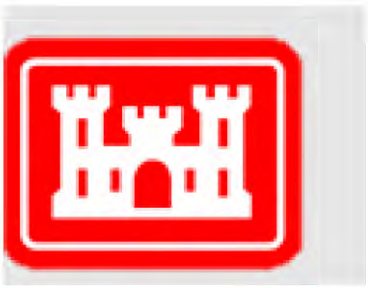
Draft

Keystone Dam Safety Modification Study Environmental Assessment

Arkansas River Basin
Tulsa County, Oklahoma

March 2024



Tulsa District
U.S. Army Corps of Engineers

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Section 1. Introduction

This Environmental Assessment (EA) has been prepared by the U.S. Army Corps of Engineers (USACE) Tulsa District (SWT) to evaluate the Keystone Dam Safety Modification Study (DSMS). This EA is an assessment of potential impacts that may result from the implementation of the final array of alternatives in comparison with the No Action Alternative. It has been prepared in accordance with 33 Code of Federal Regulations (CFR) Part 230 and the 1978 Council on Environmental Quality (CEQ) regulations 40 CFR Parts 1500-1508. In fulfillment of these and all other legal, regulatory, and policy requirements, this EA describes the purpose and need for the action, the range of alternatives considered, and discloses the environmental impacts of the alternatives.

1.1 Background

The project was placed in flood control operation in September 1964. The pool of record was 757.2 feet (ft) National Geodatic Vertical Datum of 1929 (NGVD29) and occurred on May 29, 2019. The release of record was 300,000 cubic feet per second (cfs) and occurred on October 4, 1986. The Keystone Dam spillway was originally designed for a maximum discharge of 939,000 cfs based on the original Spillway Design Flood. A recent Inflow Design Flood Update identified that the recommended Probable Maximum Flood (PMF) at Keystone Dam would result in a maximum discharge of 1,218,000 cfs (this includes the use of Tainter gates and flow over the embankment) with some uncertainty in the discharge capacity of the existing gates and overtopping flow.

1.2 Study Purpose and Need

The purpose of this DSMS, including the Dam Safety Modification Report (DSMR) and EA, is to evaluate Risk Management Plans (RMPs) and identify a plan to reduce risk associated with Keystone Dam.

The Tulsa metro area and adjacent communities is the immediate impact area affected by a failure of Keystone Dam. Tulsa has a population of nearly 400,000 with a metropolitan area population of nearly one million. The city is the second most populous in the state and Tulsa County is also the most densely populated county in the state. Population projections for the area are anticipated to increase over the next 50 years. Failure of Keystone Dam could result in impacts along the Arkansas River throughout Oklahoma and Arkansas.

Development in the Tulsa area on the southern bank of the Arkansas River is primarily commercial and industrial and includes the Holly Refinery, along with numerous other manufacturing, chemical and oil and gas facilities. The northern bank of the river is marked by a mix of residential, commercial and industrial development. There are also numerous levee systems along the entire Arkansas River.

The greatest life safety risk in the event of a breach would be in the populated areas just below Keystone Dam. As discussed, this area has noteworthy commercial/industrial development along with residential development.

1.3 Project Description

Keystone Dam is a high hazard potential dam located in Tulsa County at mile 538.8 on the Arkansas River 15 miles west of the City of Tulsa, Oklahoma, as shown below in Figure 1. This site is located about 2 miles downstream from the confluence of the Cimarron and Arkansas Rivers.

The features comprising the dam include right and left embankment sections, right and left concrete gravity spillway non-overflow sections, a gated concrete gravity spillway section, and a two-unit power plant. The right embankment section is 1,965 ft-long, and the left embankment is 1,023 ft-long. The maximum height of the dam above the streambed is about 121 ft. Figure 2 below shows an overhead view of the project features.

Figure 1. Keystone Dam Location

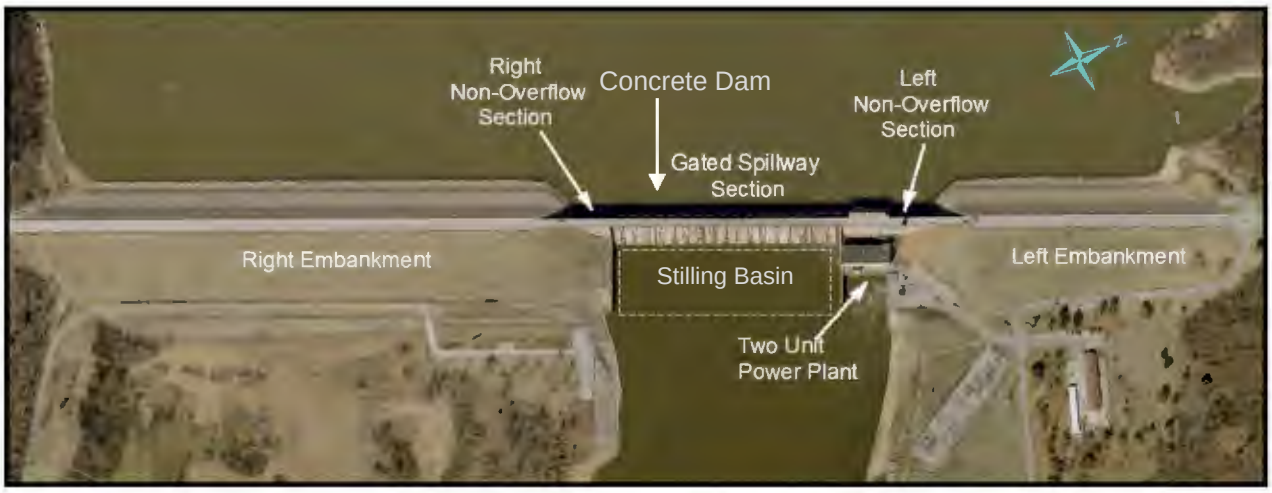

Figure 2. Keystone Dam Pertinent Features

1.4 Project Authority

1.4.1 Construction Authority

Keystone Dam was originally authorized by Congress in the Flood Control Act of May 17, 1950 (Project Document SD 107, 81st Congress, 1st Session). The authorized purposes of Keystone Dam are flood risk management, water supply, hydroelectric power, navigation, recreation, and fish and wildlife enhancement. Following authorization, construction of Keystone Dam began in January 1957 and the project was placed in operation in September 1964. The two generating units for hydroelectric power became operational in May 1968.

1.4.2 Dam Safety Modification Authority

The ER 1110-2-1156 prescribes the guiding principles, policy, organization, responsibilities, and procedures for implementation of risk-informed dam safety program activities and a dam safety portfolio risk management process within USACE. The purposes of the dam safety program are to protect life, property, and the environment by ensuring that all dams are designed, constructed, operated, and maintained as safely and effectively as is reasonably practicable. Prudent stewardship of available resources is essential to preserve the existing infrastructure. When unusual circumstances threaten the integrity of a structure and the safety of the public, USACE has the authority to take expedient actions, require personnel to evaluate the threat, and design and construct a solution.

USACE has developed a Dam Safety Action Classification (DSAC) system to provide consistent and systematic guidelines to address dam safety issues and deficiencies at USACE projects. The DSAC ratings, which reflect the degree of urgency in taking action, are informed by the probability of failure and incremental risk associated with the project. The classification scale ranges from 1 to 5, with 1 being the most urgent. Keystone Dam is a DSAC 2 (High Urgency) dam. USACE considers this level of life risk to be unacceptable, except in unusual circumstances.

1.4.3 Dam Safety Modification Study Process

The DSMS was conducted following the six-step framework of the USACE Civil Works planning process contained in ER 1105-2-100, dated April 22, 2000, as adapted for addressing dam safety issues in ER 1110-2-1156.

The risk-informed planning process for DSMSs consists of three iterations of the six-step planning process. The goal of the first iteration – Scoping, Kick-off, and Vertical Team Buy-in – is to develop the scope, schedule, and budget for the DSMS and obtain Vertical Team buy-in. The goal of the second iteration – tentatively selected plan (TSP) – is to identify the TSP and refine the scope to complete the DSMR. This iteration also includes preparation of a cost estimate as well as documentation of design requirements and assumptions and remaining uncertainties. Finally, the goal of the third iteration – Dam Senior Oversight Group (DSOG) and Final Report Approval – is to obtain DSOG endorsement of the DSMR, complete the required technical and policy reviews and report approval. There is typically some additional refinement and design of the TSP during this iteration.

It should be noted, the DSMR will not be released for public review due to the potential of sensitive information associated with dam functions and features.

1.4.4 Primary Risk Drivers

An existing conditions risk assessment (ECRA) was conducted for Keystone Dam. This study identified four potential failure modes (PFM)s that were determined to be primary risk drivers for the dam which include:

- PFM 30: Overtopping of the Embankment;
- PFM 65: Gate Reliability Failure;
- PFM 66: Uplift Pressure Causes Failure of Stilling Basin Slabs; and
- PFM 73: Headcutting Failure of the Stilling Basin (Figure 3).

Additionally, PFM 29 scour of embankment into right abutment was evaluated in the modification study and, while not risk driving, opportunities were identified to further lower risk at Keystone Dam by addressing PFM 29.

