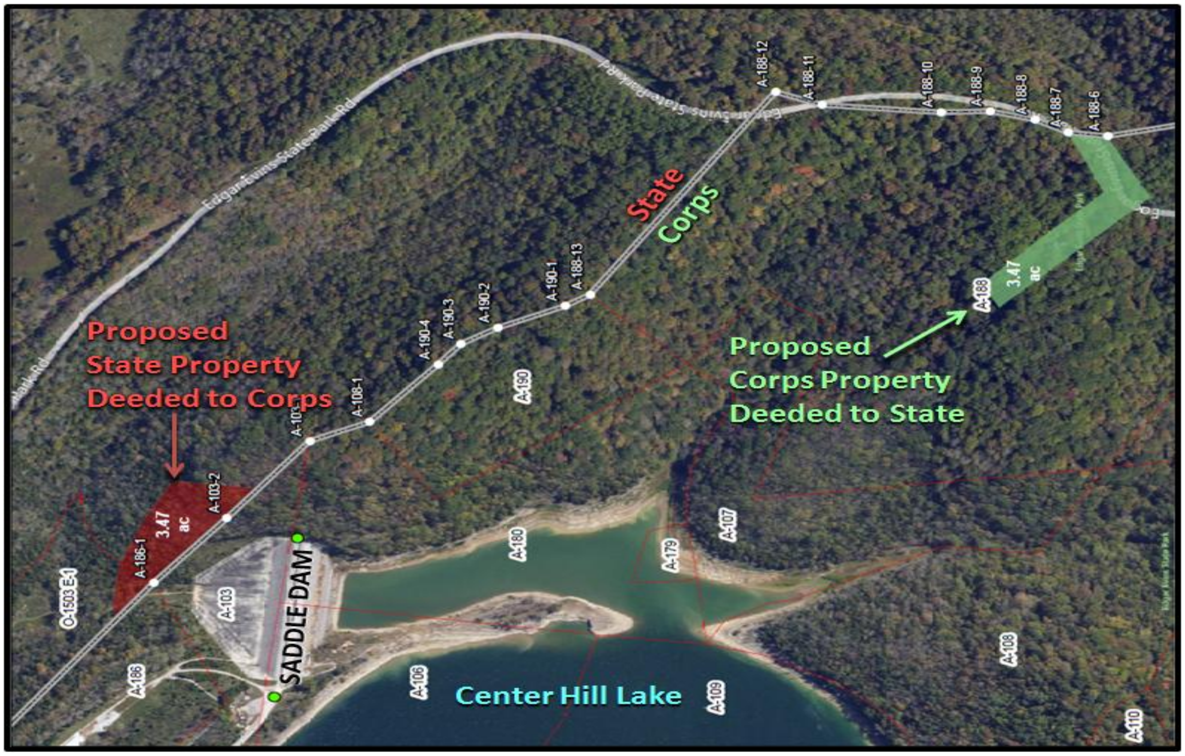

Figure 17. Federal and State Property Exchange Aerial.

NO ACTION

No Action would implement the previously approved plan alternative to install grout curtains and a barrier wall into the lakeside of the saddle dam and construct a cofferdam. No land exchange is needed for the previously approved plan because all the construction would occur on Corps property. Park facilities would remain on Corp property and leased to the Park. The Corps would acquire a permanent easement for the existing saddle dam access road and would be responsible for road improvements, maintenance, and repair. The road is required to maintain and monitor the downstream side of the saddle dam. The previously approved plan alternative is subject to saddle dam failure (Section 2.3 Saddle Dam Embankment). In the event of fuse plug pilot channel operation (691.4) and saddle dam failure (658’) and complete erosion to the valley floor (570’) the ensuing flood would be around 120’ deep. The force of the water would likely obliterate resources described in this EA and further downstream of the Moss Hollow Branch watershed. Approximately 87% of the volume of Center Hill Lake would be lost (Table 3). If the saddle dam remains intact, the ensuing flood would be around 33’ deep and approximately 31% of the lake volume would be lost (Table 3). Resources would be damaged but may recover. All other alternatives would not be involved in any the land exchanges because they are located on Corps property.

PROPOSED ACTION

The RCC Berm would be constructed. There is no other location that would meet design requirements. Land would have to be acquired from the Park to construct the RCC Berm and adjacent dam safety inspection buffer area on federal property. The land exchange would be necessary to ensure that the Park does not lose acreage and that it gains control of Park owned facilities that are currently located on Corps property. All other alternatives would not be involved in any the land exchanges because they are located on Corps property.

3.6. RECREATION

Recreation was not originally an authorized project purpose at Center Hill Dam. Section 4 of the 1944 Flood Control Act established development of the recreational potential at federal water resource projects as a full project purpose. Recreation has become a major factor in the regional economy. Because of the temperate climate and relatively long recreation season, visitors have many opportunities to fish, hunt, camp, picnic, boat, canoe, hike, and enjoy the outdoors. Center Hill Lake supports 8 recreation areas, 15 minor access areas, 4 campgrounds, 9 marinas, 2 group camps, 3 state parks, and 3 picnic areas with 214 picnic sites. The Caney Fork tailwater sustains a well known trout fishery. Fishing and boating, particularly trout fishing and canoeing, are the major activities accounting for recreation. An estimated 2.9 million people visit the lake annually (Corps 2007). The Corps and Park do not allow public access to right rim including the saddle dam due to safety and security concerns. The Corps does not allow public access on the left rim, groin, or at the tailwater leaks due to safety and security concerns. Picnic Spring was once open to the public, but current conditions prohibit public access.

NO ACTION

No Action would implement the previously approved plan alternative to install grout curtains and a barrier wall into the lakeside of the saddle dam and construct a cofferdam. The previously approved plan alternative is subject to saddle dam failure (Section 2.3 Saddle Dam Embankment). With a saddle dam failure and complete erosion, the lake would drain to elevation 570’, which would reduce the pool to approximately 8,000 surface acres (Table 2). Lake related recreation would have great difficulty in accessing the remaining pool as all the boat ramps and large expanses of lakeshore would be exposed. The tailwater trout fishery would be eliminated with the loss of cold water storage; however, there would be fishing opportunities as the tailwater transitioned to a warm water fishery. It would likely take decades for recreation and associated economic benefits to recover provided Center Hill Lake could be restored to existing conditions.

Grouting the right rim and abutment, maintenance grouting for the entire project, and plugging the left rim cave and downstream sinkholes is not anticipated to affect recreation since the public is not allowed in these areas. Plugging the upper and lower leaks would affect tailwater low flow; however, this anticipated impact was mitigated by installing an orifice gate and rehabilitating the SSG to provide no less than 200 cfs of cold oxygenated water during low flow conditions.

The left rim cut would not be stabilized. Any debris entering the Highway 96/141 intersection during storm events would cause traffic delays. Recreation would be periodically affected by road flooding if the spring culvert and weirs are not repaired.

PROPOSED ACTION

The RCC Berm is designed to withstand a saddle dam failure and repeated over-toppings and still preserve most of the pool (69%) at 658'. If the current IOP was maintained under this condition, the lake could still be accessed at 618'. To mitigate for this EIS anticipated lower pool, boat ramps were extended below this elevation to ensure lake access. During the drought of 2007-2008, the pool reached elevation 621.8 and the tailwater trout fishery was maintained. This alternative would sustain recreational opportunities.

The left rim cut stabilization would reduce debris flows into the Highway 96/141 intersection. Spring culvert and weir repairs would avert periodic Highway 141 road flooding and reopen public access to Picnic Spring. None of the other revised or proposed alternatives would affect recreation as these areas are closed to the public due to safety and security concerns.

3.7. CULTURAL RESOURCES

Historic buildings, structures, and archaeological sites are common to the Center Hill Lake area and contribute to the cultural heritage of the surrounding region. Buildings, structures, sites, and objects that are eligible for inclusion in or are listed on the National Register of Historic Places (NRHP) are referred to as historic properties. Historic properties possess unique characteristics that relate to important people; events or trends; works of art, architecture, or engineering; or data of the past. The Corps has undertaken several studies to identify historic properties within the Center Hill Lake Project.

Center Hill Dam and Powerhouse have been determined eligible for the NRHP under criteria A and C (O'Bannon 2005). The Corps completed a Historic American Engineering Record (McCormick 2012) in order to record this significant engineering structure and to permanently curate the information with the National Archives and Record Administration. Sixty-two archaeological sites have been identified at Center Hill Lake. Twenty-six of the sites are categorized as not eligible for the NRHP and the remaining thirty-six recorded sites have not been evaluated. There is little potential for significant archaeological sites along the shoreline where soils have been eroded or in the immediate vicinity of the Dam where the original construction obliterated the land (Gregory and Lowry 2012; Kerns-Nocerita et al 2008; Willey 1947).

The Corps completed a cultural resource survey specifically to consider direct and indirect impacts from the construction of the Proposed RCC Berm to historic properties. The Hale/Alcorn house, an early 20th century vernacular structure, is located in Moss Hollow Branch drainage. Archaeological deposits associated with the house are recorded as 40DK25 with the Tennessee Division of Archaeology (McCormack 2012).

NO ACTION

If No Action is taken to address seepage at the saddle dam, then during a catastrophic flood, the saddle dam is likely to collapse. Dam failure would result in draining the lake to elevation 570. Archeological sites that are currently inundated would be exposed. The draining of the lake would likely erode sites within the Lake. In addition, the combined velocity of volume of water raging down the Caney Fork and the Cumberland River would likely cause erosion of archaeological sites within stream banks and destruction of historic structures along the waterways for miles. In addition, to the natural forces of erosion, significant data would most likely be lost to looters seeking to obtain objects for personal possessions or illegal sales. An aggressive monitoring program of sites on Corps property may deter looting of Corps sites or lead to Archaeological Resources Protection Act (ARPA) prosecution, but sites on non-federal lands are not protected by ARPA. Sites within Center Hill Lake would likely be exposed for several years until vegetation is established or a determination is made to construct a new dam and restore the lake to normal operating elevations between 618 and 685.

PROPOSED ACTION

Potential impacts to cultural resources would occur during construction or would be visual in nature. The cultural resource survey of the proposed RCC Berm, associated work areas, and land exchange area did not identify any historic properties in the proposed impact footprint. The proposed RCC Berm is not in the view shed of the Center Hill Dam; therefore, the RCC Berm would not cause effects on the Center Hill Dam historic property. The results of this survey were coordinated with State Historic Preservation Officer and American Indian Tribes with ancestral connections to the area under the National Historic Preservation Act. Appendix B summarizes this coordination leading to “no adverse effect” determination.

Revisions to previously considered actions addressed in prior EAs with the potential to cause effects on historic properties include stabilizing the left rim cut, removing trees for dam safety purposes, replacing the Picnic Spring culvert, and replacing weirs. Erosion of the left rim cut from the 2010 storms eliminates the ability to plug the left rim cut. In 2008, the Corps intent was to plug and revegetate the cut. This approach was determined to minimize adverse effects on changes to the setting of Center Hill Dam. However, this option is no longer viable due to the erosion that has occurred. The Corps will initiate consultation with the SHPO to identify approaches to the left rim bank stabilization that could minimize visual effects to the Dam’s setting. Alternatively if changes to the setting cannot not be avoided and minimized and will have an adverse effect, the Corps will seek to resolve adverse effects.

3.8. ECONOMIC RESOURCES

The Center Hill Dam and Lake Project is a significant economic contributor to the region. Recreation is a major factor generating an average of more than $92 million in recreation benefits. In 2003, the Tennessee Wildlife Resources Agency (TWRA) estimated that the trout fishery below Center Hill alone had a total economic impact of $1.8 million dollars. In a recent creel survey twice as many rainbow trout and four times as many brown trout were caught in 2010 than in 2003 (Ivasauskas and Bettoli, 2012). In 2002, visitors spent over $110 million within 30 miles of Center Hill Lake (Corps 2007).

In addition to the economic benefits of recreation, the lake provides hydropower. Power produced is sufficient to supply a city with a population of 375,000. Between 1983 and 2004, hydropower returned an average of $3.8 million in hydropower revenues to the Treasury annually. Center Hill Dam prevents significant flood related damages. It is estimated that more than $285 million of damages have been prevented for communities and businesses along the Caney Fork and Cumberland Rivers.

NO ACTION

No Action would implement the previously approved plan alternative to install grout curtains and a barrier wall into the lakeside of the saddle dam and construct a cofferdam. This alternative is prone to saddle dam failure (Section 2.3 Saddle Dam Embankment). A complete saddle dam failure would lower Center Hill Lake elevation 570'. The greatest negative impacts realized would be to economic resources due to the loss of 87% of the reservoir volume. Hydropower, flood damage reduction, recreation, and water supply all contribute to economics. Hydropower cannot be generated at elevation 570'. Loss of flood storage would expose downstream communities to repeated flooding events. The lake would be inaccessible. The lack of water storage would limit water suppliers. It would take decades for these economic resources to recover. With a loss of most of the lake, a No Action for all the other alternatives (previously approved plan, revised plan, and proposed actions) would have little effect on economic resources.

PROPOSED ACTION

The proposed RCC Berm Alternative would maintain most of the capabilities of these economic resources by saving the main dam and preserving lake elevation to 658' in the event of saddle dam failure. There would be some loss of flood storage abilities which would expose downstream communities to flooding risks. However, the lake would be able to operate at the lower end of the IOP to reduce flood risks, provide some support to recreation and water supply, but forego hydropower.

None of the other alternatives (previously approved and revised plans, and proposed actions) would affect economic resources.

3.9. ENVIRONMENTAL JUSTICE

The U.S. Census Bureau reported that the population of DeKalb County in 2010 was 18,723. DeKalb County maintains a relatively diversified employment base with manufacturing, education, health care and retail trade as the primary industries in terms of employment. Other major industries include accommodation and food services, administration and support services, construction, wholesale trade, and transportation. As of 2010, the total civilian labor force in the county was 8,370; unemployment rate was 5.1% (7.9% average for Tennessee). As of 2010, the per capita income level in DeKalb County was $17,976 ($19,393 average for Tennessee). The percent of persons living below the poverty level in DeKalb County in during 2006-2010 was 19.2% (16.5% average for Tennessee). The Census Bureau defines a "poverty area" as a census tract with a poverty rate of 20% or more. Based on this information, DeKalb County is not considered a poverty area. In 2010, 9.9% of the county population was considered minority. In Tennessee 20.5% of the state was considered minority.

NO ACTION

Implementation of the previously approved plan would implement the grout curtains, barrier wall, and cofferdam alternative at the saddle dam; and known alternative with saddle dam failure modes. A complete saddle dam failure would disproportionally inundate all economic classes and ethnic populations living in the floodplain near or adjacent of the Caney Fork and Cumberland Rivers. Those populations living on higher ground would not be inundated, but they would be affected by the by flood damage.

PROPOSED ACTION

Implementation of the revised plan would entail construction of the RCC Berm. The RCC Berm would be more operable and reliable in dealing with a flood. A saddle dam failure would disproportionally inundate fewer people of all economic classes and ethnic populations living in the floodplain near or adjacent of the Caney Fork and Cumberland Rivers. Those populations living on higher ground would not be inundated, but they would be affected by the by flood damage.

3.10. AQUATIC RESOURCES

Center Hill Lake supports a warm and cool-water fishery. Major game species include: black bass (*Micropterus spp.*), sunfish (Family *Centrarchidae*), walleye (*Stizostedion vitreum*), and catfishes (*Ictalurus spp.*). The cold hypolimnetic water supports a trout fishery below the main dam in the Caney Fork River tailwater. The tailwater flow is maintained by upper and lower leaks in the right rim (Figures 2 and 7), and supplemental releases from the orifice gate, sluice gate, and/or service station generator when no water is released from hydropower. TWRA has primary responsibility for fisheries management in the lake and tailwater.

Aquatic resources found on the right rim include Moss Hollow Branch that flows through the bottom of the valley downstream of the saddle dam. Based on our delineation, Moss Hollow Branch is an intermittent/perennial stream. The saddle dam access road crosses the Moss Hollow Branch streambed via an existing ford (Figure 3). Traffic compacts the stream substrate. Seepage from the lake, storm water from the saddle dam, intermittent streams, springs, seeps, and wet weather conveyances feed Moss Hollow Branch (Figure 18). The stream is wet most of the year downstream of the gravel access road crossing and occasionally dries during the summer months (Figure 19). This is a flashy stream system where storm water run-off causes the stream to quickly rise and fall. The stream supports aquatic insects and amphibians; however, it does not support fish or freshwater mussels. The upper and lower leaks are on the right rim bluff downstream of the main dam. The upper leak flows through bedding planes (rock layers) encased in rock and the concrete dam abutment and seeps through a joint down the front of the dam. The lower leak was explored in 2001. The cave is about 140’ long and tapers from an approximate 6’ diameter to less than 2’ diameter.

Continuous flow is variable and swift. Air space decreases to a few inches halfway through the cave system. No aquatic species were reported.

Aquatic resources found on the left rim include springs, and an unnamed intermittent stream adjacent to the left rim access road is dry most of the year and grass grows in the streambed. Robert Howard, DWR/TDEC performed the delineation. The stream does not support fish or freshwater mussels (Figure 20). The stream is a tributary to Picnic/Quarry Springs downstream in the Long Branch campground. The combined Picnic and Quarry Spring flows support a short perennial stream that flows into the Caney Fork River tailwater (Figure 21). They support aquatic insects typical of surface streams. Common carp have been observed in the quarry pond. As there is no upstream access through the spring culvert, it is assumed the carp were placed in the quarry pond when the pond had public access. Trout have been observed in the campground but further upstream migration is prevented at the downstream outlet of the Picnic Spring culvert.

In comments to the original EA (2005) the USFWS raised concerns regarding the possibility of bats living in the left rim cave. The left rim cave is 200' below the top of ground and measures roughly 80' high and 15' wide, has water flushing through it, and is accessed through a 1' boring hole. The cave does not fit characteristics of summer roosting or winter hibernation habitat of the gray bat. The USFWS concurred.

Geotechnical investigations determined that the water flushing through the left rim cave and sinkholes originates from Center Hill Lake and flow to Picnic and Quarry Springs. The Corps continuously coordinates with the USFWS and the DNA.

Neither agency has records of the potential presence of subterranean species in the karst features located within the project footprints.

NO ACTION

This alternative would implement the previously approved plan (Table 1). Construction of saddle dam grout curtains and barrier wall was designed to cutoff seepage flow under the saddle dam embankment. Reduced seepage would reduce water flow into Moss Hollow Branch. However, seeps and springs originating from the hillsides would likely continue to flow to provide water to Moss Hollow Branch (Figure 19) for aquatic insects and amphibians.

This alternative has known dam failure modes (refer to Section 2.3 Saddle Dam Embankment). A saddle dam failure even with a barrier wall would result in loss of the lake to elevation 570'. Most of the lake fish would be lost since the pool would be drastically reduced. With a reduced lake volume, loss of cold water storage would result in the elimination of the trout fishery in the tailwater and warming of the remaining water. The upper lethal temperature limits for brown trout and rainbow trout are 70 and 77 degrees Fahrenheit respectively (TWRA 2003). The Caney Fork River tailwater environment would return to a warm water fishery and potentially support freshwater mussels provided the lake was not restored to current conditions.

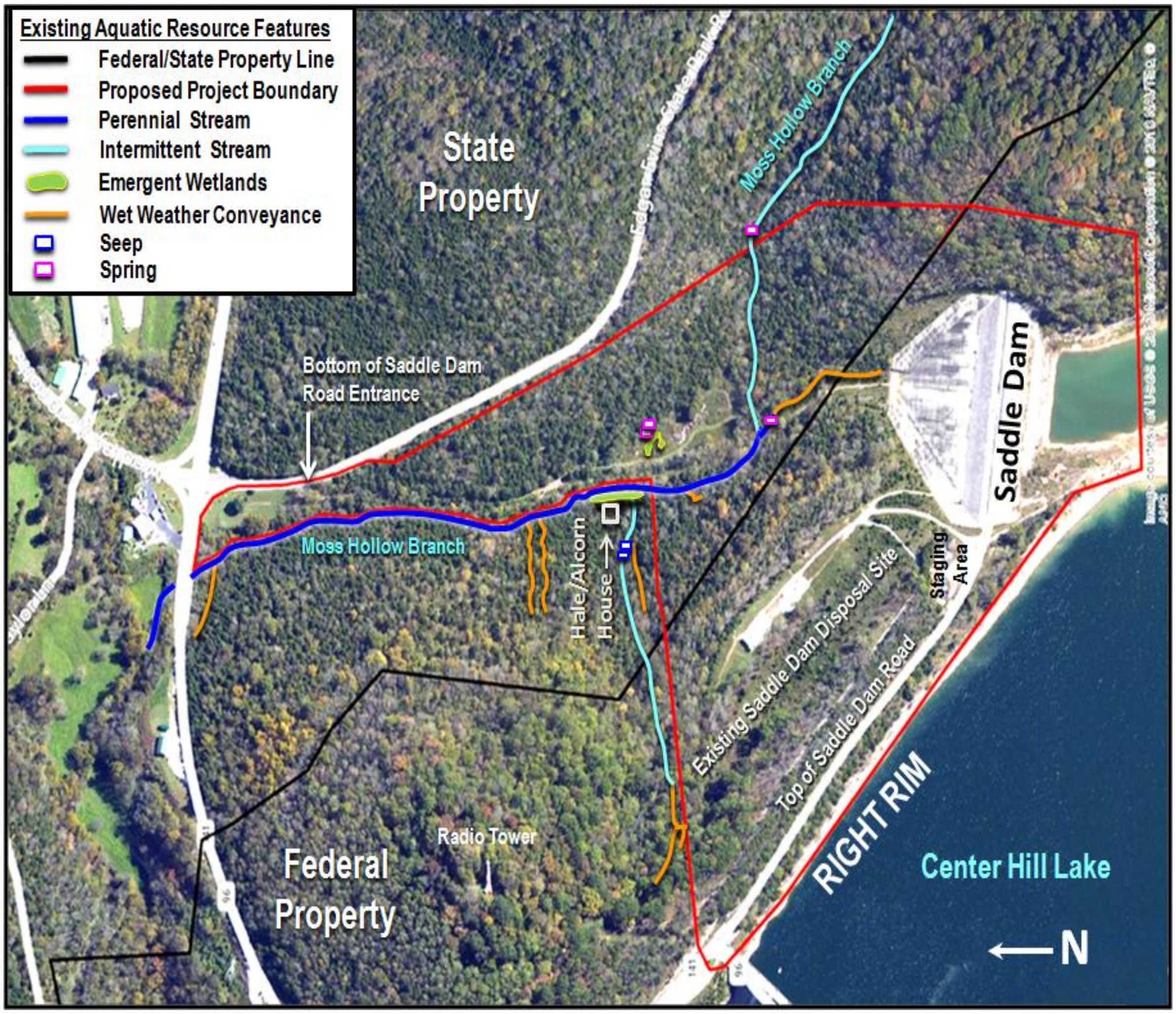

Figure 18. Right Rim – Streams, Wetlands, Springs, Seeps, and WWC/Ephemeral Stream.

Figure 19. Moss Hollow Branch during Dry/Drought Conditions (summer)

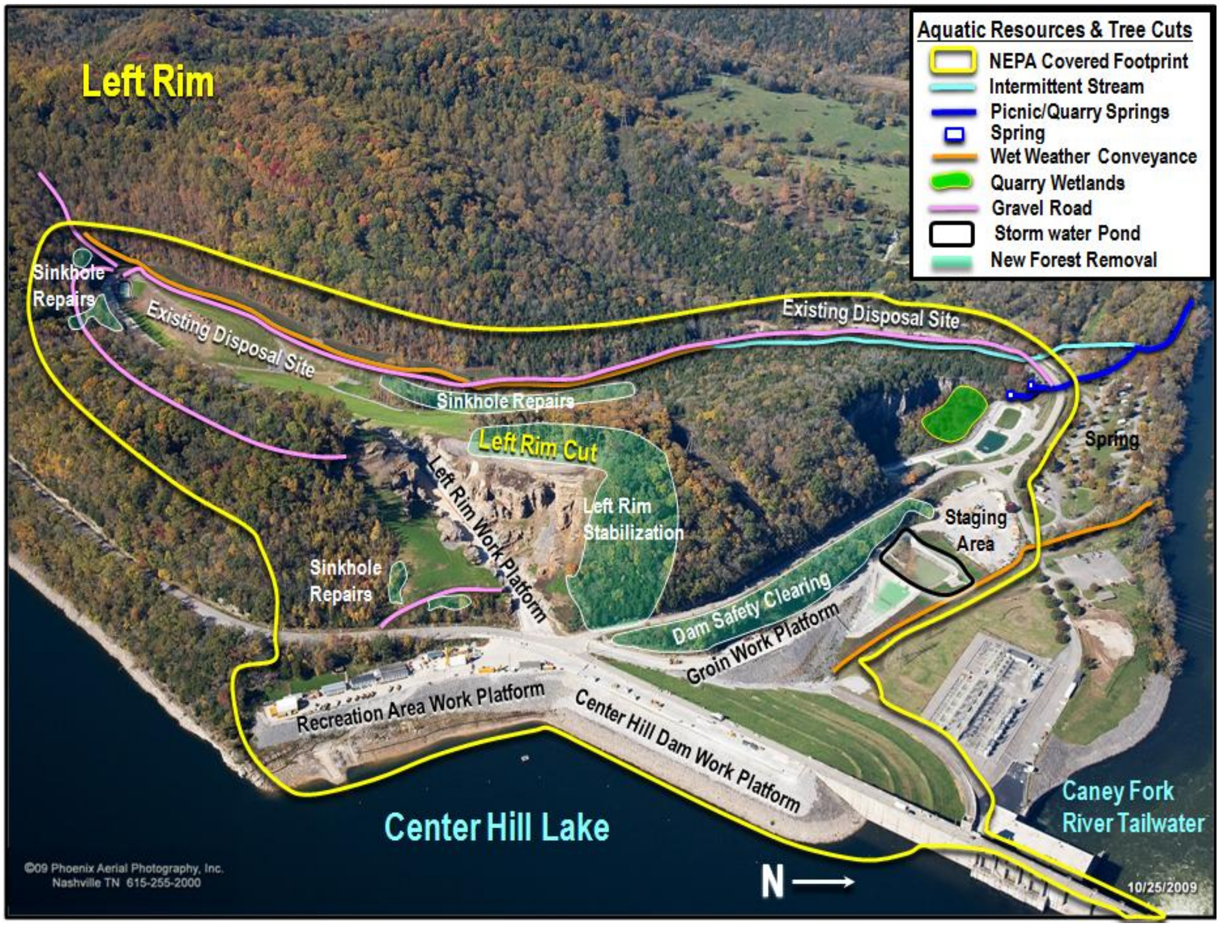

Figure 20. Left Rim Aquatic Resources and Measures Footprints.

Figure 21. Left Rim Access Road – Unnamed Intermittent Stream.

Grouting the right rim and plugging the upper and lower leaks was anticipated to affect low flow and aquatic resources in the tailwater including trout. Mitigation measures (rehabilitation of the SSG, and installation of the orifice gate) were designed to replace lost oxygenated flow in the tailwater.

Plugging the left rim cave and downstream sinkholes was anticipated to have minor effects on aquatic species. The cave system feeding the underground flow is large and complex. Picnic Springs had flow before Center Hill Dam was constructed. The plugged features may stop water loss and reduce flow to Quarry and Picnic Springs, or find a new underground route to reconnect with the existing ground water.

Maintenance grouting was perceived to retard, but not stop seepage and would need to be done periodically. Reduced water loss would have minor effect on aquatic species if the seepage reconnected to other underground solution paths.

PROPOSED ACTION

The RCC Berm is designed to contain a failed saddle dam embankment and maintain the lake to elevation 658. This alternative would preserve most of the lake fishery and maintain the tailwater trout fishery. The orifice gate and SSG would enhance the tailwater during low flow conditions.

The RCC Berm would be built in an upland site. Foundation excavation and grouting would eliminate seepage flowing from under the saddle dam; however it is anticipated that seeps and springs flowing from the hillsides would be unaffected. Aquatic insects and amphibians would be maintained when Moss Hollow Branch contains water.

3.11. WETLANDS

On the right rim, approximately 0.34 acre of wetlands has been identified within and adjacent the proposed RCC Berm impact footprint (Figures 18 and Figure 22). Moss Hollow Branch flows through the largest wetland (Wetland 1) which is approximately 0.21 acre. This wetland is classified as a palustrine emergent wetland and is located outside the project footprint and would be avoided. The remaining wetland (Wetland 2) is located within the proposed RCC Berm impact footprint. It is classified as a palustrine emergent wetland. Wetland 2 is a depressional/slope wetland about 0.13 acre in size, and appears to be sustained by seeps. Historic documents show that the valley was farmed and that a barn was located next to Wetland 2. On state acquisition, the Park stockpiled and burned treated timbers on top of Wetland 2. These activities degraded the wetland to its low quality.

On the left rim, approximately 0.47 acre of wetland exists in the quarry (Figures 20). The quarry wetland has been avoided. The wetland is monitored to identify and eliminate impacts from the adjacent treatment ponds should they leak. The wetland is sustained by three seeps that combine to form the Quarry Spring. The spring feeds a stream that flows into Quarry pond that discharges into Picnic Springs. The combined

Figure 22. Existing Condition of Right Rim Wetland No. and 2.

springs flow through the spring culvert under Highway 141 and Campground Road (Figure 6).

NO ACTION

On the right rim, this alternative would implement the previously approved plan of the grout curtains, barrier wall and cofferdam at the saddle dam. No wetlands would be lost as a result of construction. This alternative has known saddle dam failure modes. A catastrophic saddle dam and barrier wall failure would scour the Moss Hollow Branch valley and vegetation and all the wetlands would be lost.

Plugging the left rim cave and sinkholes would likely have the same effect as identified in Section 3.9 Aquatic Resources. Water loss would be reduced, but as noted, this is a large underground system and groundwater would be expected to sustain the quarry seeps that flow into the quarry wetland.

The No Action alternative would not repair the spring culvert and weirs on the left rim. Reducing discharge through the culvert and prolonged inundation of Picnic and Quarry Springs would impact the quarry wetlands. Prolonged inundation would drown the quarry wetland and result in die-off of wetland vegetation. A No Action for the remaining alternatives and measures would not affect wetlands.

PROPOSED ACTION
On the right rim, construction of the RCC Berm would require major access road improvements to support large equipment. A laydown area would be required to store aggregate and large equipment. Wetland Number 2 would be filled to accommodate road and laydown construction. Wetland impact would be unavoidable given that Wetland 2 is located within the only large flat area in the valley. Wetland 2 would be mitigated at a 2:1 ratio via an approved mitigation bank, in-lieu fee program, and/or permittee responsible mitigation. A mitigation plan addressing wetland loss is found in Appendix C.

Spring culvert and weir repairs would prevent inundation of the quarry wetland that now occurs from backwater at the spring culvert during high flows and storm events. No other revised alternative or proposed minor action would affect wetlands.

3.12. WATER QUALITY AND QUANITY

Center Hill Lake is a deep pool that strongly stratifies in the summer. Thermal stratification maintains large cold water storage in the hypolimnion which provides cold water releases in the tailwater to support the downstream trout fishery. Lake surface area (acres) and volume (acre-feet) are shown in Table 3. Lake stratification leads to dissolved oxygen problems in the tailwater during late fall. However, water releases from the sluice and orifice gates enhances dissolved oxygen and maintains the trout fishery during low flow conditions. The tailwater is classified as a trout stream by the State under Use Classifications for Surface Waters 1200-4-4. Center Hill Lake also traps sediment upstream of the dam which results in a tailwater release of very low turbidity.

On the right rim, Moss Hollow Branch is an intermittent stream with a well defined stream channel that flows through the center of the valley below the saddle dam. The stream often dries up during the summer months (Figure 19) has a flashy response to storm events. Seeps and springs often sustain flow for several weeks. When flow is present, the water is cool and clear, indicative of good water quality.

On the left rim, during large rain events, water, soil, rock, and debris flow down from the left rim cut and into the intersection of Highways 96 and 141 and road ditches (Figure 5). The storm water is captured in a storm water pond adjacent the groin (Figure 2). Picnic and Quarry Springs flow as a perennial stream (Figures 6 and 20). The water is most often cold and clear. When lake elevations exceed normal summer pool (648), both springs become slightly turbid. When lake elevation exceeds high flood events (670), both springs becomes muddy. It is likely that springs are interconnected with groundwater and flows from the lake, left rim cave, and sinkholes. The same condition occurs with the unnamed intermittent stream that flows adjacent the left rim access road off of Highway 141 (Figure 21). When storm flow is present this intermittent stream is clear. During high storm events, muddy water has been observed. It is anticipated that the upstream sinkholes are connected to this intermittent stream and may be the source of turbidity during high flows. There is no water source within the dam safety clearing footprint.

In the tailwater, upper and lower leak water quality appears to be stable. Discharge appears to remain clear at variable lake elevations. Visually, water quantity appears to increase with increasing lake elevations, however there is no way to measure flow since the weirs are damaged.

NO ACTION

On the right rim, this alternative would implement the previously approved plan to construct grout curtains, barrier wall and cofferdam at the saddle dam. This alternative has known failure modes even with a barrier wall. A saddle dam failure would produce substantial downstream sedimentation that would impact water quality in Moss Hollow Branch, Wolf Creek, Caney Fork River tailwater, and the Cumberland River. The amount of sediment transported downstream would depend on the rate of dam failure and the volume of lake lost. Flood water would deposit large volumes of sediment in Moss Hollow Branch and further downstream. Aquatic organisms and habitat would be buried under many feet of sediment that would cause turbidity during subsequent storm events. A failed saddle dam would result in approximately 87% loss of the pool to elevation 570’. The orifice gate is located near elevation 500; therefore the tailwater could be maintained with 200 cfs of flow. Loss of cold water storage would result in a warm water discharge.

Without intervention, the left rim cut erosion would continue to produce rock slides and mud flows into the intersection of Highways 96 and 141 and road ditches that drain into Center Hill Lake. Muddy storm water releases into Center Hill Lake would result in turbidity plums that impact water quality. Sinkholes would continue to erode, cave-in, increase in size, and discharge muddy water into the groundwater, Picnic and Quarry Springs, and discharge into the Caney Fork River Tailwater. If there is no action to repair the Picnic and Quarry Spring weirs, and the upper and lower leak weirs, then changing water quantity cannot be monitored.