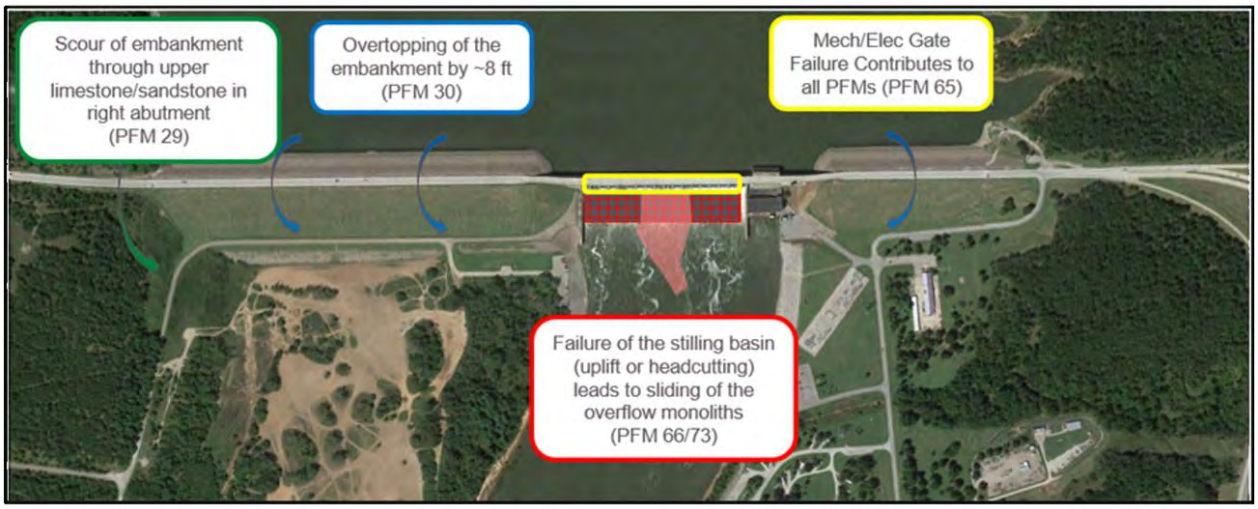

Figure 3. Risk Driving Potential Failure Modes

PFM 30: Overtopping of the Embankment

In this scenario, a significant flood near the PMF and an order of magnitude greater than anything historically observed occurs in the Arkansas River Basin causing the pool to exceed the capacity of the spillway and eventually overtop the dam. The overtopping flows can begin to erode the downstream slope of the dam and create a breach in the earthen structure. The breach can quickly widen causing a rapid increase of water and additional downstream consequences.

PFM 65: Gate Reliability

This failure mode is similar to PFM 30, however in this scenario, the inability to operate one or more of the gates also contributes to the overtopping of the embankment.

PFM 66: Uplift Pressures Fail Stilling Basin Slabs

In this scenario, a flood occurs requiring the spillway to release more water than historically seen. The water pressure on the concrete slabs at the base of the dam during extreme discharge flows could cause failure of the stilling basin slabs. This can lead to erosion of the stilling basin foundation and sliding of the concrete dam.

PFM 73: Headcutting Failure of the Stilling Basin

In this scenario, a flood occurs requiring the spillway to release more water than historically seen (near the PMF). At these very high discharges the stilling basin fails to adequately reduce the energy of the flow resulting in erosion at the end of the stilling basin. This can lead to erosion through the stilling basin foundation and sliding of the concrete dam.

1.5 Description of Alternatives Evaluated

After plan formulation to develop RMPs and the screening process, five RMPs were included in the final array for the Keystone DSMS. To evaluate these RMPs a conceptual level design and cost estimate for each RMP was developed. A general

basis of design was developed to support the rough order-of-magnitude (ROM) cost estimate and to facilitate evaluating environmental concerns, estimating risk reduction, real estate considerations, and Operations and Maintenance (O&M) considerations. These designs were largely based on existing available information with the intent of refining the design for the TSP.

The final array of RMPs is shown below.

- RMP 5a – Dam Raise with Stilling Basin Modification
- RMP 5c – Dam Raise with Stilling Basin Modification and Erosion Control Wall
- RMP 6e – New Gated Spillway with Stilling Basin Modifications
- RMP 6g – New Labyrinth Spillway with Stilling Basin Modifications
- RMP 7 – New Gated Spillway and Decommission Existing Spillway and Stilling Basin
- RMP 9 – No Action

Nine additional alternatives (RMPs 5b, 6a-d, 6f, and 6h-j) were also evaluated but were eliminated for not meeting design criteria during initial phases of analysis.

1.5.1 No Action Alternative (RMP 9)

The No Action Alternative or Future Without-Action Condition (FWAC), while it does not meet the purpose or need of minimizing dam safety concerns, serves as a benchmark of existing conditions against which Federal actions can be evaluated and, therefore, is included in this EA pursuant to CEQ regulations 40 CFR § 1502.14(c). Under the No Action Alternative, no ground-disturbing activities would be undertaken by USACE.

It is assumed that the Tulsa District will continue to operate and maintain Keystone Dam in accordance with the O&M Manual and the Water Control Manual. The Keystone Dam Surveillance Plan will be followed which establishes weekly, daily, and 24-hour surveillance monitoring thresholds for different pool elevations. The thresholds are captured in the 2019 update of the Emergency Action Plan.

As a summary, the following is anticipated over the next 50 years, absent a Federal action:

- Implementation of enhanced flood warning measures by local communities downstream;
- USACE would continue to operate and maintain the project, including monitoring existing instrumentation, with no changes to operations anticipated;
- Climate Change is not anticipated to impact probability of extreme events;
- No significant development impacting watershed hydrology is anticipated; and

- No significant changes to downstream channel capacity along the Arkansas River is anticipated.

1.5.2 RMP 5a and 5c – Dam Raise and Modification of the Existing Stilling Basin

The primary purpose of the dam raise is to store additional floodwater behind Keystone Dam until it can be passed through the existing controlled spillway structure (addresses PFM 30). Increasing the height of the dam will provide a higher potential elevation to hold water above the current top of flood storage pool. It would not result in any operational change of the dam as described in the current water control manual, including the elevation of the conservation pool and the top of flood pool.

The purpose of modifying the existing stilling basin (Figure 5) is to stabilize the stilling basin structure to protect the foundation of the concrete spillway from erosion (PFMs 66 and 73). Risk Management Plans 5a and 5c are similar plans and only differ in the measures included in the modification of the existing stilling basin. Risk Management Plan 5c includes an erosion control wall at the downstream end of the stilling basin to reduce the potential for erosion to migrate upstream into the stilling basin (PFM 73). Risk Management Plan 5c also includes 1 ft of freeboard to provide additional storage capacity in the event a gate fails to open (PFM 65).

To reduce redundancy, for the purposes of this EA RMP 5a and 5c will be discussed together. These alternatives only differ in some of their design features, while their project footprints, impacts, and analysis of those impacts remain the same.

Dam Raise

The dam will be raised by approximately 10.5 ft, along with the bridge (Highway [HWY] 151) over the spillway (Figure 4). Additional earthen material will be added to the left and right embankments of the dam and concrete added to the dam structure for additional height.

Figure 4. Risk Management Plan 5c

Modification of the Existing Stilling Basin

The existing stilling basin slabs will be anchored to the foundation and include a new overlay of concrete. The existing baffle blocks (energy dissipation block within the stilling basin) will be replaced with new strengthened blocks of similar size.

The right stilling basin training wall will be anchored to reinforce the structure while the stilling basin is de-watered. The general footprint of the existing spillway stilling basin

and stilling basin walls is approximately 3.5 acres. All work is expected to occur within the existing footprint (Figure 5).

Figure 5. General Location of Stilling Basin

Stilling Basin Cofferdam

A cofferdam, or barrier, will be constructed on the downstream side of Keystone Dam to allow for dewatering of the stilling basin so construction can be completed in dry conditions. Two permanent dividers wall will be constructed within the stilling basin to facilitate construction. The permanent divider walls will be extended downstream of the stilling basin ~250 feet using temporary coffercells. Releases from the reservoir will be made from two-thirds of the basin while work is accomplished in the remaining third. An erodible earthen cofferdam would be constructed “in-the-wet” on the downstream side of the stilling basin between the temporary coffercells. In case of flooding, all gates may need to be used to pass the flood waters and this erodible cofferdam may be washed downstream (Figure 6). Temporary bridges will be used to access each de-watered section of the stilling basin. These bridges may be placed from either the right or left side of the stilling basin. Construction of the temporary earthen cofferdam and

coffercells will be from rockfill roadways constructed downstream of the coffercells. The rockfill roadways and earthen cofferdams will be replaced as needed when releases from Keystone Dam are required and erode the fill material.

Figure 6. Bridge and Cofferdam Locations

1.5.3 RMP 6e – 804-ft-wide Gated Auxiliary Spillway with Stilling Basin Modifications

This alternative involves constructing a new gated spillway in the right abutment. With this alternative, approximately 151 acres of new, permanent ground disturbance would be required to fully construct and operate the new structure.

The purpose of the new gated spillway is to provide a means to release additional water from Keystone Dam to prevent overtopping (PFM 30). It allows the project to restore most of the original design freeboard, or distance from the water surface to the lowest elevation at which water overflows the dam (PFMs 30 and 65). The additional releases provided by this RMP would also improve energy dissipation within the stilling basin (PFM 73).

The addition of a new spillway would not result in a change to the existing conservation pool elevation or normal top of the flood pool elevation. The new spillway would be utilized during extreme events after the existing spillway gates are fully opened.

The stilling basin modifications would include stabilizing the stilling basin structure to protect the rock foundation downstream of the concrete spillway from erosion (PFMs 66 and 73).

New Gated Auxiliary Spillway

An 804-ft-wide gated spillway would be constructed in the Keystone Dam right abutment and would have approximately 14 - 50-ft wide spillway bays (see Figure 7). The existing HWY 151 alignment would be modified to cross over this new gated spillway. An approach channel would be constructed upstream of the gated spillway. The total estimated excavation is 11,000,000 cubic yards (cys) of material. No releases from the new gated spillway are expected to occur until the existing gates are fully opened or if the new gated spillway is used for normal operation of the project.

Disposal of excavated material may be placed on USACE-owned property, as well as private off-site locations. If placed on USACE-owned property, the sites would be outside of the 1/100-year floodplain and accessible by “on-road” vehicles. Sites designated for material disposal on USACE fee-owned land have not been identified; however, it can be expected that the material may be used to supplement shoreline protection, other approved projects, or on sites with low habitat quality to avoid significant resources. If on-site, the estimated area would require 155 acres, resulting in a direct and permanent impact. A Supplement to this EA may be required to evaluate disposal locations to adequately address natural and cultural resources if this alternative is selected for implementation.

Modification of the Existing Stilling Basin

The existing stilling basin slabs will be anchored to the foundation and include a new overlay of concrete. The existing baffle blocks will be replaced with new strengthened blocks of similar size.

The right stilling basin training wall will be anchored to reinforce the structure while the stilling basin is de-watered. There would be no change to the existing footprint of the stilling basin.

Stilling Basin Cofferdam

A cofferdam described in RMP 5a/5c will be required to construct the features of work in the stilling basin.

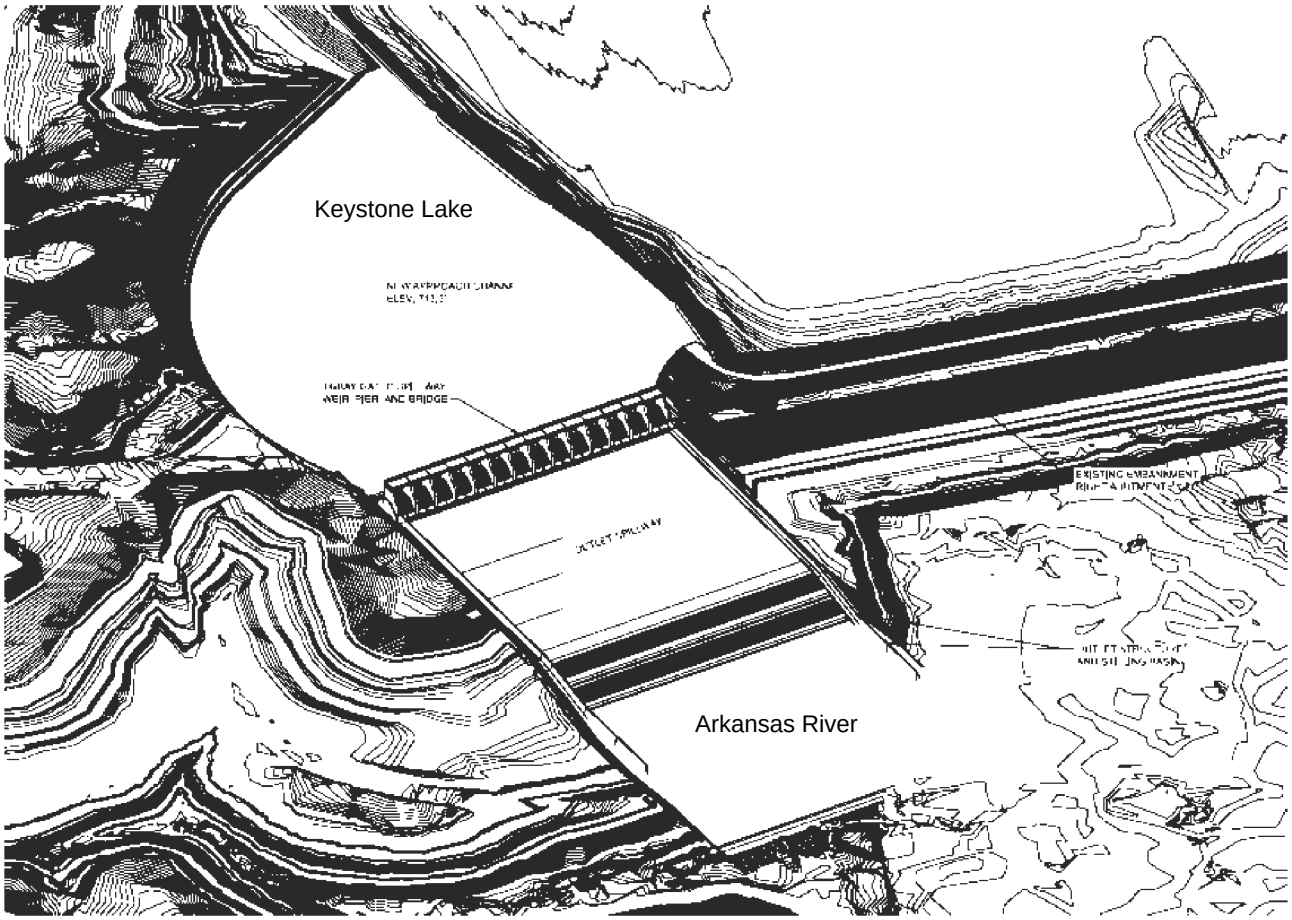

Figure 7. Isometric Illustration of RMP 6e

1.5.4 RMP 6g – 803-ft-wide Labyrinth Auxiliary Spillway with Stilling Basin Modifications

This alternative involves constructing a new un-gated spillway in the right abutment. With this alternative, approximately 40 acres of new, permanent direct ground disturbance would be required to fully construct and operate the new structure.

The purpose of the new un-gated spillway would be to provide a means to release additional water from Keystone Dam to prevent overtopping (PFM 30). A hydraulic baffle, used to dissipate the waters energy, would be constructed across the face of the existing spillway to protect the gates and superstructure during pool elevations greater

than the original design elevation (766 ft NGVD20). The additional releases provided by this RMP would also improve energy dissipation within the stilling basin (PFM 73).

The addition of a new spillway would not result in a change to the existing conservation pool elevation or normal top of flood pool elevation. The new spillway would be utilized during extreme events after the existing spillway gates are fully opened.

The purpose of modifying the existing stilling basin is to stabilize the stilling basin structure to protect the lower portion of the concrete spillway from erosion (PFMs 66 and 73).

New Labyrinth Auxiliary Spillway

An 803-ft-wide labyrinth spillway would be constructed in the right abutment (see Figure 8). A new HWY 151 bridge would be constructed over the new spillway exit channel. A total of approximately 5,500,000 CY of excavation is estimated for the construction of RMP 6g. An approximately 600-ft approach channel would be constructed upstream of the new spillway. Similar to RMP 6e, on-site and off-site disposal will be considered and may require Supplemental analysis for environmental and cultural resources. If on-site, the estimated area would require 70 acres, resulting in a direct and permanent impact.

Existing Stilling Basin Modification

The existing stilling basin slabs will be anchored to the foundation and include a new overlay of concrete. The existing baffle blocks will be replaced with new strengthened blocks of similar size.

The right stilling basin training wall would be anchored to reinforce the structure while the stilling basin is de-watered. There would be no change to the existing footprint of the stilling basin.

Stilling Basin Cofferdam

A cofferdam described in RMP 5a/5c would be required to construct the features of work in the stilling basin.