Without tree clearing under the dam safety clearing alternative, karst development and muddy seepage flow along the groin may not be detected. Without a new spring culvert, backwater may eventually inundate the quarry wetland.

PROPOSED ACTION

The revised plan would implement the RCC Berm alternative on the right rim. The RCC Berm would contain much of the sediment resulting from the eroding saddle dam earthen embankment and sediment stored in Center Hill Lake and thereby minimizing water quality impacts. Flood water discharging over the RCC Berm would likely be muddy, but it is expected that once elevation drops below 658’, the RCC Berm would contain the lake, and muddy discharges would cease. Retention of most of the lake to elevation 658’ would preserve cold water storage that maintains the tailwater fishery. The sluice and orifice gates would continue to provide improved oxygenated water into the tailwater.

RCC Berm construction would require access road improvements. A stream crossing up to 50' wide would replace the ford crossing in Moss Hollow Branch and protect the stream substrate. Approximately 450' of Moss Hollow Branch would be temporarily covered (Figure 12) to construct an aggregate storage and equipment laydown area. Water quality certification in the form of an aquatic resources alteration permit (ARAP NRS12.227) has been acquired for the stream crossing and temporary stream covering. Permit conditions require day-lighting Moss Hollow Branch and restoring the 50' riparian buffer on each side of the stream on project completion. Stream substrate is to be restored or avoided (bottomless cover) after temporary laydown area is not needed. A mitigation plan for this project is found in Appendix C. All other revised alternatives and proposed actions would have little impact on aquatic resources.

Repair of the right rim upper and lower leak weirs are not anticipated to affect water quality or quantity. Weir repairs would allow the leaks to be measured and monitored over time. Substantial water quantity or quality changes would trigger an investigation to consider any future action at the leaks.

Implementing left rim stabilization would reduce storm water velocity, soil erosion and sediment loss. Left rim stabilization would be expected to halt current on-going water quality impacts. Stabilization would remove the need to maintain the existing storm water pond downstream of the main dam currently required to capture muddy flows from the left rim cut.

In karst topography, the left rim sinkholes serve as conduits to channel surface water into the groundwater. Sinkhole repairs would not impede subterranean flow. Surface water would filter through the stabilized surface openings. Sinkhole repairs would reduce soil erosion and collapse, and minimize muddy flows that currently enter the groundwater system and impacts water quality of Quarry and Picnic Springs.

Converting approximately 2 acres of trees to open grassed space in the dam safety clearing would facilitates dam safety inspections. A grass cover would act as a filter to capture soil particles should muddy seeps develop. Any developing erosion would be easily observed in a grassed area and therefore could be stabilized quickly to prevent runoff and water quality impacts to surface waters.

Spring culvert and weir repairs are not anticipated to affect water quality or quantity. Weir repairs would allow Quarry and Picnic Spring flows to be measured and monitored over time. Substantial water quantity or quality changes would trigger an investigation to consider any future action at the springs.

3.13. UPLAND VEGETATION AND OPEN SPACE

The forest on the right and left rims contain a mixed mesophytic deciduous forest consisting of an oak-hickory complex interspersed with Eastern red cedar (*Juniperus virginiana*) stands. Trees species common to the area include oaks (*Quercus* spp.), hickories (*Carya* spp.), yellow poplar (*Liriodendron tulipifera*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), hackberry (*Celtis occidentalis*), elms (*Ulmus* spp.), American beech (*Fagus grandifolia*), and blackgum (*Nyssa sylvatica*). Common understory species include flowering dogwood (*Cornus florida*), black cherry (*Prunus serotina*), redbud (*Cercis canadensis*), and persimmon (*Diospyros virginiana*). Historically, forests were repeatedly logged. Open space was often burned to maintain agricultural fields. Since federal land acquisition in the 1940's, and State land acquisition in the mid 1970s, forests have been allowed to develop.

Federal land acquisition for the Center Hill Project began in the early 1940's. The Corps owns approximately 20,000 acres of land. State land acquisition for Edgar Evins State Park (Park) began in the early 1970's. The State owns approximately 6,000 acres of land. Since government acquisition, little tree clearing has been allowed. Fields and clear cut areas were allowed to grow into forest via natural succession. As a result trees range between 40 to 70 years old within the combined 26,000 acres of government properties.

The right rim RCC Berm impact footprint is approximately 68 acres. About 24 acres are considered permanent and temporary open space; and 44 acres are forested (Figures 14 and Table 5). Permanent spaces are areas with hardened surfaces, or are mowed and include the saddle dam (7 acres), staging area (1 acre), Corps storage building and road (1 acre), top of saddle dam and tower road (1 acre) and bottom of saddle dam road (1 acre). Temporary open spaces are defined as areas fields and scrub brush with trees less than 4 inches in diameter at breast height (dbh) and includes the saddle dam disposal area (7 acres) and open fields (6 acres).

The left rim potential impact footprint covers approximately 167 acres. Seventy-six acres is considered permanent and temporary open space, and 91 acres are forested (Figure 20). Permanent open space includes the earthen and concrete main dam and work platform (11 acres), groin platform, staging area, groin and quarry treatment ponds (15 acres), access road and left rim cut work platform (6 acres), logging road (1.5 acres), and the recreation area work platform (1.5 acres). Temporary open space includes the access road disposal and parking area off Highway 141 (2 acres), left rim disposal area (5 acres) and past tree removal during construction of the left rim cut (34 acres).

Construction of the left rim cut work platform in the left rim cut required temporary removal of approximately 34 acres of forest habitat (EA Supplement 2, 2008). Since 2008, the surrounding forest functioned as a seedbed. Currently hundreds of tree seedlings are now interspersed in the native warm season grass cover. Left undisturbed, this temporary opening would be expected to continue to transition to forest via natural succession resulting in no net lost to forest habitat. The temporary open habitat provided many benefits to wildlife as described in Section 3.13 Wildlife.

NO ACTION

Under the previously approved plan, plugging the left rim cave and downstream sinkholes would require removal of approximately 1 acre of trees to access these areas. Right rim access road improvements to the top and bottom of the saddle dam would require selected tree removal of up to 2 acres of trees. No other project feature under the approved plan would require tree removal. The left rim cut would continue to erode and destabilize trees at the top of the cut.

The previously approved plan would implement construction of grout curtains, barrier wall, and cofferdam at the saddle dam. This alternative has known dam failure modes even with a barrier wall. A failed saddle dam would drop pool elevation by nearly 120 feet, from the fuse plug pilot channel (691.5) to the valley floor (570). The valley and downstream forest would be scoured and removed by the force of flood water. It would take years for the vegetation to recover and would impact a large area of downstream floodplain.

PROPOSED ACTION

Up to 30 acres of tree would be removed in the right rim RCC Berm construction footprint to accommodate access road widening and improvements, access to the saddle dam disposal area, construction of the laydown area, hillside grading at the RCC Berm, and a dam safety inspection buffer surrounding the RCC Berm and saddle dam (Figure 14). Approximately 5 acres of forest would be permanently lost and converted to permanent open space (improved roads, RCC Berm footprint, and dam safety inspection buffer). There are 13 acres of temporary open space in the saddle dam disposal area and fallow fields scattered in the right rim footprint. Five acres in these temporary open areas would be planted with native tree seedlings resulting in only a temporary loss of forest habitat. The loss of up to 30 acres (temporary loss of 25 acres, and 5 acres restored in the saddle dam disposal site) equates to about 0.12% of 26,000 acres of equitable forest habitat located on Corps and Park property (26,000 acres of forest habitat).

On project completion, all cut acres would be stabilized with native warm season grasses and planted with native tree seedlings. Warm season grass seed mix would include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and forbs. Tree species would include mast producing trees for wildlife forage, and sloughing bark tree species beneficial for native bat habitat. Species would include white oak (*Quercus alba*), northern red oak (*Quercus rubra*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), slippery elm (*Ulmus rubra*), black locust, (*Robinia pseudoacacia*) American elm (*Ulmus americana*), shellbark hickory (*Carya laciniosa*), and sycamore (*Platanus occidentalis*). Other tree seedling species may be recommended by USFWS and the Park.

Cut trees would be sold or hauled into the woods to provide wildlife habitat. A portion of the woody debris can be chipped and used onsite as ground cover to minimize erosion during construction activities. The last option is to burn woody debris onsite. An air curtain destructor or incinerator would be considered during clear cutting operations to remove wood waste. The wood ash would be removed and disposed in a State licensed and Corps approved landfill.

On the left rim, if all the revised alternatives and measures (left rim stabilization, sinkhole repairs, and dam safety clearing) are implemented, proposed timber clear cutting would temporarily remove up to 12 acres, and permanently remove 2 acres of the remaining 88 acres of forest. The first option is to sell the trees. The second option is to haul cut trees into the woods to provide wildlife habitat. For the third option, some of the wood can be chipped and used onsite as ground cover to minimize erosion during construction activities. For the fourth option, an air curtain destructor that produces little smoke would be considered to incinerate wood waste. The wood ash would be removed and disposed in a State licensed and Corps approved landfill. On project completion, these acres would be stabilized with native warm season grasses and planted with native tree seedlings. The permanent loss of 2 acres of trees can be replaced by planting tree seedlings in the left rim disposal area. Planting the 2 acres would remove 2 acres from future disposal. The loss of up to 17 acres of trees (temporary loss of 15 acres, and 2 acres replaced in the left rim disposal site) equates to about 0.06% of 26,000 acres of equitable forest habitat.

Left rim stabilization would temporarily remove 12 acres of trees (Figure 3 and 20). When the hillsides are stabilized, native warm season grasses and tree seedlings would be planted around exposed rock outcrops. The soil/rock berm would be constructed when the left rim cut is stabilized. The forest would regenerate through natural succession. In time, the left rim cut would look similar to the surrounding landscape.

Left rim downstream and new sinkholes have been developing on the left rim (Figure 3). Cave-ins in the forest have destroyed many trees. Up to 3 acres of trees would have to be removed to access and repair the sinkholes. Repaired sinkholes would be stabilized in accordance with a standard State TDOT sinkhole treatment (Figure 4). Repairs would minimize surface erosion and collapse. Groundwater would not be impeded, and surface water would flow into the sinkholes. The area around the sinkholes would be stabilized with a vegetative cover. In time, the forest would re-establish via natural succession.

About 2 acres of trees would be permanently removed from the Dam Safety Clearing footprint. The area would be grassed and converted to permanent open space to facilitate dam safety inspections around the groin. The left rim contains two disposal sites (7 acres). Two acres of tree seedlings would be planted in the disposal site so no forest habitat would be lost. This alternative would meet dam safety regulations. No trees would be removed with implementation of the spring culvert and weir repairs and the upper and lower leak weir repairs.

Under the revised plan, implementing all the alternatives and measures would remove a combined total of 47 acres of forest from both the right and left rims. Forty-seven clear cut acres would temporarily impact approximately 0.18% of the total forest habitat (26,000 acres) located on the combined Corps and Park properties. These tree species are common in the area. The surrounding forest would act as a seedbed to provide volunteer seedlings equivalent to the hundreds of tree seedlings that are now interspersed in the native warm season grass cover adjacent the left rim cut work platform. Temporary and permanent forest loss is addressed in a mitigation plan found in Appendix C.

3.14. WILDLIFE

Corps and Park land is managed to promote beneficial habitat conditions for both game and non-game wildlife species. Forests and open areas provide habitat for game species such as white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), eastern cottontail (*Sylvilagus floridanus*), and squirrel (*Sciurus* spp.). Beaver (*Castor canadensis*) inhabit the Moss Hollow Branch watershed.

Temporary open space creates wildlife openings by encouraging herbaceous and shrubby growth that provides food, nesting, and cover habitat for wildlife. Early seedling and sapling stages of dogwood (Cornus spp), blackberry (Rubus spp), elderberry (*Sambucus canadensis*), and viburnums (Viburnum spp), provide habitat for ruffed grouse (Bonasa umbellus), American woodcock (Scolopax minor), and yellow-breasted chat (*Icteria virens*), bobwhite quail (*Colinus virginianus)*, bobcat (*Lynx rufus*) and snakes. As trees mature a new wildlife group moves in to include squirrels (Sciurus spp), wild turkey (*Meleagris gallopavo*), scarlet tanagers (*Piranga olivacea*), pileated woodpeckers (*Dryocopus pileatus*) and bats (IDFW, 2004).

According to the TWRA, permanent openings such as grassed areas provide open hunting space for raptors. Eastern bluebirds (*Sialia sailis*), great crested flycatchers (*Myiarchus crinitus*), common flickers (*Colaptes auratus*), mourning doves (*Zenaida macroura*) and many songbirds use sunny grassed areas for singing and display sites (TWRA, 2002). Open space can produce insects up to 25 times higher than forested areas. Insects are a primary food source for birds and bats. Heavily forested areas would benefit from open areas by providing forest openings and edge habitat for foraging birds and bats (IDFW, 2004). Temporary openings that transition to forest would change the age structure of the forest. TWRA notes that temporary openings increase plant diversity and produce nearly ten times the amount of plants used by wildlife as one acre of mature forest. For 100 acres of forest, a 10- acre clearing is desirable

NO ACTION

Wildlife would temporarily relocate during implementation of the previously approved plan. Waterfowl and migrating birds may be temporarily displaced from the area; however, the birds have access to the entire Center Hill Lake. Impacts to birds would be considered negligible. On project completion, wildlife would be expected to return. On the right rim, No Action implementation would include construction of grout curtains, barrier wall, and cofferdam at the saddle dam. This alternative has known dam failure modes even with a barrier wall. A complete saddle dam failure and ensuing 120’ deep flood would scour vegetation and drown resident wildlife. Wildlife would return when vegetation cover is re-established. Recovery would take a long time depending on the severity of habitat damage.

PROPOSED ACTION
Wildlife would temporarily relocate during implementation of the revised plan (RCC Berm), measures. Project construction is located within a 1-mile radius of the Main Dam. Waterfowl and migrating birds may be temporarily displaced from the area; however, the birds have access to the entire Center Hill Lake and would be expected to return on project completion. Bird impacts would be considered negligible. On project completion, displaced wildlife would be expected to return. The revised plan would implement the RCC Berm alternative at the saddle dam. If the fuse plug pilot channel operates (elevation 691.4'), the RCC Berm would contain the failed saddle dam and most of the lake to elevation 658'. The ensuing flood would be approximately 33' deep. Much of the vegetation would be scoured and some of the resident wildlife would drown. Wildlife would return when vegetation cover is re-established. Recovery would take a long time depending on the severity of habitat damage.

3.15. STATE AND FEDERALLY LISTED SPECIES

The Corps has maintained coordination with USFWS and the Tennessee Division of Natural Areas (DNA) since the original EA (2005). At that time the USFWS raised concerns regarding the potential presence of gray bats (*Myotis grisescens*) in the left rim cave and lower leak, and Price's potato bean (*Apios priceana*). The left rim cave is 200' below ground and measures roughly 80' high and 15' wide. It was accessed through a 1' boring hole. The cave has water flushing through it that originates from Center Hill Lake. On the right rim, the lower leak was explored in 2001. The cave is about 140' and tappers from an approximate 6' diameter to less than 2' diameter. Water flushes through the lower leak. Air space decreases to a few inches halfway through the cave system. The Corps determined, and the USFWS concurred that the left rim cave and lower leak did not fit the characteristics of the summer roosting or winter hibernation habitat of the gray bat (USACE 2007a). According to a phone conversation on February 7, 2005 with the USFWS, Price's Potato Bean is most likely not located within the area of potential effect. No significant adverse impact to federally listed species was anticipated. A Biological Assessment was not prepared at that time. Three state listed species were identified in the project area, Harper's umbrella plant (*Eriogonium longifolium var. harperi*), fen orchis (*Liparis loeselii*), and Svenson's wild-rye (*Elymus svensonii*). These plants were avoided.

To ensure that all species of concern were addressed, the USFWS (Robbie Sykes, personal communications) and DNA (Tennessee Natural Heritage Program (TNHP)) were contacted on June 27, 2013. Species within a 1-mile radius (Figure 23) and a 1 – 4-miles radius (Table 7), of Center Hill Dam were considered. Each species was then considered individually with regard to its physical location, habitat needs, or foraging area. A Biological Assessment (BA) was written for the federally listed species (Appendix D).

State species that were located in the potential impact footprints or that may use the area for nesting and foraging habitat have been noted in Figure 23. All other state species were not specifically noted because their location was outside the potential footprints and therefore would not be impacted by implementation of the previously approved plan, or revised plan and measures. A summary of an Effects Determination for state and federally listed species is shown in Table 7. The BA contains information supporting the determination for the federally listed species and is summarized in this section.

Federally Listed Bats: On November 30, 2011, the Corps requested USFWS assistance to conduct a preliminary survey to identify potential summer Indiana bat habitat on the right rim. Several suitable Indiana bat maternity and roosting trees and snags were located within the proposed RCC Berm impact footprint. On April 24, 2012 the Corps again met with the USFWS. Both agencies agreed that the listed Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*), could potentially be present. An AnaBat Bat Detector (Harvey et al., 2011) was used for acoustic sampling to determined bat presence via echolocation calls. Corps personnel performed acoustic sampling within the proposed RCC Berm impact footprint for five consecutive nights between May 23 and 27, 2012. Acoustic sampling locations are shown in Figure 24.