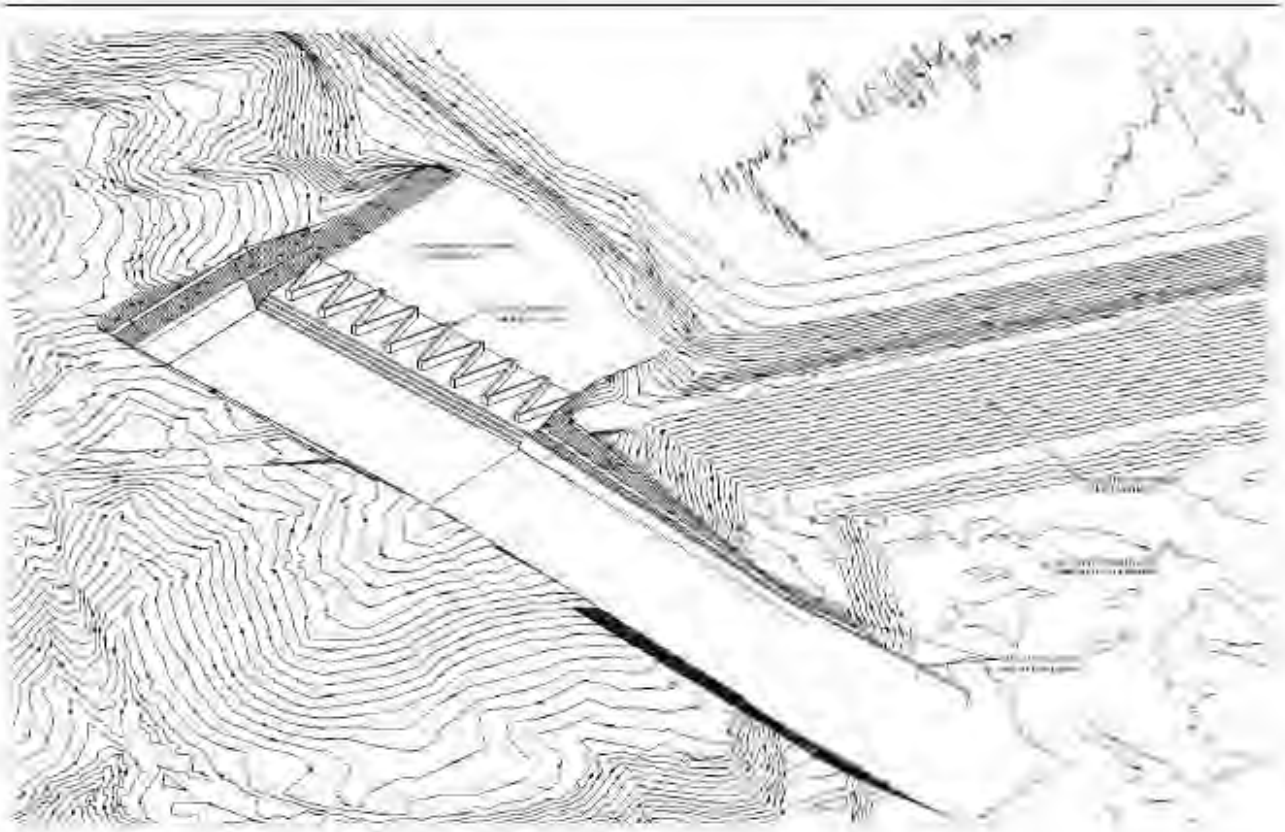

Figure 8. Isometric Illustration of RMP 6g

1.5.5 RMP 7 – 904-ft-wide Gated Auxiliary Spillway with Dam Raise and Decommissioning of Existing Service Spillway

This alternative involves constructing a new gated spillway in the right abutment. With this alternative, approximately 120 acres of new, permanent direct ground disturbance would be required to fully construct and operate the new structure.

The purpose of the new gated spillway is to replace the existing spillway at Keystone Dam with a new more robust structure (PFMs 66 and 73). The existing spillway would be decommissioned, and the dam raised by approximately 4 feet (PFM 30).

New Gated Spillway/Dam Raise

A new 904-ft-wide gated spillway would be constructed in the right abutment and consist of 19 – 40 ft-wide spillway bays. The existing HWY 151 alignment would be modified to cross over this new gated spillway. A total of approximately 20,000,000 CY of excavation is estimated for the construction of RMP 7. An approach channel will be constructed upstream of the spillway. Similar to RMP 6e, on-site and off-site disposal will be considered and may require Supplemental analysis for environmental and

cultural resources for disposal on 295 acres of land. Additional details regarding excavation elevations would be determined during the PED phase.

The gated spillway would be operated to match the operation of the existing spillway. The existing spillway would be decommissioned with only the existing sluice gates (valves designed to seal in one direction) remaining in service.

The embankment would be raised by approximately 4 ft and HWY 151 would continue over the proposed decommissioned spillway (Figure 9). Dam embankment material would be excavated to tie the dam raise into the existing embankment.

Existing Spillway Modification

The existing spillway would be decommissioned and filled with concrete to create a permanent dam. The existing sluice gates and the existing stilling basin would be left in-place.

Existing Spillway Cofferdam

To facilitate the abandonment of the existing service spillway, cofferdams upstream of the spillway in the lake, and downstream of the stilling basin would be required. After completion of construction, a portion of the cofferdam would be removed to allow for hydropower generation and the use of the existing sluice gates.

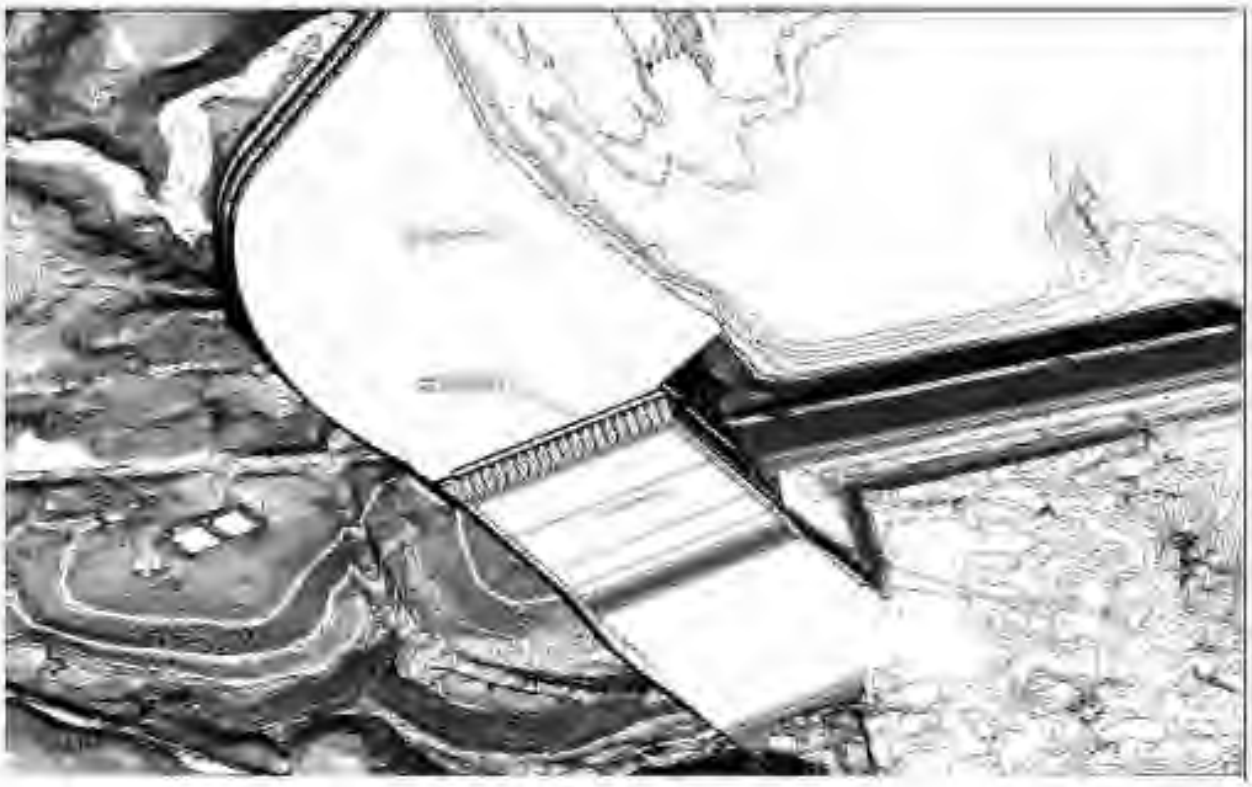

Figure 9. Isometric Illustration of RMP 7 Gated Spillway

1.5.6 As-Low-As-Reasonably-Practicable Consideration (ALARP)

ALARP considerations are actions should be taken to reduce risk below the tolerable risk limit until such actions are impracticable or not cost effective. Modifications to the selected RMP that can be implemented from an ALARP perspective were considered for the following PFMs:

- PFM 29 (Internal Erosion into Right Abutment Upper Rock)
    - Recommended ALARP measure discussed in more detail below.
- PFM 65 (Mechanical/Electrical Gate Failure)
    - Additional freeboard would be added to the dam raise to account for the inability to open a Tainter Gate during an extreme flood.

PFM 29 (Internal Erosion into Right Abutment Upper Rock)

The proposed filter berm for PFM 29 is intended to cover the area of existing seepage in the right abutment. The proposed filter berm would provide a filtered exit, collection system, and weir to monitor the quantity of seepage.

The filter berm would generally be constructed of three materials: fine filter aggregate (ASTM C33 concrete fine aggregate), random fill, and topsoil to support vegetation growth. Existing random fill areas (including waste fill zones) may need to be excavated along with limited intact bedrock to facilitate construction of the berm. Existing waste fill material could potentially be re-used as random fill in the filter berm. Any existing seepage collection system would be removed, and all seepage collected to a common location for minimal future maintenance and inspection activities.

1.5.7 Screening and Evaluation Criteria

The initial array of measures included the No Action Alternative and mandatory RMPs described in ER 1110-2-1156. Measures were screened against the primary study objective of reducing the incremental dam safety risk associated with the dam to meet the Societal Tolerable Risk Limit. Measures were then screened out based on being ineffective at reducing risk, low efficiency, having unacceptable risk, or having unacceptable impacts. Tulsa District considered the initial measures utilizing the following criteria:

1. Effectiveness – the extent to which a measure meets the study objectives.
2. Constructability/Implementability – the extent to which a measure can be constructed, implemented, and/or increase project risk during construction.
3. Cost Efficiency – the magnitude cost compared to other measures.
4. Risk Transfer – the potential for the measure to transfer the existing conditions risk from one area of the study to another.
5. Non-Breach Consequences – the extent to which the measure impacted non-breach risk.
6. Social Effects – assessing impacts to the local community, transportation impacts, as well as recreation and other social aspects.

7. Environmental/Cultural Impacts - the extent to which the measure would impact the natural and human environment.

8. Real Estate Impacts – the extent to which the measure would require the acquisition of additional real estate.

9. Impacts to Authorized Project Purposes – the extent to which the measure would impact the other authorized project purposes of water supply, hydroelectric power, navigation, recreation, and fish and wildlife enhancement.