Corps personnel met with TWRA to review recordings. Four common bat species and a Myotis species were identified (Table 8). Myotis species are difficult to identify due to similar sonar signatures. Recordings were sent to Eric Britzke, PhD, Research Wildlife Biologist, US Army Corps of Engineers, Engineer Research and Development Center (ERDC) to identify the Myotis calls to species level. According to Dr. Britzke, Indiana bats were not recorded, and gray bats were recorded on two nights. Gray bats use caves year round and forage in forested areas. Gray bats would be expected to seek foraging habitat around the lake and adjoining forest when trees are removed from the left and right rim project footprints. While Indiana bats were not present, suitable habitat exists. Potential Indiana bats would be expected to seek roost and maternity trees around the lake and adjoining forest when the trees are removed from the left and right rim project footprints. To minimize disturbance to gray bats and potential Indiana bats, trees would be cut during the time of year when bat s are hibernating (October 15 – March 31). If this window cannot be met due to construction constraints, selective cutting and protective bat measures would be implemented. Based on this information, the Corps determined that construction activities May Affect, Not Adversely Affect the Indiana and gray bats. The USFWS concurred with this finding.

Since the RCC Berm construction includes blasting, the USFWS raised concerns that blasting could disturb gray bat caves in the vicinity. Controlled blasting would be required to anchor the RCC Berm foundation into competent underlying limestone rock and to remove limestone outcrops. This blasting area would be located immediately downstream of the saddle dam. Small charges would be used so as not to jeopardize the integrity of the saddle dam. Blasting vibrations would attenuate within 1,000 feet.

On September 17, 2012, the Corps met with USFWS and provided cave locations within a 1, 2, 3, and 4 mile radius of Center Hill Dam. The closest potential cave was the Lower Leak on the right bluff downstream of the dam (Figures 2 and 7). The lower leak was slightly less than 0.4 miles away from the proposed RCC Berm footprint.

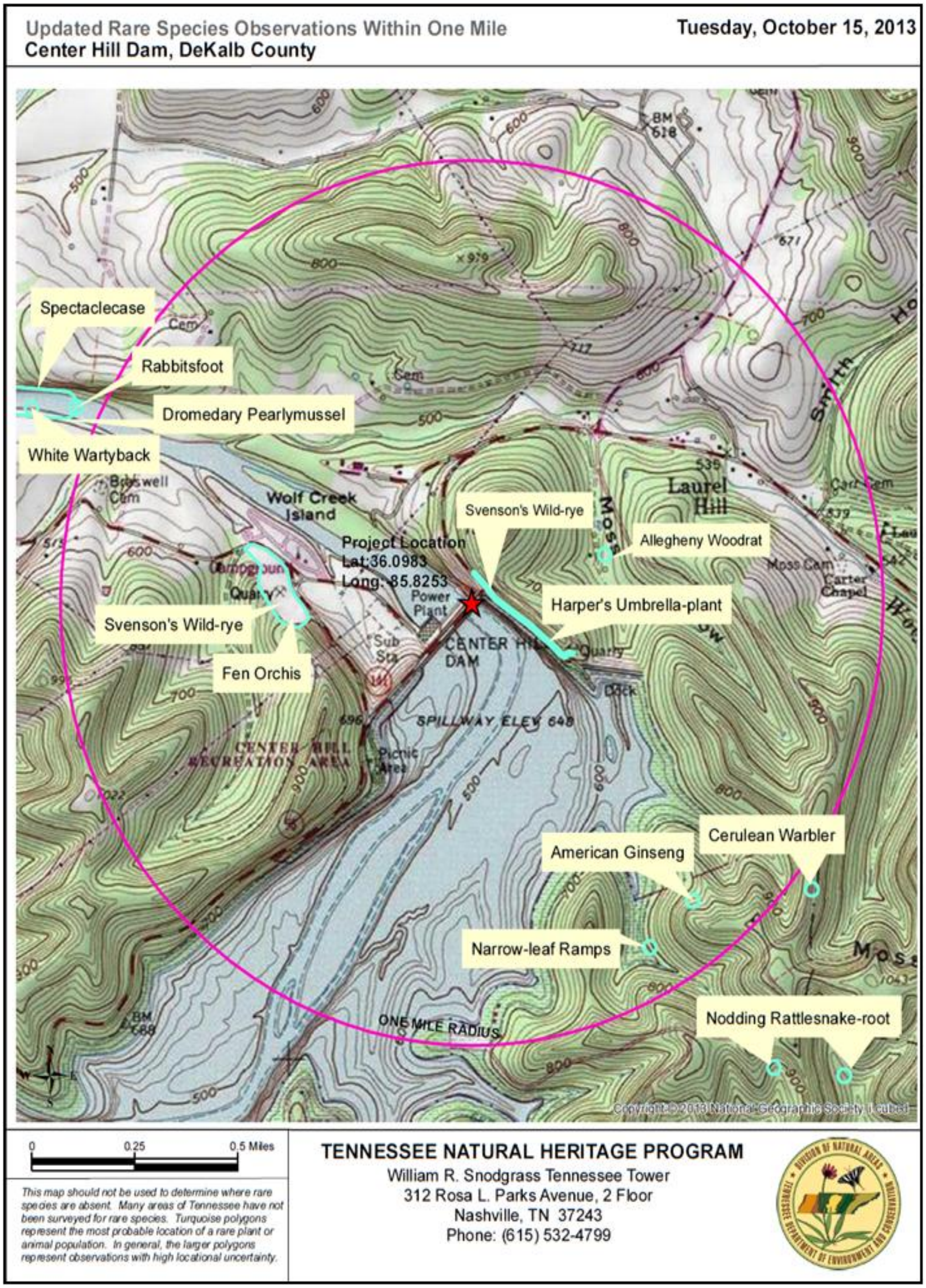

Figure 23. NHP Species Map - Listed Species with a 1-mile Radius.

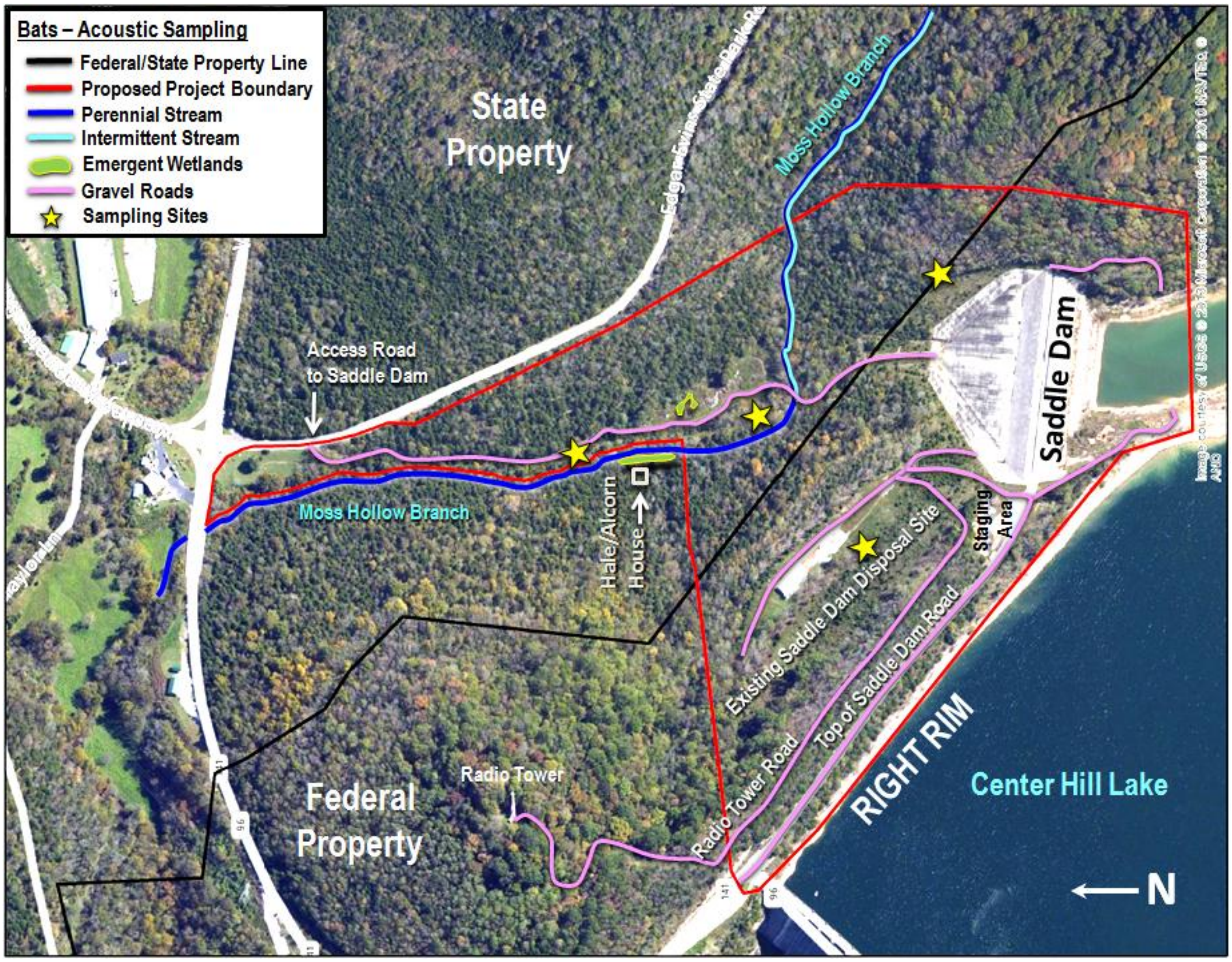

Figure 24. Acoustic Sampling Locations to Determine Bat Presence.

In 2001, the lower leak was explored and there were no reports of bats due to flushing water and small air space over the water. The Corps also noted that the lower leak is located under a major highway (96/141) and adjacent the dam. Blasting vibrations would be imperceptible compared with the rumblings from heavy highway traffic above the lower leak, and dam operations (generation; warning horns; sluicing; and spilling) next to the lower leak. Any construction disturbance (previously approved or revised plan) including blasting was anticipated to be imperceptible given the noise and vibrations that currently exist at the lower leak. The Corps had determined that construction activities May Affect, but Not Likely to Adversely Affect the gray bat. Based on this information and protective measures that are outlined under Section 6 – Environmental Commitments, the USFWS concurred with the Corps' determination of May Effect, Not Likely to Adversely affect the Indiana and gray bats.

On March 6, 2013, the Corps contacted the USFWS regarding proposed tree removal on the left rim of less than 1 acre around the edges of the two disposal sites (Figure 20).

Table 7. Effect Determinations for State and Federal Listed Speices.

Type	Scientific Name	Common Name	Federal Status	State Status	Potential Impact on Left and Right Rims
Plant	*Acalypha deamii*	Deam's Copperleaf		S	Not found within impact footprints
Plant	*Allium burdickii*	Narrow-leaf Ramps		T-CE	Not found within impact footprints
Plant	*Allium tricoccum*	Ramps		S-CE	Not found within impact footprints
Plant	*Amsonia tabernaemontana var. gattingeri*	Limestone Blue Star		S	Not found within impact footprints
Plant	*Apios priceana*	Price's Potato-bean	T	E	No Effect; Not found impact footprints
Plant	*Draba ramosissima*	Branching Whitlow-grass		S	Not found within impact footprints
Plant	*Elymus svensonii*	Svenson's Wild-rye		E	Construction may impact individuals
Plant	*Eriogonum longifolium var. harperi*	Harper's Umbrella-plant		E	Construction may impact individuals
Plant	*Erysimum capitatum*	Western Wallflower		E	Not found within impact footprints
Plant	*Juglans cinerea*	Butternut		T	Not found within impact footprints
Plant	*Liparis loeselii*	Fen Orchus		T	No Impact – Protected in Quarry Wetland
Plant	*Packera plattensis*	Prairie Ragwort		S	Not found within impact footprints
Plant	*Panax quinquefolius*	American Ginseng		S-CE	Not found within impact footprints
Plant	*Prenanthes crepidinea*	Nodding Rattlesnake-root		S	Not found within impact footprints
Plant	*Stellaria fontinalis*	Water Stitchwort		S	Not found within impact footprints
Plant	*Tortula fragilis*	Fragile Tortula		E	Not found within impact footprints
Mussel	*Cumberlandia monodonta*	Spectaclecase	E	NL	No Effect; No habitat in impact footprints
Mussel	*Cyprogenia stegaria*	Fanshell	E	E	No Effect; No habitat in impact footprints
Mussel	*Dromus dromas*	Dromedary Pearlymussel	E	E	No Effect; No habitat in impact footprints
Mussel	*Epioblasma brevidens*	Cumberlandian Combshell	E	E	No Effect; No habitat in impact footprints
Mussel	*Epioblasma capsaeformis*	Oyster Mussel	E	E	No Effect; No habitat in impact footprints
Mussel	*Epioblasma obliquata obliquata*	Catspaw	E	E	No Effect; No habitat in impact footprints
Mussel	*Epiobasma triquetra*	Snuffbox	E	NL	No Effect; No habitat in impact footprints
Mussel	*Lampsilis abrupta*	Pink Mucket	E	E	No Effect; No habitat in impact footprints
Mussel	*Lexingtonia dolabelloides*	Slabside Pearlymussel	E	NL	No Effect; No habitat in impact footprints
Mussel	*Obovaria subrotunda*	Round Hickorynut		NL	Not found within impact footprints
Mussel	*Plethobasus cicatricosus*	White Wartyback	E	E	No Effect; No habitat in impact footprints
Mussel	*Plethobasus cyphyus*	Sheepnose	E	NL	No Effect; No habitat in impact footprints
Mussel	*Pleurobema clava*	Clubshell	E	E	No Effect; No habitat in impact footprints
Mussel	*Quadrula cylindrica cylindrica*	Rabbitsfoot		NL	Not found within impact footprints
Mussel	*Villosa trabalis*	Cumberland Bean	E	E	No Effect; No habitat in impact footprints
Snail	*Lithasia armigera*	Armored Rocksnail		NL	Not found within impact footprints
Fish	*Etheostoma olivaceum*	Sooty Darter		D	Not found within impact footprints
Reptile	*Crotalus horridus*	Timber Rattlesnake		NL	Construction may disturb individuals
Bird	*Dendroica cerulean*	Cerulean Warbler		D	Construction may disturb individuals
Bird	*Haliaeetus leucocephalus*	Bald Eagle	R	D	No Effect; nest located 8 mi. upstream
Bat	*Myotis grisescens*	Gray Bat	E	E	May Affect, Not Likely to Adversely Affect.
Bat	*Myotis sodalis*	Indiana Bat	E	E	May Affect, Not Likely to Adversely Affect.
Mammal	*Neotoma magister*	Allegheny Woodrat		D	Construction may disturb individuals

Codes: E – Endangered, T – Threatened, R – Recovered but Protected, S – Special Concern, D – Deed in need of Management, CE – Commercially Exploited, NL – Not Listed.

Table 8. Acoustic Sampling Results of Bat Species

Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Myotis grisescens *	Gray Bat	*Nycticeius humeralis*	Evening Bat
Lasiurus borealis	Eastern Red Bat	*Perimyotis subflavus*	Tri-colored Bat
** Species determined by Dr. Britzke, ERDC*		*Lasiurus cinerecus*	Hoary Bat

The Corps had located a few potential Indiana bat roosting trees and proposed a 20-50 ft buffer around these potential sites. The USFWS noted that these areas were within the 1 mile radius of the bat survey conducted between May 23 and 27, 2012. Trees needed to be removed prior to April 1, 2013 for the survey to be valid. They agreed with the proposed buffer and requested that disposal material at these locations be placed at least 20 feet from the base of suitable live roost structures. Impacts to the Indiana bat would be minimal.

On June 6, 2012, the Corps contacted the USFWS regarding tree removal for the left rim stabilization and sinkhole repair alternatives (Figure 20). The USFWS noted that tree removal within these footprints were within the 1 mile radius and covered under the bat survey until April 1, 2014. Plans would be made to remove trees between October 15 and March 31. Impacts May Affect, Not Likely to Adversely Affect, gray bats and potential Indiana bats.

<u>Federally Listed Plants</u>: There are no records for the Price's Potato-bean (*Apios priceana*) within a 1-mile radius of Center Hill Dam. This plant grows in open, rocky, wooded slopes and is often found where bluffs or ravine slopes meet creek or river bottoms. The plant is shade intolerant. Most of the area is in forest and well-shaded.

<u>Federally Listed Freshwater Mussels</u>: Mussels require perennial streams with fast running water and cobble, gravel, and sand habitat. Moss Hollow Branch is an intermittent stream that occasionally dries up part of the year (Figure 19). The intermittent stream adjacent the left rim access road to Highway 141 is dry most of the year (Figure 21). Both streams do not have the water or habitat to support freshwater mussels. Picnic and Quarry Springs have been walked from their springheads to the confluence with the Caney Fork Tailwater. Quarry Spring starts in the quarry, flows through a wetland, into a pond, and into Picnic Spring. Picnic Spring originates from a limestone bluff, and during low flow, the stream is a few inches deep. The substrate contains a thin layer of gravel over a hardened surface. The combined springs discharge from a culvert under Highway 141 (Figure 6) and flow over bedrock with some cobble up through the campground. The stream down-cuts into hardpan and is strewn with branches and vegetative debris to its confluence with the Caney Fork River tailwater. No bivalve shells have been observed or collected. In 2009-2010, a mussel survey was performed in the Caney Fork River tailwater, from the main dam to the confluence with the Cumberland River (Lewis 2011). Only two live Pimplebacks (*Quadrula pustulosa*) were found among the miles of relic shells of 30 species that could be identified. The 2009-2010 survey confirmed that none of the freshwater

mussel species listed in Table 4, exist in the Caney Fork River tailwater below the dam to the confluence with the Cumberland River due to the changes in water quality brought about by the operation of Center Hill Dam.