1.6 Common Features for Each Alternative

1.6.1 Staging, Laydown, and Haul Routes

All construction alternatives evaluated would include the implementation of staging, laydown, and haul routes. Staging and laydown areas are proposed for five separate locations, but it should be noted not all areas may be necessary because only approximately 10 acres in total will be needed during construction (Figure 10). Shrubs and trees would be cleared, and gravel laid down to allow for appropriate drainage and surface conditions. However, due to the location of the proposed staging and laydown areas there is very little vegetation clearing expected. All proposed staging areas are described within this EA, but some may be screened out during the preconstruction, engineering, and design (PED) phase due to accessibility for large construction equipment.

Haul route locations are not known but expected to be further developed during the PED phase. New haul routes are not expected to require vegetation clearing and would be avoided/minimized to the extent practicable. Existing roads may be expanded with appropriate road base to allow two-way traffic for large construction equipment.

All impacts from staging, laydown, and haul routes would be temporary in nature and fully restored with native vegetation upon completion of construction features.

Figure 10. Proposed Staging and/or Laydown Areas

1.6.2 On-site Concrete Batch Plant

A 20-acre concrete batch plant will be established near the dam site for construction within the White Water Off-road Vehicle (ORV) Park (Figure 11). The batch plant will be established on non-wetland soils that have been previously disturbed by off-road vehicle use. Use of the batch plant includes laydown areas and storage areas of materials such as sand, concrete, and gravel. Additionally haul routes will be established to truck in the necessary equipment and materials for the batch plant as well as construction but are not expected to disturb existing trees.

Figure 11. Proposed Location of Concrete Batch Plant

Section 2. Affected Environment and Environmental Consequences

This section presents a description of the environmental resources and baseline conditions that could be affected from implementing the Final Array of Alternatives. The No Action Alternative is intermittently referred to as the FWAC scenario and can be interchanged within this section.

Numerous alternatives were formulated, evaluated, and screened as described in Section 1. The final array of RMPs includes RMP 5a, RMP 5c, RMP 6e, RMP 6g, RMP 7, and the No Action Alternative. For the purposes of this document, RMP 5a and 5c have been combined throughout the discussions and analysis due to their similarities and identical impacts.

In compliance with the National Environmental Policy Act (NEPA), Commission on Environmental Quality (CEQ), and 33 Code of Federal Regulations (CFR) Part 230 guidelines, the discussion of the affected environment (i.e., existing conditions) focuses on those resource areas that are potentially subject to significant impacts. In addition,

the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

For each resource area section, the resource is: (1) generally defined, (2) given an appropriate project area, (3) described for existing conditions, and (4) evaluated for the consequences of the alternative. The project area for each resource is a geographic area within which the final array may exert some influence. The existing conditions discussion for each resource area presents the condition of the resource within the respective study area.

Under NEPA, the significance of project impacts is a function of context and intensity. For biological resources, context refers to the importance (ecological, commercial, scientific, recreational, etc.) or regulatory (i.e., legally protected) status of the resource, and intensity refers to the magnitude – scale and duration – of the impact. Both beneficial and adverse impacts are recognized; either can be significant.

2.1.1 Impact Descriptions

The terms “effect” and “impact” are synonymous as used in this analysis. Both short- and long-term effects are relevant in considering the significance of an impact. Effects are also expressed in terms of duration. The duration of short-term impacts is considered to be one year or less. Long-term impacts are described as lasting beyond one year. They can potentially continue in perpetuity; in which case they would also be described as permanent. Effects may be beneficial or adverse and may apply to the full range of natural, aesthetic, historic, cultural, and economic resources of the project area and the surrounding area. Definitions and examples of direct and indirect impacts as used in this document are as follows:

- Direct Impact - A direct impact is one that would be caused directly by implementing an alternative and that would occur at the same time and place.
- Indirect Impact - An indirect impact is one that would be caused by implementing an alternative that would occur later in time or farther removed in distance but would still be a reasonably foreseeable outcome of the action. Indirect impacts may include induced changes in the pattern of land use, population density, growth rate, air, water, and other natural resources and social systems.

2.1.2 Significance Criteria and Impact Characterization Scale

In accordance with CEQ regulations and implementation guidance, impacts are evaluated in terms of their significance. The term “significant” requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several settings, such as society as a whole (human, national); the affected region; the affected interests; and the locality. Significance varies with the setting of the final array of alternatives. For instance, in the case of a site-specific action, significance would usually depend on the effects on the locale rather than on the world as a whole.

Impacts are characterized by their relative magnitude, and may be beneficial or adverse, with the degree of increasing impacts from negligible, minor, moderate, to significant. Significant adverse or beneficial impacts are the highest levels of impacts. Conversely, negligible adverse or negligible beneficial effects are the lowest level of impacts.

Intensity refers to the severity of impact with regard to the above ratings (negligible through significant). Factors contributing to the evaluation of the intensity of an impact include, but are not limited to, the following:

- The balance of beneficial and adverse impacts, in a situation where an action has both;
- The degree to which the action affects public health or safety;
- The unique characteristics of the geographic area where the action is proposed, such as proximity to parklands, historic or cultural resources, wetlands, prime farmlands, wild and scenic rivers, and ecologically critical areas;
- The degree to which the effects on the quality of the human environment are likely to be controversial;
- The degree to which the effects of the action on the quality of the human environment are likely to be highly uncertain or involve unique or unknown risks;
- The degree to which the action might establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action “temporary” or by breaking it down into small component parts;
- The degree to which the action might adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (NRHP) or might cause loss or destruction of significant scientific, cultural, or historic resources;
- The degree to which the action might adversely affect an endangered or threatened species or critical habitat that has been determined to be critical under the Endangered Species Act (ESA); and;
- Whether the action threatens a violation of Federal, state, or local law or requirements imposed for the protection of the environment.

2.2 Climate, Climate Change, and Greenhouse Gases

The climate in the Tulsa area is considered continental, characterized by abundant sunshine and rapid fluctuations in temperature. Winters are generally mild, and temperatures rarely fall below 0 degrees Fahrenheit (°F). During the summer, temperatures often exceed 100°F from late July to early September. The average annual temperature is 61°F, with average highs ranging from 79°F to 93°F during

summer and from 38°F to 50°F during winter. The National Weather Service (NWS) reports average low temperatures in the winter months generally range between 10°F and 33°F (NWS, 2022).

As part of a climate change adaptation pilot program, the USACE Institute for Water Resources (IWR) funded a study of the Oologah Lake watershed, located on the Verdigris River in southeastern Kansas and northeastern Oklahoma. The study was titled “Reservoir and Watershed Risk-Based Assessments – Oologah Lake and Watershed Responses to Climate Change Pilot Study.” Since the Oologah Lake watershed is part of the Arkansas River watershed and is adjacent to the Keystone Lake watershed, conclusions drawn from this study are applicable to the Keystone Dam Safety Modification Study.

A set of 112 hydrographs was developed by colleagues at the University of Oklahoma by simulating runoff from bias-corrected, spatially disaggregated (BCSD) statistically downscaled climate projections with the Variable Infiltration Capacity (VIC) model. Numerical routing was then used to transform these hydrographs into a long-term simulation of pool elevations so that droughts could be identified and the critical period for each could then be determined as well.

Although this study focused on drought, important conclusions can be drawn about future precipitation. The model projections show no major changes to average precipitation, and hydrologic runoff stresses resulting from climate change at Oologah Lake are not expected to substantially increase over time. The Oologah Lake and Watershed Responses to Climate Change Pilot Study revealed no major changes to precipitation.

The Engineering and Construction Bulletin (ECB) 2018-14 does not require a quantitative assessment of how climate change might impact probable maximum flood (PMF) magnitudes for a particular study area. The ECB notes that *“Only after a substantial body of research has been amassed to facilitate a quantitative understanding of the relationship between climate change and the magnitudes of extreme storms can USACE begin to develop the tools and technical guidance necessary to facilitate a quantitative assessment of how to incorporate climate change impacts into applied hydrologic analyses supporting PMF magnitudes and/or the uncertainties associated with them…At the time of the issuance of this ECB, there is no consensus how extreme storms will evolve in the future, and this issue is not addressed in this ECB.”* A quantitative climate change analysis was not performed for this study, but assumptions from the Oologah Lake Pilot Study were utilized.

2.2.1 No Action Alternative

The Climate Change qualitative analysis utilizing the Oologah Lake Pilot Study showed no major changes to precipitation in the watershed and no noteworthy trends in observed stream flow datasets or climate vulnerabilities for the Arkansas River Basin. The U.S. Global Change Research Program (USGCRP) looks at two potential future conditions as part of its predictive modeling process (USGCRP, 2018). Under conditions of lower greenhouse gas (GHG) emissions, the average temperature in the Southern

Great Plains region may increase as much as 5.1°F by 2050, and 8.4°F by 2100 from averages observed from 1976–2000. If the current rate of GHG emissions continues, the potential increase is greater in the long-term, which may result in as many as 60 days with temperatures over 100°F by 2100.

Over the planning horizon, local weather events, like flooding and drought, will still occur. Through these resources and analyses, climate change is not anticipated to impact probability of extreme hydrologic events and is not expected to change in the No Action Alternative within the 50-year period of analysis.

2.2.2 All Action Alternatives

No impacts on climate or climate change are expected from the construction of the dam modification alternatives. While GHG emissions from construction would contribute to climate change, they would represent a negligible fraction of all emissions influencing climate change. GHG capture is expected to be negligible due to impounding water from a catastrophic event (1/67,000) because this impact will be infrequent. As such, no change from the predicted climate and climate change would occur as a result of the actionable alternatives based on the analysis described in Section 2.2.

2.3 Air Quality

The U.S. Environmental Protection Agency (EPA) is primarily responsible for regulating air quality nationwide. The Clean Air Act (CAA) (42 U.S.C. 7401 *et seq*.), as amended, requires EPA to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from numerous and diverse sources considered harmful to public health and the environment. The CAA established two types of national air quality standards classified as either “primary” or “secondary.” Primary standards set limits to protect public health, including the health of at-risk populations such as people with preexisting heart or lung diseases (such as asthma), children, and older adults. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has set NAAQS for six principal pollutants known as “criteria” pollutants. Criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). If the concentration of one or more criteria pollutant in a geographic area is found to exceed the regulated “threshold” level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas. Oklahoma is currently in attainment for all six criteria pollutants (Oklahoma Department of Environmental Quality [ODEQ], 2021a).

2.3.1 No Action Alternative

This resource is not expected to change substantially during the planning horizon of this project. While ongoing construction associated with various projects is expected to

continue in the Tulsa area; local, state, and federal emission standards are expected to maintain air quality attainment standards.

The construction of various other ongoing projects in the Tulsa area would be expected to have minor to moderate adverse impacts on air quality from heavy equipment exhaust emissions. This impact would be short-term and lessen over time as projects are completed. As such, the emissions associated with construction activities would likely be spread out over a longer period, further reducing the concentration of exhaust emissions.

No long-term change in air quality is expected in the Tulsa area in the No Action Alternative as newer, cleaner forms of construction and transportation are developed and used on a wider scale.

2.3.2 RMP 5a and 5c

The construction of the dam raise alternative would have long-term, minor to moderate, direct adverse impacts on air quality for the Tulsa area from the use of trucks, dump trucks, cranes, skid-steers, front-end loaders, tractors, and barges. The increase of construction activity would result in the long-term increase of air pollution in the immediate surrounding area as total construction time is expected to be 8+ years. The narrow construction area of the dam raise would limit exhaust emissions. Limited space is available for heavy equipment that can be used at any given time. This would limit spikes in emissions throughout construction. Change in attainment status for any of the criteria pollutants in the Tulsa area is not expected. No conformity determination would be required as the Tulsa area is currently in attainment status for air quality.

2.3.3 RMP 6e

Similar to RMP 5a and 5c, the construction of the RMP 6e would have long-term, minor to moderate, direct adverse impacts on air quality for the Tulsa area. The increase of construction activity would result in the long-term increase of air pollution in the immediate surrounding area as total construction time is expected to occur for approximately 12+ years.

2.3.4 RMP 6g

Similar to RMP 5a/5c, the construction of the RMP 6g would have long-term, minor to moderate, direct adverse impacts on air quality for the Tulsa area, except that the total construction time would occur for approximately 10+ years.

2.3.5 RMP 7

Similar to RMP 5a/5c, the construction of the RMP 7 would have long-term, moderate, direct adverse impacts on air quality for the Tulsa area. The increase of construction activity would result in the long-term increase of air pollution in the immediate surrounding area as total construction time is expected to occur for approximately 18+ years.

2.4 Geology, Topography, and Soils

Landforms surrounding Keystone Lake range from strongly sloping hills around the dam and lower reaches of the lake to gently sloping grasslands at the upper reaches. The lake is located in the Eastern Sandstone Cuesta Plains subdivision of the Interior Central Lowland physiographic province. The majority of the shoreline can be described as sharply sloping toward Keystone Lake, with short rocky bluffs making up some of the shoreline.

The geology of the area is dominated by materials of the Pennsylvanian period. Principal geologic formations found in the project areas are Vamoosa, Barnsdall, Tallant, Wann and Ada.

The main soil series within the Keystone study area is the Niotaze-Bigheart-Rock outcrop complex, 15 to 25 percent slopes, extremely stony soil. The Niotaze soil occurs in 0-40-inch-thick surface layers, is normally found on hill slopes, is somewhat poorly drained, and contains loamy colluvium derived from sandstone over clayey residuum weathered from shale. The Bigheart soil occurs in 0-20 inches thick surface layers, normally found on hill slopes, is well drained, and contains residuum weathered from sandstone. The Rock Outcrop occurs in a 0-2 inches thick surface layers, and normally found on hill slope areas.

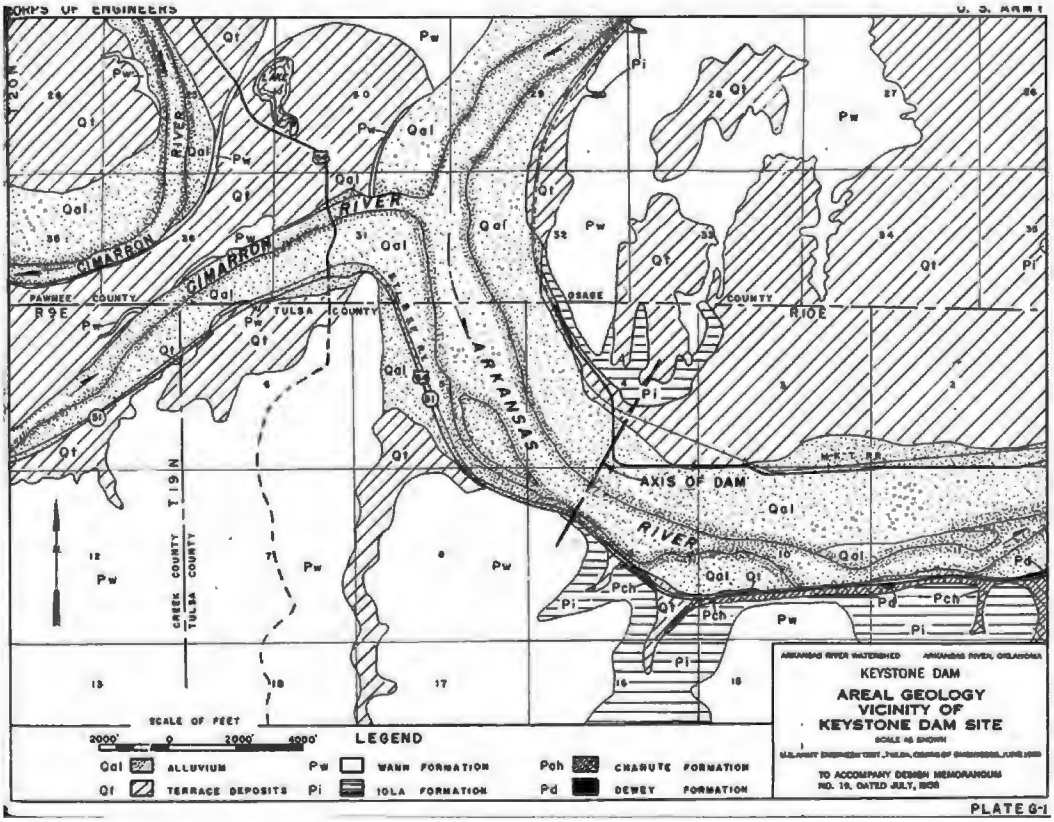

Figure 12. Keystone Dam Geology

Prime Farmland

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. Civil Works projects must identify prime farmland soils within a study area and determine whether actionable alternatives will affect the soils.

The prime farmland soils are as follows: Choska very fine sandy loam, 0 to 1 percent slopes, rarely flooded; Cleora fine sandy loam, 0 to 1 percent slopes, occasionally flooded; Kamie loamy fine sand, 3 to 8 percent slopes; Larton-Glenpool complex, 0 to 3 percent slopes; and Severn very fine sandy loam, 0 to 3 percent slopes, rarely flooded Table 1).

Table 1. Total Acres of Soil and Surface Types within the Keystone Dam Safety Modification Study Area

Map Unit Symbol	Soil Type	Acres	Farmland Status
NBRF	Niotaze-Bigheart-Rock outcrop complex, 15 to 25 percent slopes, extremely stony	216.6	Not prime farmland
NBRG	Niotaze-Bigheart-Rock outcrop complex, 25 to 45 percent slopes, rubbly	161.4	Not prime farmland
7	Choska very fine sandy loam, 0 to 1 percent slopes, rarely flooded	17.6	Prime farmland
9	Cleora fine sandy loam, 0 to 1 percent slopes, occasionally flooded	106.3	Prime farmland
21	Glenpool loamy fine sand, 3 to 15 percent slopes	16.8	Not prime farmland
23	Kamie loamy fine sand, 3 to 8 percent slopes	112.9	Prime farmland
27	Kiomatia loamy fine sand, 0 to 1 percent slopes, frequently flooded	157.8	Not prime farmland
28	Larton-Glenpool complex, 0 to 3 percent slopes	20.4	Prime farmland
48	Radley silt loam, 0 to 1 percent slopes, frequently flooded	0.1	Not prime farmland
49	Severn very fine sandy loam, 0 to 3 percent slopes, rarely flooded	38.4	Prime farmland
BNRD	Bigheart-Niotaze-Rock outcrop complex, 1 to 8 percent slopes	9.9	Not prime farmland
DAM	Large dam	37.0	Not prime farmland
NBRE	Niotaze-Bigheart-Rock outcrop complex, 3 to 15 percent slopes, very stony	38.5	Not prime farmland
W	Water	414.7	Not prime farmland
	Total		1,348.3

Figure 13. Soil Distribution Throughout the Study Area

2.4.1 No Action Alternative

The anticipated FWAC will not change geology, topography, or soils within the study area.