Federally Protected Birds: The Bald Eagle (*Haliaeetus leucocephalus*) is a recovered species removed from the federal list on August 9, 2007. Although delisted, they are still protected by the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and the Lacey Act. A Bald Eagle's nest has been observed on Center Hill Lake, but the nest is located approximately 8 miles upstream from Center Hill Dam.

State Listed Plants: Two state listed plants are located within the proposed impact footprints. Svenson's Wild-rye (*Elymus svensonii*) and Harper's Umbrella-plant (*Eriogonum longifolium var. harperi*) have been located on the right rim bluff ledges adjacent the access road to the top of the saddle dam. Efforts would be made to avoid the plants. Impacts may be minimized by using protective caging around the plants. The Corps would coordinate with DNA to identify safe relocation sites to other populations on the project if relocation is needed due to road widening. Other listed state plants are located outside of the left and right rim impact footprints.

State Protected Reptile: The timber rattlesnake (*Crotalus horridus*) is not state listed; however it is protected from harvest. TWRA considers this snake a "species of conservation need". As a conservation measure, the Corps worked with TWRA during August 13-15, 2012 to collect snakes from of the proposed right rim (RCC Berm) impact footprint. One individual was found and relocated.

State Listed Bird: The Cerulean Warbler is a small Neotropical migrant songbird. It spends its non-breeding season (fall – winter) in northern South America, and spends its breeding season (spring – summer) in the eastern United States. This species nests and forages in deciduous forests with tall, mature trees, near stream bottoms, along lake and river shores, or on river islands. The TNHP map shows a location record that is outside of the left and right rim impact footprints (Figure 23).

State Protected Mammal: On August 13-15, 2012, the Allegany woodrat (*Neotoma magister*) was observed in the right rim footprint. It is not state listed; however the species is uncommon and "deemed in need of management". The native North American rat ranges from 6 to 10 inches long (excluding the furred tail) and weighs under a pound. Allegheny woodrats form small colonies. They are nocturnal and found in forested habitat with rocky ledges and outcrops. Allegheny woodrats are mainly distributed along the Appalachian Mountains, but have been extirpated from many New England states. The Tennessee River is generally considered as the southern range limit. Population declines have been attributed to parasites, predation, competition for hard mast, and loss of habitat.

NO ACTION

Minimal impacts would be expected to occur to federally listed species. An abundance of equivalent forested habitat (26,000 acres) is found on the Corps and Park properties.

Listed species would temporarily relocate due to construction disturbance, but would be expected to return on project completion. State listed plants located on the right rim access road bluff to the top of the saddle dam would be avoided, protected with fencing, or relocated to other populations on the project during road improvements.

The previously approved plan would implement construction of grout curtains, barrier wall, and cofferdam at the saddle dam. This alternative has known dam failure modes (Section 2.3 Saddle Dam Embankment). A saddle dam failure and ensuing flood would scour vegetation and remove habitat and resident listed species. Except for the saddle dam embankment, no other project feature or minor action is expected to affect state an d federally listed species.

PROPOSED ACTION

This alternative would implement the revised plan and measures. Equivalent impacts would be expected as described under the No Action alternative.

3.16. WATER SUPPLY

The City of Cookeville, the City of Smithville, and Riverwatch resort have lake intakes below the lowest operating elevation at 618'. Smith Utility District has a water intake in the Caney Fork River tailwater near river mile 7.5.

NO ACTION

Implement the previously approved plan to construct grout curtains, barrier wall and cofferdam at the saddle dam. This alternative has known failure modes even with a barrier wall. A complete saddle dam failure would drop the pool to elevation 570'. At this elevation, water supply intakes within the lake would be impacted resulting in intake relocation and consideration of an alternate water supply source. No other project feature would affect water supply.

PROPOSED ACTION

Implement the revised plan to construct a RCC Berm. If the saddle dam fails, the RCC Berm would maintain the lake to elevation 658'. Existing water supply intakes in the lake would be maintained. No other project feature would affect water supply.

3.17. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

In the right rim footprint, an open area on Park property adjacent to the access road to the bottom of the saddle dam had been used to stockpile cleared brush and pressure treated timbers preserved with chromate copper arsenate (CCA) (Figure 25). The wood came from old dismantled state park campsites and had accumulated since the 1980's. Prior to the 1980's, the wood and treated timbers were burned on site. As part of the Corp's site preparation, Phase I and II Environmental Site Assessments were completed in accordance with ER 1165-2-132. During August 13-15, 2012, the treated timber was removed from the site. The Park obtained a permit and disposed the contaminated timber piles into a State licensed and Corps approved landfill. Soil samples were collected after timber removal to determine soil contamination. Arsenic, copper, chromium and polycyclic aromatic hydrocarbons (byproducts of fuel burning) concentrations were elevated above the local background range in the burn pit area. Except for arsenic, none of the contaminants posed an unacceptable risk to human health. The old burn pit area covers approximately 0.08 acre. There is no contaminated soil elsewhere on the left or right rim on Corps property.

On January 25, 2013, the Corps met with the Tennessee Division of Remediation (TDOR) that has regulatory authority to address soil contamination. The area of elevated arsenic is located in a 0.08 acre area which includes a buffer surrounding the soil sampling sites. TDOR acknowledged that the contaminated soil is on State property and understood the Corps' need to use the flat open area as an aggregate storage and equipment laydown area for proposed RCC Berm construction activities.

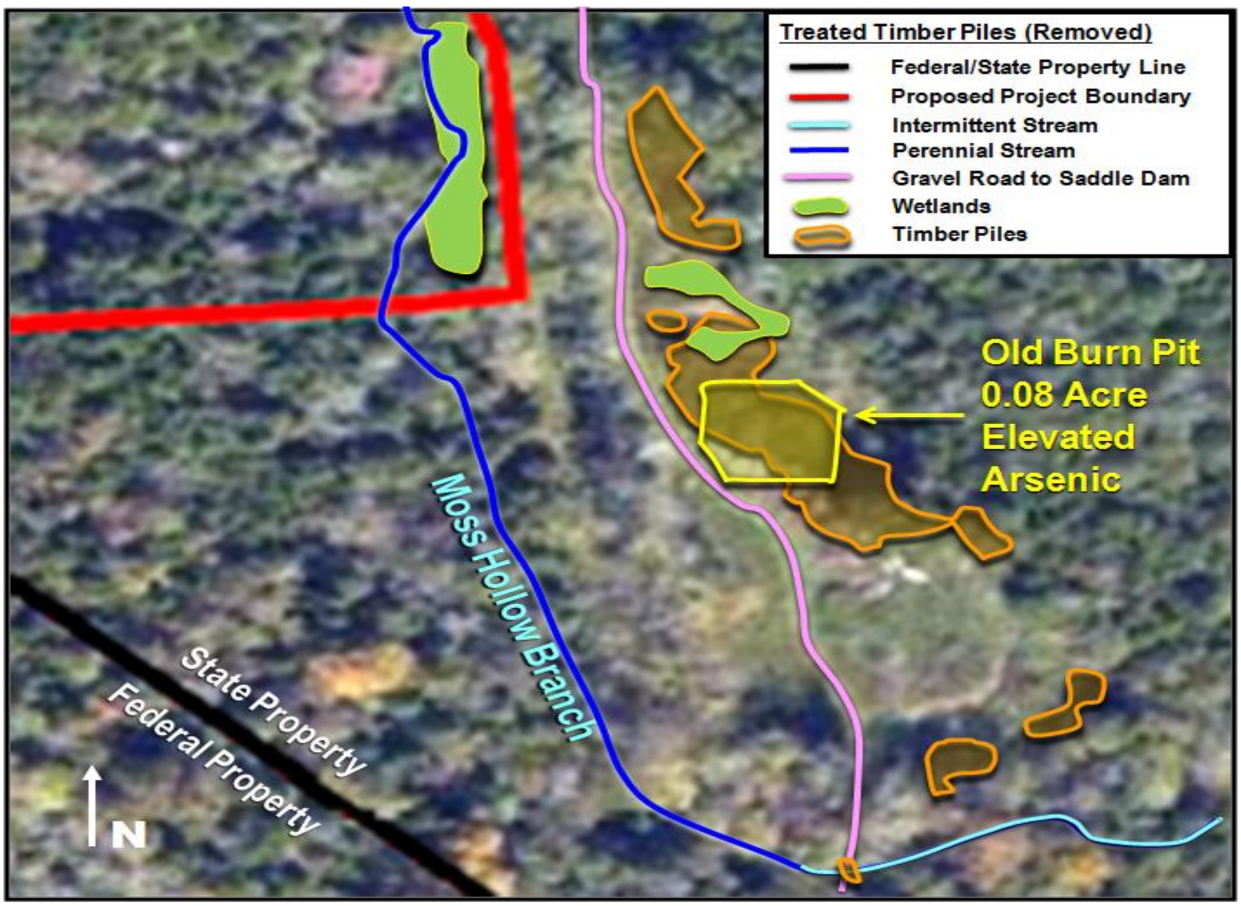

Figure 25. Treated Timber Piles, Burn Pit, and Elevated Arsenic Soil Locations.

NO ACTION

The previously approved plan to construct grout curtains, barrier wall and cofferdam at the saddle dam would be implemented. The access road to the bottom of the saddle dam would be improved so maintenance equipment can safely travel to the saddle dam. The 0.08 acre footprint of elevated arsenic soil would be avoided. However, the area would be identified and fenced to prevent access and unintended exposure.

PROPOSED ACTION

The arsenic soil is located in the largest flat area in the valley. Initially the area would be fenced an avoided to prevent access and unintended exposure. It would be difficult and unsafe to work around the contaminated footprint. The Corps plans to request that the contaminated arsenic soil be removed and the site remediated to eliminate unacceptable exposure risk to human health prior to construction. The Corps proposed to cover the arsenic soil in place with a membrane and gravel layer to minimize exposure risk to human health until the soil is removed. Coordination with TDOR would continue through project construction. It is TDOR's responsibility to determine how contaminated soil would be removed from State property.

3.18. TRAFFIC AND SAFETY

On the left rim, signage, speed limitations and traffic signals have been installed on the main dam due to on-going construction. The left rim cut work platform enters the Highway 96/141 intersection (Figures 5 and 20). During large storm events, debris washes down the left rim work platform and into the intersection creating a traffic hazard. The spring culvert is located under Highway 141 and Campground Road across from Long Branch Campground (Figure 6). During high flow and storm events, backwater inundates Quarry and Picnic Springs and threatens to flood Highway 141. On the right rim, the access road to the bottom of the saddle dam exits into a blind curve on Edgar Evins State Park Road (Figure 26). The access road entrance is narrow and steep.

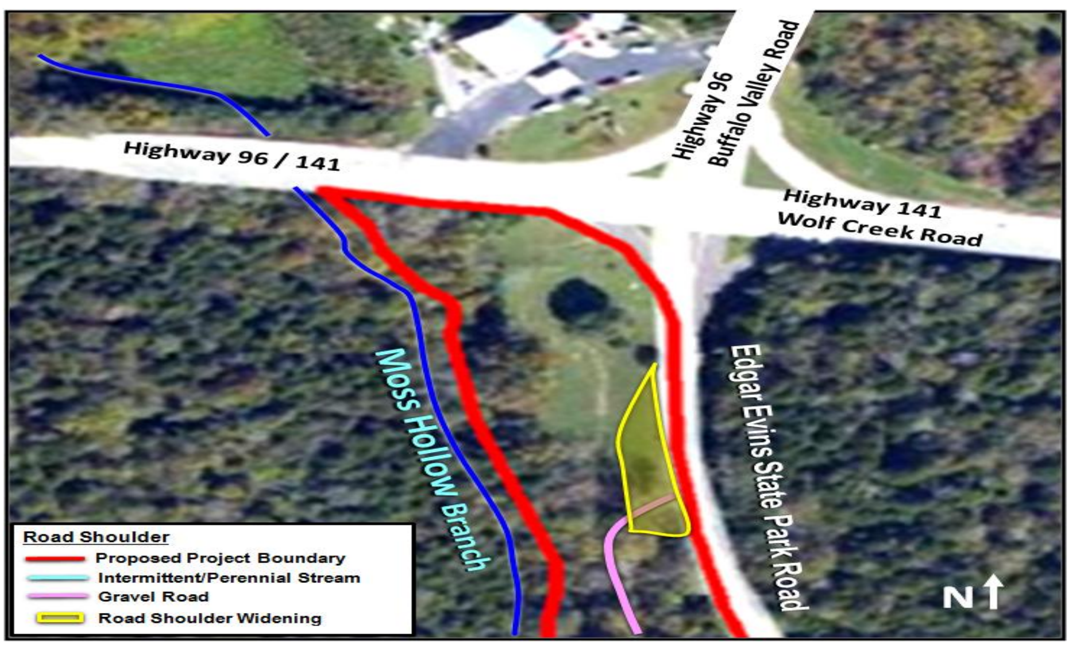

Figure 26. Intersection of Saddle Dam Access Road and Edgar Evins State Parks Road.

NO ACTION

This alternative would implement the previously approved plan. There would be no change to the current road condition or traffic pattern on the left or right rim. Flagmen or signal lights may be placed at the saddle dam access road entrance and Edgar Evins State Park Road intersection

PROPOSED ACTION

This alternative would implement the revised plan and measures. Left rim cut stabilization would prevent debris flows from entering the Highway 96/141 intersection (Figure 5). Traffic lane re-alignment would be necessary during stabilization. This work would not take place until completion of on-going construction at the main dam. The dam safety clearing alternative footprint is sandwiched between the groin work platform and Highway 141 (Figures 3 and 20). Tree removal may impact traffic on Highway 141 with lane closures if trees cannot be removed from the groin work platform. Spring culvert replacement to prevent road flooding would temporarily disrupt traffic on Highway 141 (Figure 6).

On the right rim, construction traffic to and from the proposed RCC Dam would travel on Edgar Evins State Park Road to enter the access road entrance to the bottom of the saddle dam. Proposed construction would affect traffic to and from the Park for potentially 2-3 years. The gravel access road entrance to the saddle dam and road shoulder would require widening to accommodate large construction equipment. Creation of a pull-over would minimize impact to Park traffic. Warning signs, flashing lights, light signals, or flagmen may be warranted to ensure safe traffic conditions. On project completion, the widened road shoulder would allow large equipment access to maintain the access road to the proposed RCC Berm and saddle dam with little hindrance to the Park traffic. For all construction activities, detailed traffic and design plans and timing of the work would require review from TDOT.

3.19. AIR QUALITY

The Environmental Protection Agency (EPA) has designated DeKalb County as an attainment area with regard to the National Ambient Air Quality Standard.

NO ACTION

Implementation of the previously approved plan would have temporary, localized, and minimal impacts on air quality from vehicle and equipment exhaust and from fugitive windborne dust. These effects would be minimized by ensuring vehicle and equipment exhaust systems are in good repair. Dust would be controlled with daily road sweeping or water spraying. On project completion, air quality would return to ambient conditions.

PROPOSED ACTION

Implementation of the approved plan and measures would have temporary, localized, and minimal impacts on air quality as described under the No Action alternative. Stabilization of the left rim cut would reduce dust from exposed soil and dried sediment wash-off on Highway 96/141 intersection. On project completion, air quality would return to ambient conditions.

3.20. NOISE

Local noise is produced by commercial and local traffic on state Highways 96 and 141 crossing the main dam. Noise increases during the recreation season with increased lake use (motor boats) and traffic to the State Park and Corps recreational areas and campgrounds. Dam operations (warning horns, generation, and sluice gate operation) contribute noise when operating. On-going construction activities temporarily contribute to background noise. Noise is regulated by Engineering Manual 385-1-1 Safety and Health Requirements (Safety Manual). The manual prohibits exposure to noise that is greater than 115 dB for more than 15 minutes. Contract specifications require maintenance logs for safety checks to ensure mufflers and noise reducing devices are working properly.

NO ACTION

Implementation of the grout curtains, barrier wall and cofferdam at the saddle dam, would temporarily increase background noise in the short-term. Noise would be regulated by the Safety Manual and contract specifications. On project completion, noise would return to background levels.

PROPOSED ACTION

Implementation of the RCC Berm and measures would temporarily increase background noise in the short-term. Noise would be regulated by the Safety Manual and contract specifications. Construction noise would be temporary and would cease on project completion.

3.21. AESTHETICS

Center Hill Lake is known as a beautiful area and has many recreational facilities (Section 3.5 Recreation). On the right rim, the lake side of the saddle dam can be seen from the Park tower. The land side of the saddle dam can be seen from a pull-over on the Edgar Evins State Park Road during the winter. The forested area around the saddle dam makes the structure less visible. On the left rim, past and on-going construction has noticeably altered the viewshed. There are 4 work platforms (main dam, recreation area, groin, and left rim cut). A large cut bisects the left rim hill (Figures 2 and 5).