An unprecedented and historic flood event could threaten the stability of these resources upstream, within, and downstream of Keystone Dam in the No Action Alternative.

2.4.2 RMP 5a and 5c

The dam raise alternatives would be located within previously disturbed federal property. Fill material would be placed on approximately 40 acres in order to increase the height of the dam. The placement of material would be on an impervious surface and would have no measurable direct impact on the geology, topography or soils of the dam itself. The height of the dam would be increased by approximately 10.5 ft; however, this effect is negligible because the change in topography is used to strengthen the overall structure providing direct beneficial effects to Keystone Dam.

There will be approximately 10 acres of impact to prime farmland soil from construction of staging, laydown, and haul routes which would involve clearing of existing vegetation. However, these impacts would be temporary in nature and the areas will be replanted upon completion of the project with Crosstimbers habitat or equivalent vegetation. In addition, adverse direct impacts from construction will be minimized by standard erosion control measures.

There will be approximately 20 acres of impact to non-prime farmland soils for the purposes of construction and operation of the concrete batch plant. Due to the existing condition of the soil (frequently disturbed), direct impacts from grading and displacement of natural soil are expected to be negligible once the site is reestablished after construction is complete.

There would be no impact to the geology of the project area.

Construction that disturbs upland areas (land above Section 404 jurisdictional waters) is subject to the National Pollutant Discharge Elimination System (NPDES) requirements of Section 402(p) of the Clean Water Act. In Oklahoma, ODEQ is the permitting authority and administers the NPDES. Operators of construction activities that disturb 1 or more acres must prepare a Storm Water Pollution Prevention Plan (SWPPP), submit a Notice of Intent to ODEQ and obtain authorization under General Permit OKR10 for Storm Water Discharges from Construction Activities, conduct onsite posting and periodic self-inspection, and follow and maintain requirements of the SWPPP. During construction, operators must assure that measures are taken to control erosion, reduce litter and sediment carried offsite (silt fences, hay bales, sediment retention ponds, litter pick-up, etc.), promptly clean-up accidental spills, use BMPs onsite and stabilize sites against erosion before completion.

2.4.3 RMP 6e

There would be permanent and direct soil disturbance to 80 acres within the project area for construction of the gated spillway and approximately 155 acres for disposal of excavated material. There would be approximately 11,000,000 cys excavated from the right abutment over a period of up to 12 years. This impact would convert Niotaze-Bigheart-Rock outcrop complex, 15 to 25 percent slopes, extremely stony and 25 to 45 percent slopes, rubbly (not prime farmland) to an impervious surface. Excavation is anticipated to go as deep as 150+ ft in some areas. Excavation is expected to have a moderate adverse direct impact to topography due to the major change in elevation. Material excavated from the project area will be transferred from the site to both commercial locations and within USACE fee-owned property. USACE would contour any areas excavated to reflect appropriate conditions to reduce the risk of increased erosion.

Similar to RMP 5a/5c, this alternative would disturb soils for construction of a concrete batch plant and associated staging, laydown, and haul routes. This work would be subject to NPDES requirements.

2.4.4 RMP 6g

Similar to RMP 6e, permanent and direct soil disturbance would be approximately 40 acres within the project area for construction of the gated spillway and approximately 70 acres for excavated material disposal. There would be approximately 5,500,000 cys excavated from the right abutment over a period of up to 10 years. Excavation is anticipated to go as deep as 165+ ft.

Similar to RMP 5a/5c, this alternative would disturb soils for construction of a concrete batch plant and associated staging, laydown, and haul routes. This work would be subject to NPDES requirements.

2.4.5 RMP 7

Similar to RMP 5a/5c, a portion of RMP 7 is located within previously disturbed federal property consisting of impervious surfaces and would have negligible direct impacts on the geology, topography, and soils of the dam. This alternative would disturb soils for construction of a concrete batch plant and associated staging, laydown, and haul routes. This work would be subject to NPDES requirements.

Similar to RMP 6e, permanent and direct soil disturbance from RMP 7 would be approximately 120 acres within the project area for construction of the gated spillway and approximately 300 acres for excavated material disposal. This would require approximately 20,000,000 cubic yards to be excavated from the right abutment over a period of up to 18 years.

2.5 Noise

2.5.1 Noise Thresholds

Acceptable noise levels have been established by the U.S. Department of Housing and Urban Development (HUD) for construction activities in residential areas. Commonly used construction materials and designs can protect building occupants from the

impacts of exposure to outdoors noise that does not exceed 65 decibels A (dBA). Noise above 65 but not greater than 75 dBA is categorized as normally unacceptable. Normally unacceptable noise exposure is more substantial; barriers may be necessary between the site and prominent noise sources to make the outdoor environment acceptable; special building construction may be necessary to ensure that people indoors are sufficiently protected from outdoor noise.

2.5.2 Noise Generators in the Study Area

Noise generation within the study area can come from a variety of sources like vehicular traffic, gunfire, boating, residential, industry, stereos, and large crowds. Due to the amount of tourism that occurs around the study area, noise can intensify during the spring and summer time while individuals are accessing recreation parks and sites.

Sensitive noise receptors in the study area include two campgrounds, one residential neighborhood, and the Keystone Lake Project Office (Figure 14).

Figure 14. Sensitive Noise Receptors in the Study Area

2.5.3 No Action Alternative

The No Action Alternative will not create noise within the study area. Although the noise generators listed above are expected to increase in the FWAC.

2.5.4 RMP 5a and 5c

Noise levels created by construction equipment will vary greatly depending on factors such as the type of equipment, the specific model, the operation being performed, and the condition of the equipment. Equipment needed for this RMP include: trucks, dump trucks, cranes, skid-steers, front-end loaders, tractors, and barges. The sound level of the activity also depends on the amount of time that equipment is operated over the period of the construction. Typically, construction related activities dissipate to background ambient levels approximately 800-1,600 ft from the noise generator. Two sensitive noise receptors in the project area are within 1,100 ft of the dam and, while the residential area is farther from the dam, it is within 800 ft of two of the potential staging areas. There will be a long-term moderate adverse direct impact to one campground and the Keystone Lake Project Office due to the proximity to construction work. The use of BMPs such as keeping equipment in good operating condition, proper training, and providing appropriate health and safety equipment would minimize the potential noise impacts associated with RMP 5a/5c construction. Additional consideration regarding noise mitigation may also include noise barriers to reduce noise to an appropriate threshold if noise becomes an issue to nearby sensitive noise receptors.

2.5.5 RMP 6e

It is expected the use of blasting equipment such as a hydraulic excavator would create long-term moderate adverse indirect impacts to Keystone Lake State Park. Blasting can be expected to produce between 100 to 120 decibels (dB). This impact is expected to be moderate due to the indirect effects of blasting and associated noise on recreationalists visiting the Keystone Lake State Park and adjacent marina, the closest cabin is approximately 800 ft away from the new spillway site. There are no expected direct effects on individual hearing. Blasting is also expected to have an indirect effect on wildlife, which may lead to abandonment of the surrounding crosstimbers habitat.

2.5.6 RMP 6g

This alternative is expected to have the same impacts as RMP 6e, but over a period of approximately 10 years.

2.5.7 RMP 7

This alternative is expected to have the same impacts as RMP 5a/5c and 6e, but over a period of approximately 18 years.

2.6 Transportation

The main transportation through the study area is HWY 151. This road is approximately 2.3 miles long and its entire length is located within Tulsa County. This is the major roadway located within the study area. The 2020 Annual Average Daily Traffic on HWY 151 was 7,500 (ODOT, 2022).

Primary access along an east-west axis north of Keystone Lake is via HWY 64, the Cimarron Turnpike and Sand Springs Expressway. Access along an east-west axis south of Keystone Lake includes HWY 51.

2.6.1 No Action Alternative

The No Action Alternative will not change transportation within the study area. Although a catastrophic dam breach event would have permanent adverse impacts on transportation in the area through the loss infrastructure such as major highways and local/rural roads regularly used for commuting and everyday travel.

2.6.2 RMP 5a and 5c

This alternative will have long-term moderate adverse impacts to transportation due to the expected closure of HWY 151 for approximately 3 years. Upon reopening, HWY 151 would return to its original lane width, but some narrowing of the shoulders may be necessary. Final dimensions are to be determined during the PED phase.

Routes requiring use of HWY 151 will be rerouted causing increases in the average commute time of 29 minutes. In addition, closure of the HWY 151 bridge would affect the mobility of school district vehicles as well as emergency vehicle response time due to increased travel time of 20 minutes. The closure is expected to divert approximately 2,092 individuals per day. The diversion caused by the closure of HWY 151 has the potential to increase 20 miles or 29 minutes to the average commute for individuals traveling to their place of work, assuming a starting point of HWY 64 (immediately north of Keystone Dam/HWY 151) and an ending point of HWY 51 (immediately south of Keystone Dam/HWY 151). The HWY 151 bridge was closed in 2013 for 18 months for a bridge replacement. USACE will minimize traffic disruptions by restoring access to HWY 151 as soon as construction has been completed.

Wilson Avenue (State Highway [SH] 97) in Sand Springs, Oklahoma and SH 48 may be used as an alternate route while HWY 151 is closed during construction. Wilson Avenue has four lanes and accommodates an average daily traffic rate of 31,300 vehicles while Highway 48 only has two lanes and has an average daily traffic rate of 1,600 vehicles. Both routes could expect adverse long-term minor direct impacts from increased wear on road surfaces. Appropriate communication with nearby communities must be upheld during the construction phase to ensure effects do not rise to a significant level.