NO ACTION

Under this alternative the previously approved plan would be implemented. On the right rim, construction of the grout curtains, barrier wall, and cofferdam would be visible from the Park tower and lake. This alternative has known failure modes even with a barrier wall. A saddle dam failure would drain most of the lake and scour vegetation downstream of the saddle dam. It would take a long time for the altered view to recover. On the left rim, the left rim cut would continue to erode and destabilize. Vegetation cannot grow on an eroding hillside. A soil/rock berm cannot be placed in the cut entrance to soften the view, until the cut hill slopes are stabilized. No other project feature would affect aesthetics.

PROPOSED ACTION

This alternative would implement the revised plan and measures. The view from the Park tower overlooks the lakeside of the saddle dam. Most of the RCC Berm construction would occur on the land side below the saddle dam. Because of location, the saddle dam would screen most of the RCC Berm construction and thereby minimize impact to the view shed. A forest buffer would be maintained along the Edgar Evins State Park Road to help screen construction activities. The project would be more visible in the winter after the leaves fall. On project completion, the area would be stabilized with native warm season grasses and native tree seedlings to return to forest via natural succession.

The left rim cut would be graded to blend into the existing hillside. When it is stable, a soil/plug berm would be installed at the cut opening. The dam safety clearing would be converted from woods to grass. Visual impact would be small as this area would blend in with the adjacent grassed area in front of the main dam. Aesthetics impacts would be small with implementation of the rest of the project features and measures.

4. CUMULATIVE EFFECTS

Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the (proposed) action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions (40 CFR 1508.7)”. Council for Environmental Quality (CEQ) guidance identifies an 11-step process for evaluating cumulative effects.

The Previously Approved Plan (2006 MRER) covers all the project features for the entire project (Table 1) that would implement the plan as is. The Revised Plan (draft 2013 MRER Supplement and measures) can be considered an incremental change to the larger Previously Approved Plan. The Revised Plan considers changes made to some of the project features that include some measures. If approved, the Revised Plan would replace the Previously Approved Plan.

Based on the public and agency scoping and review performed for the previous NEPA documents the geographic scope and time frame would be the same. For the purposes of cumulative effects, the geographic scope covers Center Hill Lake and the Caney Fork River tailwater (26.4 miles) to the confluence of the Cumberland River (mile 309). The temporal boundary covers the past 60 years, after impoundment of Center Hill Lake, and 10 years into the future, on completion of dam repairs.

Past, present, and foreseeable actions that could combine for cumulative effects include, listed species, dam safety considerations, climate, human population growth, and land and water developments. The assessment can be defined as “what resource goals is the proposed action going to affect”. Effects can result from either direct-project related, indirect-project related, and independent indirect causes. Based on public and agency scoping and review on previous NEPA documents, the targeted resources affected by human activities include: 1) terrestrial resources; 2) aquatic resources; 3) threatened and endangered species; 4) cultural resources; 5) water supply; and 6) economics resources. The baseline condition is the free-flowing Caney Fork River prior to dam construction (Center Hill and Great Falls Dams).

4.1. TERRESTRIAL RESOURCES

Past Actions

Early European settlers arrived in the late 1700's and brought dramatic change to the landscape (TWRA, 2005). Logging supported the local economy for generations as described by Crouch (1973) in the following passage: "Many hundreds of log rafts have made the trip down the Caney Fork and Cumberland Rivers to the mills at Nashville…Trees were felled, cut into logs and skidded to the top of the steep bluffs overlooking the river. They are dropped over a slide and rode to the bottom at the river's edge. There they were assembled in large rafts…About 6 feet of water was required to clear all the bars. Not every raft arrived at Nashville. Some were wrecked and broken up going around the treacherous bends in the river. It has been reported that 90 rafts were taken down the river in 1929."

Large scale forest clearing began in the late 1800's and continued into the early 1900's. Forest clearing followed by grazing, farming, and settlements resulted in loss of open space and forest habitat for many plant and animal communities. The chestnut blight in the early 1900's impacted the oak/chestnut forests and destroyed the chestnut trees. Other stressors included the introduction of exotic invasive species which out-competed native species and brought the wooly adelgid which is currently killing the hemlock trees (TWRA, 2005).

Present actions

According to Edgar Evins State Park personnel, the existing forest cover represents a second-growth hardwood forest interspersed with Eastern red cedar stands now typical of the Eastern Highland Rim. Common species include oaks, hickories, yellow popular, tulip popular, black walnut, white ash, hackberry, elms, American beech, and blackgum. Common understory species include flowering dogwood, black cherry, redbud, and persimmon. Federal land acquisition for Center Hill Dam and Lake began in the 1940's. State land acquisition for Edgar Evins State Park was completed in 1975. Since acquisition, the terrestrial habitat on both federal and state property remains almost entirely intact and has been allowed to develop into mature forests.

The left rim had 34 acres of trees removed as a consequence of implementing the Previously Approved Plan covered in previous EAs. Thirty acres were stabilized with warm season grasses. The removal of 30 acres of trees is a temporary impact because the forest is expected to regenerate via natural secession. The surrounding forest acts as a seed source. Many volunteer seedlings now grow in the warm season grasses. Four acres of trees were permanently removed. Four acres of tree seedlings would be planted in disposal areas on project completion to replace the 4 acres lost to road expansions and work platforms.

Reasonable Foreseeable Future Actions

On the left rim, an additional 17 acres of trees would be removed as a consequence of implementing the Revised Plan and alternatives and measures covered in this EA. Fifteen acres would be temporarily impacted. They would be stabilized with warm season grasses. Forest would regenerate via natural succession. Two acres would be permanently lost and maintained in grass to facilitate dam safety inspections. Two acres of tree seedlings would be planted in disposal areas on project completion to replace the 2 acres lost to meet dam safety guidance.

On the right rim, up to 30 acres of trees would be removed as a consequence of implementing the Revised Plan and alternatives and measures covered in this EA. Twenty-five acres would be temporarily impacted. They would be stabilized with warm season grasses. Forest would regenerate via natural succession. Five acres of trees would be permanently removed. Five acres of tree seedlings would be planted in disposal areas on project completion to replace the 5 acres lost to road expansions and construction of the RCC Berm.

The seepage and rehabilitation project footprints covered 68 acres on the right rim and 135 acres on the left rim. Out of a total of 235 acres, 181 acres was forest. A total of 79 acres of forest was removed. Approximately a total of 68 acres of forest was temporarily impacted and would be expected to return to forest via natural succession. Eleven acres were permanently removed. The project has 20 acres of existing disposal sites. On project completion, 11 acres in the disposal sites would be planted with tree seedlings to replace the 11 acres of forest that were permanently lost to construction activities. This action would ensure that none of the 79 acres of impacted forest would be permanently lost. Foreseeable future actions would have negligible impact on terrestrial resources. Over time, the forest would be expected to return to near pre-construction conditions.

If no action is taken, seepage rehabilitation and repairs would implement the Previously Approved Plan that removed 34 acres of trees. Thirty acres of trees were temporarily impacted. Four acres of trees were permanently removed. The plan would temporarily impact an additional 3 acres of forest. A total of 33 acres of forest would regenerate via natural succession. Four acres of permanently lost forest would be replaced by planting 4 acres of tree seedlings in existing disposal sites to ensure there would be no loss of forest habitat.

The plan would implement construction of grout curtains, barrier wall, and coffer dam at the saddle dam. This alternative has known dam failure modes. In the event of a saddle dam failure and loss of the pool to elevation 570’, the uncontrolled rapid release of a large wall of water would scour many acres of downstream forest. Over time scoured areas would return to forest via natural succession.

4.2. AQUATIC RESOURCES

Past Actions

The Caney Fork River originates along the Cumberland Plateau in central Tennessee. The river was divided by Great Falls (CFRM 94), a natural barrier that isolated the aquatic fauna of the upper Caney Fork basin. In 1917, a private hydropower dam (currently owned and operated by TVA) was constructed on top of Great Falls which impounded the confluence of the Caney Fork and Collins Rivers creating an impoundment covering 1,830 surface acres (Crouch 1973). Great Falls Lake is narrow but deep. The Great Falls Dam tailwater feeds into the headwaters of Center Hill Lake.

The 1949 impoundment of the Caney Fork River at mile 26.6 destroyed much of the native aquatic habitat and changed the river from a free-flowing river to an impoundment covering over 18,000 surface acres (Center Hill Lake). The Caney Fork River tailwater became a regulated river downstream of Center Hill Dam. The change in flow pattern, depth, and temperature affected aquatic communities in Center Hill Lake and in the tailwater. In the lake, fish communities transformed from species found in free flowing rivers to species tolerant of reservoir conditions. Cold water releases transformed the tailwater fish community from a warm water fishery to a cold water fishery that now supports stocked rainbow, brook, and brown trout. Freshwater mussels intolerant of reservoir conditions and the cold water releases gradually died. A 2010 mussel survey only collected two individuals of one species in 26 miles of tailwater that used to support thousands of mussels comprised of over 62 species.

On the right rim, an intermittent stream, Moss Hollow Branch, flows into Wolf Creek that drains into the Caney Fork River tailwater. Moss Hollow Branch supports aquatic insects and amphibians. It does not support fish or freshwater mussels. Approximately 0.34 acres of wetlands are maintained by springs and seeps that occasionally dried up. The stream and wetlands were impacted when the area was logged and farmed.

On the left rim, aquatic resources consist of an unnamed intermittent stream, springs, and a 0.47 Quarry wetland. The unnamed intermittent stream supports aquatic insects and amphibians. It is usually dry and does not support fish or freshwater mussels. Stone from the quarry was used to construct Center Hill Dam. Springs developed in the quarry (Quarry Spring) now sustain the quarry wetland (0.47 acre). Picnic Spring has been flowing since prior to dam construction. It was once used for refrigeration by the local community. Picnic and Quarry Springs support aquatic insects and amphibians year round. There is no fish access through the spring culvert. The Quarry pond contains fish that were apparently placed in the pond when there was public access.

Normal lake operations maintained the pool between 623.5’ and 648’. In 2008, the pool was lowered following accordance with an interim risk reduction measure (IRRM) that stipulated that the elevation in Center Hill Lake be operated between 618’ and 630’. The purpose of the temporary lowering was to reduce hydraulic pressure on the main and saddle dam embankments during project feature construction. Pool lowering was anticipated to produce warmer water in the tailwater that would impact the trout fishery.

The IRRM pool lowering has changed the seasonal flow regime in the tailwater and has resulted in warmer water temperatures during certain hydrologic conditions. Pool level lowering altered habitat in the lake which may have affected certain aquatic species. The cold water budget for the lake was impacted due to a significant reduction in the volume of cold water in storage from the pool drawdown.

Present actions

The purpose of the previously approved and revised IRRM plan is to reduce the risk of dam failure at Center Hill Dam. The previously approved plan was implemented in 2008. Some of the project features have been completed or are under construction. As a result of the pool lowering at Center Hill and Wolf Creek Dams, the Nashville District implemented a Cumberland River Basin Interim Operating Plan (IOP) to document and evaluate these simultaneous pool drawdowns and their effect upon the system, as well as measures to offset impacts from these drawdowns. Through adaptive management based reservoir system operations, the impact to the aquatic resources in the Center Hill Lake and tailwater have been minimized. The Great Lakes and Ohio River Division Engineer approved revision of the Cumberland River Basin IOP on September 24, 2013 in order to allow an incremental pool raise of 20 feet at Wolf Creek Dam and Lake Cumberland. Pool lowering at Wolf and Center Hill Dams was anticipated to produce warmer water in the tailwater that would impact the trout fishery below Wolf and Center Hill Dams. The reservoir fishery and tailwater fishery has been maintained. Maintaining the status quo makes it improbable that mussels would re-establish in the lake or reservoir under the existing conditions, however, a survey will need to be performed prior to pool raising at Wolf Creek Dam to support this conclusion. A mussel survey performed below Center Hill Dam in 2009-2010 found only 2 individuals of a common mussel species left alive. Inhospitable conditions for mussels in the Caney Fork River tailwater below Center Hill Dam have extirpated all other mussel species. Inhospitable conditions will continue and be maintained when Center Hill Lake is raised and returned from interim pool elevations between 618’ and 630’, to normal pool elevations between 623.5’ and 648’.

During implementation of the previously approved plan, new studies and designs determined that alternatives under some of the project features needed revision. The revised plan and measures are incremental changes to the approved plan. Without revision, the previously approved plan alternative (grout curtains, barrier wall, and cofferdam) would be implemented. This alternative has known dam failure modes that would increase the risk of major impact to aquatic resources. This alternative does not meet tolerable failure risk. The saddle dam embankment feature considers a new repair alternative (RCC Berm) not discussed in previous EAs. The revised MRER plan alternative is the RCC Berm. This RCC Berm is a more robust, reliable, durable and cost effective alternative that meets tolerable failure risk. The revised MRER plan and the EA address the revisions. The EA includes other actions that are minor but are associated with a project feature.

Implementation of the previously approved plan has not altered the existing condition of the aquatic environment or resources in the unnamed intermittent stream, Quarry or Picnic Spring, or the Quarry wetlands. Lack of maintenance of the spring culvert has reduced flow capacity through the culvert during high flows. The spring culvert and weir repair is a minor action that would minimize inundation frequency and duration of Quarry wetland. On the right rim, implementation of the previously approved plan has not altered the existing condition of the aquatic environment or resources in Moss Hollow Branch or the wetlands.

Reasonable Foreseeable Future Actions

The reasonable foreseeable future action is to implement the revised MRER plan and associated measures to ensure maintenance of the status quo of Center Hill Dam and Lake. Implementing modifications under the revised project features would be anticipated to reduce the risk of impact to aquatic resources.

The IOP and the IRRMP for Center Hill are a temporary measure. As each project feature is completed, a dam safety evaluation would determine if it is safe to incrementally raise the pool. Before the pool is raised the IOP and IRRMP will undergo revision. Frequency, timing, and duration of any pool raise would be based on increased dam safety and reduced failure risk. Any incremental pool raise would be anticipated to reduce potential impact on aquatic resources. The foreseeable future is to return Center Hill Lake to normal operations to ensure status quo of the aquatic environment in the lake and tailwater.

4.3. THREATENED AND ENDANGERED SPECIES

Past Actions

Prior to European settlement, the 32 state and federally listed species (Table 1) were likely more widespread throughout the Caney Fork River watershed. After settlement, logging, grazing, and farming practices altered both the terrestrial and aquatic habitats. Many plant species were likely reduced to scattered pockets of individuals including the federally listed Price’s potato-bean, and the state listed Svenson’s Wild-rye, and Harper’s Umbrella-plant. Habitat alterations also impacted summer roosting and foraging habitat for the endangered gray and Indiana bats, federally protected bald eagle and State listed cerulean warbler. Resting and foraging habitat for the State protected timber rattlesnake was also impacted.

Aquatic habitats were impacted by siltation from logging and poor farming practices. Freshwater mussel beds were greatly impacted not only by siltation but by pearling. Historically the Caney Fork River and tributaries once contained very rich, diverse mussel assemblages comprised of at least 62 species, which includes five species that are now federally listed as candidate species and 17 that are listed as federally endangered species (three of which are possibly extinct) (Lewis, 2011). In 1880, a large pearl was found at the confluence of Indian Creek and the Caney Fork River. The find resulted in massive pearl hunting where millions of mussels were split open in search of pearls (Walker, 1964). Caney Fork mussels were gravely depleted.

A major aquatic habitat alteration occurred in 1949 when the Caney Fork River was impounded which changed the free-flowing river to an impoundment. This action changed flow patterns and flow timing of the river and affected water quantity, quality, sediment transport, and habitat upstream and downstream of Center Hill Dam. Freshwater mussels sustained the greatest impact. Mussels died out upstream of Center Hill Dam because they could not survive the lake-like conditions. Remaining mussels downstream of the main dam died out because they could not survive the cold water releases. The State listed sooty darter was likely impacted. It inhabits small tributary streams to the Caney Fork River drainage, however, backwaters from Center Hill Lake and the cold Caney Fork River tailwater likely confines populations to headwaters of perennial tributary streams.

Present actions

A 2009-2010 mussel survey of the Caney Fork River tailwater, from the main dam to the confluence with the Cumberland River (26.6 river miles) found only 2 live pimpleback mussels (*Quadrula pustulosa*). No live federally listed mussel was collected. On the right rim, Moss Hollow Branch, and intermittent/perennial stream, and on the left rim, an unnamed stream intermittent stream, periodically dry up. As a result, both streams cannot support freshwater mussels or fish. The federally listed Price's Potato-bean was not observed during field searches on the left and right rim. Federally protected Bald eagles have not been observed at the right or left rims. The nearest known nest was located 8 miles upstream of the dam. A bat survey was conducted to determine the presence of any listed bat species. The survey found no presence of the Indiana bat, but did record the presence of gray bats within 1 mile of Center Hill Dam. A May Affect, Not Likely to Adversely Affect determination was made for the gray bat and Indiana bat.

Reasonable Foreseeable Future Actions

Federal and state listed species are protected on federal and state property. Foreseeable actions would include continued preservation of forest habitat on federal and state property.

4.4. CULTURAL RESOURCES

Past Actions

Archaeological sites are common in the Center Hill Dam and Lake Project. Survey data indicate that the area was occupied for at least 12,000 years. With the arrival of European settlers in the late 1700's, farmsteads were established. The land was logged several times and cleared for grazing in the hills and fields in the arable flat lands of the river floodplains. In the 1940's the federal government surveyed the Caney Fork River watershed for placement of Center Hill dam and lake to reduce flooding particularly of downstream cities and towns on the Cumberland River. Residents were relocated and many historical home sites were abandoned. Currently the Hale/Alcorn house, an early 20th century vernacular structure, is located in Moss Hollow Branch drainage within the proposed impact footprint. With the creation of Center Hill Lake in 1949, many archeological sites and historical homes were inundated.

Present actions

The Hale/Alcorn house is located downstream of the proposed RCC Berm and is protected from any disturbance resulting from proposed construction activities. As long as the lake remains above elevation 618', archeological and historic properties would remain covered by the lake. The proposed RCC Berm would ensure Center Hill Lake is maintained to elevation 658' should the saddle dam fail. Without the RCC Berm, a saddle dam failure would drop the lake to elevation 570'. The force of the ensuing flood waters would erode downstream cultural resources. The loss of the lake would expose most of the archeological sites and historic properties under the lake leaving them vulnerable to looting.

Reasonable Foreseeable Future Actions

In the foreseeable future, the land would remain under federal and state control. Future actions would be limited to periodic repairs and maintenance to the main and saddle dams, RCC Berm, access roads, and weirs. The existing condition of archeological sites and historical properties would be maintained.

4.5. WATER SUPPLY

Past Actions

Caney Fork River begins in Cumberland County approximately 12 miles northwest of Crossville, Tennessee, and flows 144 miles to enter the Cumberland River near Carthage, Tennessee, in Smith County, Tennessee. There has been a wide range of stream flows in the free flowing Caney Fork River. At Rock Island, near river mile 91, the river varied from a low flow of 100 cfs to a high flow of 210,000 cfs (Crouch, 1973). Large rivers could provide a reliable water source, but for a limited number of people in growing towns and cities.

Present actions

Water supply requires a large and reliable pool of water provided with the creation of Center Hill Lake. At the existing pool (elevation 630) the lake provides 1.02 million acre-feet of storage, and at elevation 618, the lake provides 0.84 million acre-feet of storage. Water suppliers use a fraction of this storage. The Cities of Cookeville and Smithville are the largest water supply users.

Reasonable Foreseeable Future Actions

The purpose of the previously approved and revised plans is to maintain the status quo of Center Hill Lake and Dam including a large and dependable water supply source. Center Hill Lake serves as a regional water supply. As populations grow in the region it is likely that in the foreseeable future, water supply demands would also increase.

4.6. ECONOMIC RESOURCES

Past Actions

Recreating on the Caney Fork River has a long history according to Crouch (1973). In 1881 the first train reached the Rock Island depot and the Caney Fork River. This marked the beginning of a new era as people rode up on the morning train, enjoyed a day of fishing on the Caney Fork River and returned to McMinnville and other towns on the afternoon train. Following the completion of Great Falls Dam in 1917 and the creation of Great Falls Lake, a number of summer cottages were built in the area. The Webb Hotel entertained many travelers during 1924-27. Many families owned group camps. Other camps were established such as Camp Boxwell, Hi-Lake Camp, Web School Camp, and the YMCA Camp. The federal government bought property in 1935 and the Works Progress Administration (WPA) constructed roads and trails for Fall Creek Falls State Park. In 1968 design and construction began for Rock Island State Park (Crouch, 1973). With its completion in 1950, Center Hill Lake provided many recreational facilities and opportunities for middle Tennessee. Thirty-five boat ramps provide access to the lake. There are 9 commercial marinas, and many camping facilities.

In 1917, Great Falls Dam provided hydropower generating 33,800 kilowatts that provided power for many mills. In 1925, Great Falls Dam was raised and hydropower generation increased to 6 mega-watts (Crouch, 1973). In 1950, Center Hill Dam began generating hydropower and added 135 mega-watts to the power grid.

For all its benefits, Great Falls Dam was not built to contain the record floods of 1902 and 1929 when flood flows reached 180,00 cfs and 210,000 cfs respectively. In 1902 many lives, mills, and bridges were lost, and damage was estimated to cost over 500,000 dollars. During the 1929 flood, several more mills were lost (Crouch, 1973). Center Hill Dam was built for flood control. It is estimated that more than $285 million of damages have been prevented from occurring to communities and businesses along the Caney Fork and Cumberland Rivers (Corps 2007).

Present actions

The Center Hill Project provides numerous economic benefits not only to the local economy but to the region as well. Such benefits include jobs, taxes, increased land values, recreation, hydropower, water supply, and flood protection.

Reasonable Foreseeable Future Actions

With the possibility of population growth and the increase of development (commercial or residential), it would be expected that in the reasonably foreseeable future that economic benefits from recreation, hydropower, and flood damage reduction would increase and the local economy would grow.

If the saddle dam seepage is not addressed, a saddle dam failure, ensuing flood, and loss of most of the lake would likely result in severe economic resource losses. Flooding would damage downstream infrastructure including bridges, roads, ports, commercial terminals, locks, TVA fossil plants, and other water related businesses. Without electricity provided by the fossil plants, rolling blackouts could occur with the loss of power. Loss of most of Center Hill Lake to elevation 570 would impact the regional economy.

5. ENVIRONMENTAL COMPLIANCE

5.1. EXECUTIVE ORDER 11990 – WETLANDS

Executive Order (EO) 11990 requires Federal agencies to evaluate and minimize impact to wetlands. The overall policy goal is no net loss of wetlands. A total of 0.81 acres of wetlands has been identified for the entire project (left and right rim footprints). Approximately 0.68 acres of wetlands have been avoided. The remaining 0.13 acre of wetland cannot be avoided and would be filled. The wetland would be mitigated on a 2:1 ratio via an approved mitigation bank, in-lieu fee program, or permittee responsible mitigation. Mitigation would result in no net loss of wetlands. Requirements under EO 11990 have been fulfilled.

5.2. FARMLAND PROTECTION POLICY ACT

Executive Order (EO) 11990 requires Federal agencies to evaluate and minimize impact to wetlands. The overall policy goal is no net loss of wetlands. A total of 0.81 acres of wetlands has been identified for the entire project (left and right rim footprints). Approximately 0.68 acres of wetlands have been avoided. The remaining 0.13 acre of wetland cannot be avoided and would be filled. The wetland would be mitigated on a 2:1 ratio via purchase of credits in a wetland bank or in-lieu fee program. Mitigation would result in no net loss of wetlands. Requirements under EO 11990 have been fulfilled.

5.3. EXECUTIVE ORDER 11988 – FLOODPLAIN MANAGEMENT

Under this EO, each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities. No Action has the potential of increasing the risk of damage from a “base flood”. Requirements under EO 11988 have been fulfilled.

5.4. CLEAN WATER ACT

Section 404 and 401

The proposed project is in compliance with Section 404 of the Clean Water Act, which is required for the discharge of dredged or fill material into waters of the United States, including wetlands. Wetlands have been identified within the proposed project. Approximately 0.13 acre of wetlands would be lost and would be mitigated. A 404 (b) (1) evaluation was completed for the project which discusses compliance with these guidelines with inclusion of appropriate mitigation conditions and bottomless crossings construction BMP’s to protect stream substrate from disturbance and to minimize impacts to the aquatic ecosystem (Appendix E). A Tennessee General National Pollutant Discharge Elimination System (NPDES) Permit for Discharges of Storm Water Associated with Construction Activity (TNR171208) has been obtained for the entire project. Section 401 State Water Quality Certification under the Clean Water Act in the form of an Aquatic Resources Alteration Permit (ARAP) has been obtained for the entire project (ARAP NRS12.227; ARAP NRS12.229). Requirements under the Clean Water Act have been met.

5.5. FISH AND WILDLIFE COORDINATION ACT

Under this Act, Federal agencies are required to consult with and give strong consideration to the views of the USFWS and State (TWRA) wildlife agencies regarding the fish and wildlife impacts of the proposed project. Coordination with both agencies was initiated in 2005 with the original EA and has been on-going. Agency coordination for this EA took place through a scoping letter issued on February 13, 2012. A scoping response was received from USFWS on March 14, 2012. Coordination with TWRA revealed potential presence for the state protected timber rattlesnake was (*Crotalus horridus*). During August 13-15, 2012, a timber rattlesnake was collected and relocated. On August 27, 2012, a notice of availability NOA) of the draft EA, BA, and unsigned FONSI was released for a 30-day public review. Comments from that notice were considered in this EA. The resource agencies were consulted throughout the review period and coordination has been maintained. There have been no issues. A second NOA for the revised EA, BA, and unsigned was released in October 2013. Coordination is on-going. Requirements under the Fish and Wildlife Coordination Act have been fulfilled.

5.6. ENDANGERED SPECIES ACT

The ESA requires agencies to determine if a federal action has the potential to impact federally listed species or their critical habitat. Coordination was initiated in 2005 with the original EA and has been on-going. Coordination for this EA took place through a scoping letter issued on February 13, 2012. A response received from USFWS on March 14, 2012 noted that the endangered Indiana Bat could be affected by this project. On April 24, 2012 the Corps and USFWS met to discuss the potential presence of the Indiana and gray bats.

Results from a bat survey conducted May 23-27, 2012 recorded no presence of Indiana bats even though several suitable Indiana bat maternity and roosting trees and snags were located within the proposed impact footprint. Gray bats were recorded on two of the five nights. Gray bats forage in forested areas. Based on this information, the Corps determined that tree removal May Affect, Not Likely to Adversely Affect gray bats and potential Indiana bats. The USFWS concurred with this finding. To minimize disturbance to bats, plans would be made to remove trees between October 15 and March 31. If tree removal is not completed prior to April 1, 2014, a new bat survey will be conducted.

Gray bats use caves year round. The USFWS raised the concern that blasting could disturb gray bat caves. On September 17, 2012, the Corps met with USFWS. The closest potential cave was the Lower Leak cave slightly less than 0.4 miles away from the proposed blasting activity at the RCC Berm. The lower leak cave had been explored and lacked suitable habitat for gray bats due to its small size, turbulent water flow, and decreasing air space above the water. Blasting would be strictly controlled at the base of the saddle dam. The Corps determined that construction activities including blasting May Affect, Not Likely to Adversely Affect the gray bat. The USFWS concurred with this finding. Requirements under Section 7 of the Endangered Species Act have been fulfilled.

5.7. NATIONAL HISTORIC PRESERVATION ACT AND ARCHEOLOGICAL RESOURCE PROTECTION ACT

Section 106 of the National Historic Preservation Act (NHPA) of 1966 requires Federal agencies to take into account the effects of their undertakings on properties included in or eligible for the National Register of Historic Places (NRHP). The Archaeological Resources Protection Act (ARPA) was enacted "...to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals (Sec. 2(4)(b))." The reasons behind enactment include recognition that archaeological resources are an irreplaceable part of America's heritage and that they were endangered increasingly because of the escalating commercial value of a small portion of the contents of archeological sites.

The Corps has consulted with the State Historic Preservation Officer (SHPO) and tribes for the proposed RCC berm and the associated impacts during construction. No Action could expose many archeological sites should the saddle dam fail and the pool fall to elevation 570 ASL. Loss of the lake to elevation 570 ASL would require additional consultation with the SHPO and the implementation of historic property surveys.

Consultation with the SHPO and other consulting parties regarding the additional alternatives considered in this EA (left rim cut stabilization, sinkhole repairs, dam safety clearing, and spring culvert and weir repairs, and tailwater weir repairs) is ongoing. While the sinkhole repairs, dam safety clearing and weir projects are unlikely to adversely affect Center Hill Dam, the final design of the left rim stabilization may have an adverse effect. The Corps will continue consultation and reach a determination of effects prior to finalizing a finding of no significant impacts. Should the proposed left rim bank stabilization design adversely affect Center Hill Dam, it is not the type of effect that would be significant as defined by 40 C.F.R. § 1508.27.

5.8. EXECUTIVE ORDER 12989 – ENVIRONMENTAL JUSTICE

EO 12898 requires Federal agencies to promote "nondiscrimination in Federal programs substantially affecting human health and the environment." All ethnic groups and people of all incomes living in floodplains would be equally affected by all of the alternatives. Implementation of the revised plan would implement construction of the RCC Berm. The RCC Berm would be more operable and reliable in dealing with a flood. It would equally protect all populations within floodplains downstream of Center Hill Dam. Requirements under EO 12898 have been fulfilled.

5.9. EXECUTIVE ORDER 13514 – FEDERAL LEADERSHIP IN ENVIRONMENTAL, ENERGY, AND ECONOMIC PERFORMANCE – ENVIRONMENTAL SUSTAINABILITY

The goal of EO 13514 is "to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas emissions (GHG) a priority for Federal agencies." All alternatives would use appropriate environmental management techniques to reduce greenhouse gas emissions by using fuel efficient vehicles and appropriate filters for vehicle and equipment emissions. Requirements under EO 13514 would be met.

5.10. CLEAN AIR ACT

Under the Clean Air Act (CAA) Conformity Rule, DeKalb County is in attainment with regard to the National Ambient Air Quality Standard (NAAQS). Implementation of all the proposed alternatives would not have more than a local, temporary and negligible effect on air quality. Compliance with NAAQS would not be jeopardized. CAA requirements have been met.

5.11. COMPREHENSIVE ENVIRONMENTAL RESPONSE. COMPENSATION, AND LIABILITY ACT; AND RESOURCE CONSERVATION AND RECOVERY ACT

As part of the Corps' site preparation, Phase 1 and Phase II Environmental Site Assessments were completed in accordance with ER 1165-2-132. Stockpiles of pressure treated wooden timbers preserved with chromate copper arsenate (CCA) were located within the proposed impact footprint. The Park obtained a permit and disposed of the timbers into a State licensed and Corps approved landfill. The Corps collected soil samples. Arsenic was found in a small area in concentrations that posed an unacceptable risk to human health. On January 25, 2013, the Corps met with the Tennessee Division of Remediation (TDOR). TDOR acknowledged that the contaminated soil is on State property. The Corps plans to request that the contaminated arsenic soil be removed to eliminate unacceptable exposure risk to human health. In the meantime, the Corps plans to avoid the 0.08 acre area of contamination using fencing to prevent access. If new road and laydown area designs cannot avoid the area, the Corps would resample the area to identify specific sites of elevated arsenic. TDOR concurs with the Corps' proposal to cover the arsenic soil in place with a membrane and gravel layer to minimize exposure risk to human health until the soil is removed. Coordination with TDOR would continue through project construction to provide the state time to consider state options including soil removal and disposal. It is TDOR's responsibility to determine how the state will address the contaminated soil on State property. Coordination is on-going.

6. ENVIRONMENTAL COMMITMENTS

6.1. ENVIRONMENTAL SAFEGUARDS

Efforts will be made to minimize impacts to the aquatic and terrestrial resources. Measures that would be employed are provided below:

A Tennessee General National Pollutant Discharge Elimination System (NPDES) Permit for Discharges of Storm Water Associated with Construction Activity (TNR171208) has been obtained for the entire project. Best management practices (BMPs) would be followed per state permits to stabilize ground cover and to protect the site and water resources (wetlands, streams, wet weather conveyances, springs, and seeps) from sediment loss and erosion.

Safety signage, speed limits, and signals would be installed to ensure safe road traffic conditions where appropriate. Coordination with TDOT is on-going.

The Corps would continuously reevaluate design plans and seek options that would minimize tree cutting and soil disturbing activities.

A 0.13 acre wetland on Park property cannot be avoided. This wetland would be mitigated via an approved mitigation bank, in-lieu fee program, and/or permittee responsible mitigation.

The Corps would maintain coordination throughout the project life with USFWS, TWRA, TDEC, and the Park to improve awareness of any unanticipated issues and perform restoration in a satisfactory manner.

Tree removal would be scheduled between October 15 and March 31. This seasonal window would minimize disturbance to bats and other species that may forage in the area between April 1 and October 14. Bat surveys cover a 2 year period. The Corps will have to conduct a new bat survey after April. 1, 2014.

If this seasonal window cannot be met due to construction constraints, the Corps would consult with USFWS regarding selective tree removal and other protective measures.

The first preference in tree removal is that the trees are sold. The second preference is that cut trees and vegetative debris would be hauled a safe distance into adjoining forests to provide habitat and cover for resident wildlife when practicable. The material may also be chipped and used as mulch to provide erosion control protection. Use of an air curtain destructor (incinerator) will require a permit from the State Division of Air Pollution Control and will be used only when prior options have been exhausted.

A riparian buffer zone would be maintained by limiting tree cutting and removal of vegetation to where construction activities and road improvements must occur. Where possible, an average 15’ buffer would be maintained along Moss Hollow Branch to preserve the stream corridor. In some areas along the stream, the access road is less than 10' from the stream bank, as a result, a smaller riparian buffer (less than 10') would be maintained due to limited space between the road and stream bank. Additional best management practices (BMP) would be installed along small buffers for added stream protection.

Approximately 450 linear feet of Moss Hollow Branch would be temporarily covered during construction of the proposed RCC Berm. The stream substrate is to be protected from disturbance. Spanning the stream and bottomless crossings are examples of substrate protection.

Areas that do not need to be maintained by mowing would be planted in native warm season grasses. The seed mix would include big bluestem, (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*) and native forbs. Other grass species may be considered as recommended by USFWS, TWRA, TDEC, and the Park.

Disturbed forest areas would be stabilized with native warm season grasses and planted with native tree seedlings that eventually produce hard mast, sloughing bark and snags. Tree species considered include white oak (*Quercus alba*), northern red oak (*Quercus rubra*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), slippery elm (*Ulmus rubra*), black locust, (*Robinia pseudoacacia*) American elm (*Ulmus americana*), shellbark hickory (*Carya laciniosa*), and sycamore (*Platanus occidentalis*). Other native tree species may be considered as recommended by USFWS, TWRA, TDEC, and the Park.

Storm water pollution prevention plans (SWPPP) would include water quality protection BMPs for all water resources (springs, seeps, streams, wetlands, the river, and the lake). In addition, water quality monitoring stations would be established to measure stream parameters continually. Data would provide background stream quality, and an early warning system for developing water quality problems.

All construction equipment, staging, re-fueling and clean-up areas would be located outside stream buffers and in areas of containment. Spill prevention plans would be required and spill BMPs would be installed and maintained during project construction.

Proposed construction activities would include limited, and site specific blasting when a ram-hoe cannot be used. Blasting would be restricted to small charges such that ground vibrations would attenuate within 1,000 feet from the blast point.

7. PUBLIC AND AGENCY COORDINATION

Beginning in 2005, a series of public meetings were held in communities both upstream and downstream Center Hill Dam to inform the public of seepage concerns at the dam. The meetings described seepage problems, proposed seepage repairs, potential lake lowering, potential impacts to lake users, and emergency planning should there be a dam failure. Attendees included residents, stakeholders, emergency personnel, local, state, and federal officials, and natural resources agencies. To date, over 23 public meetings have been held. Continuous project information is provided through a Center Hill Project website located on Nashville District's home page. News releases, on-site tours and events, and an on-site kiosk provide continues updates to the public.

7.1. SCOPING LETTER AND RESPONSES

NEPA requires federal agencies to consider the potential environmental impacts of their proposed project and to ask for public comment before any action is taken. A scoping letter describing *No Action and only the Proposed RCC Berm alternatives* was sent on February 13, 2012 to governmental agencies and officials, Indian Tribes, the public, private individuals, and other interested parties. The letter stated the need for federal action, project location, general scope of work, and impact footprints. Scoping comments were received and considered in this EA. Comments regarding environmental issues were addressed in the course of the NEPA process and are noted in the draft EA. Scoping comments and responses are found below. Letters are in Appendix F.

USFWS: The USFWS responded on March 14, 2012 noting that potential summer roost habitat for the federally endangered Indiana bat (*Myotis sodalis*) may exist within the potential impact footprint.

Response: The Corps consulted with USFWS. An acoustic survey recording bat calls was conducted and results of the recordings found no presence of the Indiana bat. However, the gray bat was present.

SHPO: The SHPO responded on May 16, 2012 finding that the proposed project as described in the EA would not adversely affect any property that is eligible for listing in the national register of historic places.

Response: The Corps concurs with this finding for only the RCC Berm.

TDEC: The Natural Heritage Program responded on June 27, 2012 and provided a species review listing state and federally listed species.

Response: The Corps has considered all the species noted in the letter.

7.2. ORIGINAL NOTICE OF AVAILABILITY AND RESPONSES

A Notice of Availability (NOA) was originally sent on August 27, 2012 to agencies and the public informing them that a draft EA, BA, and unsigned FONSI was available for review and public comment for 30 days. The EA described the No Action and only the Proposed RCC Berm alternatives. The unsigned FONSI explained the Corp's decision, Proposed Action (only the RCC Berm), and any commitments for mitigating potential environmental impacts. The final EA must consider and respond to all timely comments received on the Draft EA. If there is no significant new information, then the Proposed

Action as described in this EA would be selected and a FONSI would be signed. Comments regarding environmental issues were addressed in the course of the NEPA process and are noted in the draft EA. NOA comments and responses are found below.

USFWS: The USFWS responded on September 25, 2012 and noted that the Corps has coordinated with the USFWS throughout the early phases of the proposed project. The Corps determined that there would be No Effect on nine historical, federally listed freshwater mussels due to the lack of suitable habitat in the project area. The Corps determined that there would be No Effect on Price's potato-bean (*Apios priceana*) due to no records and no observance. The Corps determined that there would be No Effect on the recently recovered bald eagle (*Haliaeetus leucocephalus*) because there were no nests in the project area. The USFWS concurred with a No Effect for the federally listed mussels, Price's potato-bean, and the bald eagle. The Corps determined a May Effect, Not Likely to Adversely Affect for the Indiana bat (*Myotis sodalis*) and the gray bat (*Myotis grisescens*). The USFWS noted that based on the protective measures that the Corps has proposed (Section 6, Environmental Commitments) the USFWS concurred with a May Effect, Not Likely to Adversely Affect for the Indiana and gray bats. Based on review of the EA and BA the USFWS believes that requirements of section 7of the ESA have been fulfilled.

Response: The Corps concurs with these findings.

TDEC: The Office of Policy and Planning responded on September 28, 2012. Comments covered a proposed state and federal land exchange, land restoration, wetlands, and state permit coverage. The agency requested field verification of the information contained in the letter.

Response: The Corps responded by letter dated October 23, 2012. State Parks and Corps personal have been meeting since the early phases of this project. The proposed federal and state land exchange is considered agreeable by both agencies. Coordination continues to find ways to avoid, minimize, and if necessary, mitigate impacts to wetlands. The Corps regularly coordinates with the TDEC Cookeville Environmental Field Office for state permits and has verified that the Corps' permits are current.

TDOT: TDOT responded on September 28, 2012 requesting that the Corps coordinate with TDOT if it is determined that state road right-of-ways will be impacted by the proposed project.

Response: Coordination with TDOT is on-going.

TWRA: TWRA responded on October 3, 2012 noting that potential impacts have been addressed and the agency has no objection to the proposed project.

Response: Coordination with TWRA is on-going.

TDEC: The Natural Heritage Program responded on October 18, 2012 and concurs with the Corps determination that no impacts are anticipated for rare plants. The agency noted that the Allegheny woodrat (*Neotoma magister*) – a state species deemed in need of management - was observed during the timber rattlesnake relocation during August 13-15, 2012. The agency requests that the Corps coordinate with TWRA regarding protective measures for this species.

Response: TWRA was present when this animal was observed. The Corps has requested guidance. Coordination with TWRA is on-going.

7.3. SECOND NOTICE OF AVAILABILITY AND RESPONSES

In August 2012, the project scope was increased to include the entire seepage rehabilitation and repair project and reevaluation of the 2006 implementation plan. Given the wider scope and revisions, EA Supplement 3 was re-written into a more comprehensive document. The first draft of EA Supplement 3 is so modified that it warrants a new 30-day public review. A Notice of Availability (NOA) was sent on October 24, 2013 to agencies and the public informing them that a draft EA Supplement 3, BA, and unsigned FONSI was available for review and public comment for 30 days. The unsigned FONSI explained the Corp's decision, Proposed Action, and any commitments for mitigating potential environmental impacts.

A summary of responses will be placed in this section when received.

Appendix F contains the scoping and two NOA letters, addresses, and responses to date. A summary of timely comments received and responses to the second NOA would be summarized in this section

8. CONCLUSION

The purpose and need for federal action is to reduce the risk of dam failure and to consider revisions to project features in the previously approved 2006 Major Rehabilitation Evaluation Report (MRER) plan as described in the draft 2013 MRER Supplement. The No Action Alternative in this EA is to implement the previously approved 2006 MRER plan with no revisions to project features (Left Rim, Right Rim and Abutment, Saddle Dam Embankment, and Entire Project). A "pure" No Action alternative as required under NEPA (where no federal action or work would be done) has already been evaluated in the 2006 EA Supplement 1 (Table 2) and is incorporated by reference. This is the without project condition for the Saddle Dam Embankment Project Feature (no grout curtains, barrier wall, and cofferdam) in the draft revised 2013 MRER plan supplement. The Left Rim Feature would construct the grout curtain at the left rim cave and plug the cave and downstream sinkholes with concrete grout to stop water loss from Center Hill Lake. The Right Rim and Abutment Feature would grout the right rim and plug the upper and lower leaks at the main dam with concrete grout to stop water loss from Center Hill Lake. The Saddle Dam Embankment Feature would implement construction of grout curtains, a barrier wall, and cofferdam alternate. This alternative has known dam failure modes, and does **not** meet reduced failure risk below the tolerable limit threshold.

The Proposed Action Alternative is to implement the revised 2013 MRER Supplement plan with revisions to project features (Left Rim, Right Rim and Abutment, Saddle Dam Embankment, and Entire Project). The revised Left Rim Feature would not complete the grout curtain at the left rim cave. The left rim cave and downstream sinkholes would not be plugged with concrete grout. The revised Right Rim and Abutment Feature would not grout the right rim and plug the upper and lower leaks with concrete grout. The revised Saddle Dam Embankment Feature would implement construction of a new dam safety and engineering preferred seepage repair alternative - Roller Compacted Concrete (RCC) Berm. The RCC Berm is more reliable, robust, easier to build and inspect, less costly, can be over-topped several times, and meets reduced failure risk below the tolerable limit threshold. The revised Entire Project Feature would not implement maintenance grouting every 15 to 20 years over the entire Project. The Proposed Action included measures to address ground surface safety and continued monitoring as part of on-going dam safety. The measures were 1) left rim cut stabilization, 2) sinkhole repairs, 3) dam safety clearing, 4) spring culvert and weir repairs, and 5) upper and lower leak weir repairs.

Adaptive management guided this effort that incorporated new technical information that has been collected and evaluated in real time since completion of the previously approved plan in 2006. Adaptive management ensured that only alternatives deemed necessary and most effective and robust would be implemented to address rehabilitation and seepage repairs at the Center Hill Dam and Lake Project. Based on this EA, the recommendation is to implement the Proposed Action as described in this EA.

9. LIST OF PREPARERS

Linda Adcock, Project Manager, Programs and Project Delivery Branch
Kathryn Firsching, Office of Counsel
Britt Henderson, Design Engineer Construction Branch
Vanessa Bateman, Geologist Civil Design Branch
Melanie Leslie, Geologist Engineering and Construction
Tim Higgs, Chief, Environmental Section, Environmental Engineer Project Planning Branch
Kim Franklin, Regional Technical Specialist, Biologist Project Planning Branch
Valerie McCormack, PhD, Archaeologist Project Planning Branch
Matthew Granstaff, Biologist Project Planning Branch
Joy Broach, Aquatic Biologist Project Planning Branch

10. REFERENCES

Crouch, Arthur Weir. 1973 *The Caney Fork of the Cumberland* Website: http://www.danielhaston.com/places/caney-fork/crouch/00-cover.htm

Gregory, Danny, and Sarah Lowry. 2012. *Cultural Resources Management Plan Center Hill Lake, Caney Fork River, DeKalb, Putnam, Smith, Warren, and White Counties, Tennessee*. . Report submitted by New South Associates, Stone Mountain, Georgia to the U.S. Army Corps of Engineers, Nashville District, Nashville, Tennessee.

Harvey, Michael J., J. Scott Altenbach, and Troy L. Best. 2011. *Bats of the United States and Canada*

Ivasauskas, Thomas and Phillip W. Bettoli, Ph.D. 2012. *Progress Report, Biotic Integrity and the Recreational Fishery in the Caney Fork River below Center Hill Dam, September 2009-December 2011*. Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, Tennessee.

Kerns-Nocerito, Mechelle, Alvin Banguilan, and Varna Boyd
2008 *Report of Investigations: Archival Research Concerning Center Hill Lake, Tennessee*. Report submitted by URS Group, Inc. to the U.S. Army Corps of Engineers, Nashville District Nashville, Tennessee.

Layzer, James B., Mark E. Gordon, and Robert M. Anderson. 1993. *Mussels: The Forgotten Faun of Regulated Rivers. A case Study of the Caney Fork River*. Regulated Rivers 8: 63 -71

Lewis Environmental Consulting, LLC. 2011. 2009 – 2010 Mussel Survey of the Caney Fork River Downstream of Center Hill Dam in DeKalb, Smith, and Putnam Counties, Tennessee.

McCormack, Valerie J. 2012. Cultural Resource Survey of the Proposed RCC Dam Project Area, Center Hill Lake and Edgar Evins State Park Land Exchange Parcels, DeKalb County, Tennessee. Report submitted by the U.S. Army Corps of Engineers, Nashville District, Nashville, Tennessee, to the Tennessee Division of Archaeology, Nashville, Tennessee.

McCormick, Mary. 2012. Center Hill Dam Historic American Engineering Record. Report submitted by the U.S. Army Corps of Engineers Center of Expertise on Historic Structures, Seattle District, Seattle Washington to the U.S. Army Corps of Engineers, Nashville District., Nashville, Tennessee.

Nash, Chas. H. 1947. An Archaeological survey in the Dale Hollow and Center Hill Dam Areas. In *Tennessee Archaeologist* 3(3): 44 – 45.

National Research Council. 2004. Adaptive Management for Water Resources Project Planning. 138 pp.

O'Bannon, Patrick. W. 2005. Center Hill Dam and Powerhouse: Historic Property Survey and Inventory, DeKalb County, Tennessee. Report submitted by Gray & Pape, Inc. Cincinnati, Ohio to the U.S. Army Corps of Engineers, Nashville District.

Regulatory Resource Center, AIR regulations. 2012. Website: http://www.pmairegs.com/

Smith County Chamber of Commerce, Waterways/Tributaries. 2012. Website: http://smithcountychamber.org/waterways-tributaries/

Tennessee Department of Environment and Conservation. 2003. *Caney Fork River Watershed (05130108), of the Cumberland River Basin, Watershed Water Quality Management Plan*

Tennessee Technological University. 2008. *Central Node for Upper Cumberland Region (UCR) Foray in DeKalb County, Tennessee*, May 23-26, 2008.

Tennessee Wildlife Resources Agency. 2002. *Wildlife Management for Tennessee Landowners*

Tennessee Wildlife Resources Agency. 2003. *Management Plan for the Center Hill Tailwater Trout Fishery 2004-2009.*

Tennessee Wildlife Resources Agency. 2005. *Tennessee's Comprehensive Wildlife Conservation Strategy*

US Census Bureau. 2012. Website: http://www.census.gov

US Army Corps of Engineers. 1988. Engineering Regulation 200-2-2: Environmental Quality – Procedures for Implementing NEPA

US Army Corps of Engineers. 1992. *Authorized and Operating Purposes of Corps of Engineers Reservoirs*

US Army Corps of Engineers. 1998. *Volume VIII, Center Hill Water Control Manual, Volume VIII*

US Army Corps of Engineers. 2001. *Final Supplement 1, Environmental Impact Statement, Lower Cumberland and Tennessee Rivers, Kentucky Lock Addition Project.*

US Army Corps of Engineers

2005 *Environmental Assessment, Proposed Center Hill Dam Seepage Rehabilitation, DeKalb County, Tennessee, July 2005*

US Army Corps of Engineers
2006a *Proposed Center Hill Dam Seepage Rehabilitation, Environmental Assessment, Supplement 1, DeKalb County, Tennessee, April 2006*

US Army Corps of Engineers. 2006b. *Center Hill Dam, DeKalb County, Tennessee, Seepage Control, Major Rehabilitation Evaluation, Final Report*

US Army Corps of Engineers. 2007. *Center Hill Dam and Lake, DeKalb County, Tennessee, Changes to Center Hill Lake Elevations, Final Environmental Impact Statement*

US Army Corps of Engineers. 2007a. *Army Endangered Species Research Program, Assessment of the Population Status of the Gray Bat* (*Myotis grisescens*), *Status Review, DoD Initiatives, and Results of a Multi-Agency Effort to Survey Wintering Populations at Major Hibernacula, 2005-2007*

US Army Corps of Engineers. 2008. *Environmental Assessment, Center Hill Seepage Rehabilitation Study, Supplemental EA 2, January 2008*

US Army Corps of Engineers. 2011a. E*nvironmental Assessment, August 2011, Bear Creek Wildlife Management Area, Streambank Stabilization Project, Lake Barkley, Tennessee*

US Army Corps of Engineers. 2011b. *Environmental Assessment, December 2011, Proposed Construction and Demolition of "Sligo Bridge," State route 26 (US-70, Sparta Highway), DeKalb County, Tennessee*

US Department of Agriculture, Natural Resources Conservation Service. 2012. Website: Survey. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

US Army Corps of Engineers. 2013. Cumberland River Basin Reservoir System Water Management Operating Plan During Interim Pool Restrictions at Wolf Creek and Center Hill Dams.

US Environmental Protection Agency. 1997. Glenn Griffith (USEPA), James Omernik (USEPA) and Sandra Azevedo (OAO Corporation) *Ecoregions of Tennessee* (color poster with map, descriptive text, summary tables, and photographs)

US Environmental Protection Agency. 2007. National Management Measures to Control Nonpoint Source Pollution from Hydromodification. http://www.epa.gov/owow/NPS/hydromod/pdf/Hydromod_all_web.pdf

US Geological Survey. 1995. *Public Water-Supply Systems and Associated Water Use in Tennessee.* Prepared in cooperation with the Tennessee Department of Environment and Conservation, Division of Water Supply. Open-File Report 2010-1226

US Geological Survey – Science and Decisions Center. 2013. Website: http://www.usgs.gov/sdc/adaptive_mgmt.html

Walker, Hugh. 1964. *When Pearls Grew Big in Tennessee* The Nashville Tennessean Magazine, 1 March 1964

Willey, Gordon. 1947. Appraisal of the Archaeological Resources of the Center Hill Reservoir, Tennessee, DeKalb and White Counties. Smithsonian Institution, National Anthropological Archives, Washington, D.C.