Once the alternative is constructed, a catastrophic flood event would have a temporary direct adverse effect on rural transportation within the study area. Temporary direct adverse effects on rural transportation would include the potential for road wash-out increasing the need for restorative work, as well as make roads impassable during flooding and for an additional two-week period while roads dry. This temporary impact is only expected to occur under a catastrophic and unprecedented flooding event. This timeframe is not expected to permanently damage roadways.

2.6.3 RMP 6e

RMP 6e would require the closure of HWY 151 in order to construct a bridge over the new gated spillway. The new alignment of HWY 151 and replacement bridge would

follow the existing roadway footprint. Excavation sequencing may allow for the road to stay open with intermittent closures during blasting. RMP 6e would have long-term moderate impacts to transportation due to the expected intermittent closure of HWY 151 for 4 to 5 years.

2.6.4 RMP 6g

Similar to RMP 6e, HWY 151 would have intermittent closure for 4 to 5 years.

2.6.5 RMP 7

Similar to RMP 5a/5c and RMP 6e, road closure would be needed to replace the bridge and would have long-term moderate impacts to transportation due to the expected intermittent closure of HWY 151 for 5+ years.

2.7 Land Use

Keystone Lake was developed for flood control, water supply, hydroelectric power, navigation, recreation, and fish and wildlife purposes. USACE holds fee title to approximately 59,087 acres, and an additional 26,705 acres in flowage easement at Keystone Lake. Land uses associated with Keystone Lake are designated to support the overall goal of providing good stewardship of land and water resources while providing safe recreation opportunities and economic uses to the public. In order to implement authorized purposes and support regional management goals for recreation and natural resources, the project office maximizes resources through the use of cooperative agreements and leases with Federal, state, and local agencies. USACE has licensed 12,280 acres of land to the Oklahoma Department of Wildlife Conservation (ODWC) for wildlife management. These lands are part of the 21,592-acre Keystone Wildlife Management Area (WMA) operated by ODWC in portions of Creek, Osage, and Pawnee Counties in north-central Oklahoma. The lands within Keystone Lake include infrastructure to support hydroelectric power and navigation activities, and various parks, campgrounds, and marinas to support recreation, including Brush Creek and Keystone Lake State Park within the immediate project area. Additional recreation opportunities exist for fishing downstream of Keystone Dam and off-roading at White Water ORV Park.

2.7.1 No Action Alternative

The No Action Alternative will not change land use of the existing condition over the next 50 years. A catastrophic event leading to PFM 30 would have direct adverse impacts on land use downstream of Keystone Dam; however, this event is highly unlikely to occur.

2.7.2 RMP 5a and 5c

The estimated duration period of this alternative is eight or more years. There could be long-term minor adverse impacts to land use due to the conversion of USACE fee-owned property such as open publicly maintained fields to construction areas, construction easements, haul routes, and staging areas. The change in land use of the

property will not be permanent, but public access associated with recreation would be restricted from these areas during construction.

There are expected long-term adverse indirect impacts to land use due to the expected closure of White Water ORV Park because it will be unavailable for public use. This effect will not be permanent because the concrete batch plant used for construction would be removed from the portion of the project area that included the White Water ORV Park. In addition, there will be an indirect effect on Keystone Lake State Park due to the closure of HWY 151. This indirect effect is expected to be minor because the facility will still be accessible to the public through alternative routes.

2.7.3 RMP 6e

Long-term moderate adverse impacts to land use, recreation, and transportation may happen near construction areas, construction easements, along haul routes, staging areas, and in open areas such as parking lots of maintained fields due to the estimated time to completion of the alternative because of prolonged closure of HWY 151 and the indirect impacts from the blasting required to remove material from the right abutment construction site. The blasting is expected to intermittently occur over a period of 4 to 5 years. If blasting is irritating and/or bothersome for the public, USACE expects less visitation to recreation areas around Keystone Dam. The uses of Keystone Lake will remain constant even throughout construction.

2.7.4 RMP 6g

RMP 6g is similar to RMP 6e but will occur over a period of 4 to 5 years.

2.7.5 RMP 7

RMP 7 is similar to RMP 6e but will occur over a period of 5+ years.

2.8 Utilities

There are three utilities located within the immediate area of Keystone Dam: a powerline connected to the Keystone Lake Project Office; a switchyard operated by Southwestern Power Administration (SWPA); and a telecommunications line used by the City of Mannford and owned by Cimarron Telephone Company.

Figure 15. Utilities Around Keystone Dam

2.8.1 Upstream of Keystone Dam

The hydropower facility located at the Keystone Dam has been in operation since 1968. The dam houses two hydropower-generating turbines with a power-generating capacity of 80 megawatts and a full-power discharge from the reservoir of 12,000 cfs. SWPA, as the region's Power Marketing Administration, is authorized to market the hydropower generation at Keystone Dam. When the Keystone Lake level is in the flood pool, hydropower generation is used as the first method of flood control release as part of the USACE flood risk management strategy. When the lake level is in the conservation pool, SWPA schedules and calls on Keystone Dam hydropower generation to meet peak electricity demand needs of Federal hydropower customers in a six-state region. Keystone Dam hydropower generation is operated as part of a system of Federal hydropower projects in the region to meet the peak electricity demand.

During hydropower generation, the hydropower units can release an estimated 6,000 cfs (1 unit) or 12,000 cfs (2 units) of water that flows through the river throughout the study area. During periods of low precipitation, water levels behind the dam drop into the conservation pool. Once in the conservation pool, the only water released downstream is to meet hydropower or, occasionally, water supply demand, which is typically released via the hydropower units.

2.8.2 Downstream of Keystone Dam

Numerous power transmission lines and oil/gas pipelines traverse the area supporting corresponding operations along the river (Guernsey, C.H. and Company, 2005). This includes a gas pipeline that crosses the river, approximately 2 miles west of the Highway 97 Bridge, while a large electrical transmission line crosses the river just east of the bridge near the confluence of Prattville Creek.

The Sand Springs Wastewater Treatment Plant (WWTP) treats nearly all of the city's wastewater and has a capacity of 3.1 million gallons per day, while the lagoon system at the facility has a capacity of 50,000 gallons per day.

An existing Public Service Company (PSO) electrical transmission corridor (200 to 300 feet wide) crosses the Arkansas River approximately 2,000 feet downstream of the Highway 97 bridge. Related, supporting PSO infrastructure includes a tower in the river 2,300 feet downstream of the Highway 97 bridge as well as a tower less than 100 feet from the southern bank of the Arkansas River and 200 feet from the western bank of Prattville Creek on the 4-H and Future Farmers of America livestock area. The two PSO transmission towers that tie in on the northern side of the Arkansas River are located 500 to 600 feet from the top of its banks, 8.9 miles downstream of Keystone Dam.

There are seven wastewater treatment facilities with their corresponding collection systems within the project area. The City of Tulsa wastewater treatment system includes four treatment plants: Northside, Southside, Haikey Creek, and Lower Bird Creek. The City of Tulsa has two water treatment plants that supply drinking water to more than 145,933 metered accounts in the city and on average treats 220 million gallons of water per day. The Environmental Operations Division of the Public Works & Development Department operates the city's water supply lakes, water treatment plants, and water pipelines.

2.8.3 No Action Alternative

While at this time there are no anticipated requests for adding utilities at or near Keystone Dam, if future requests for additional use and/or installation of utilities are needed, the request would have to be approved through USACE because the dam is owned in fee. There would be no impacts to utilities as a result of the No Action Alternative; however, there is the potential of increased flood risk due to dam failure to utilities within the study area due to an unprecedented, historic, and catastrophic event.

2.8.4 RMP 5a and 5c

The powerline, switchyard, and telecommunications line will not be adversely affected by either RMP 5a or 5c. The telecommunications and power line that cross the dam may be adjusted with the dam raise but are not expected to be relocated. All downstream utilities described would not be affected by the alternative due to the distance away from the project area.

2.8.5 RMP 6e

The impacts described above for RMP 5a and 5c are applicable to 6e.

2.8.6 RMP 6g

The impacts described above for RMP 5a and 5c are applicable to 6g.

2.8.7 RMP 7

The impacts described above for RMP 5a and 5c are applicable to 7.

2.9 Hazardous Materials and Solid Waste

In order to complete a feasibility level Hazardous, Toxic, Radiological Waste (HTRW) evaluation for the Keystone DSM, a records review was conducted following the guidance of ER 1165-2-132: *HTRW Guidance for Civil Works Projects*, and portions of ASTM E1527- 13: *Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process*.

Once the database searches were complete, USACE analyzed the results for recognized environmental conditions (RECs) that could affect the proposed project or need further investigation, given the proposed project measures. The results of that analysis, specifics of the REC (where applicable), and justification for dismissal from further evaluation (where applicable) are discussed below.

It should be noted that while ASTM E1527-13: Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process was the applicable standard at the time the feasibility level review was conducted, as of February 13, 2023, this standard has been updated to ASTM E1527-21. Any additional Phase 1 Environmental Site Assessments that may be conducted prior to construction will adhere to the new standard.

Due to the extensive area of the search, environmental databases had to be searched manually. These databases included the following sources:

- Environmental Protection Agency (EPA) Cleanups in my Community (CIMC) database
- EPA Envirofacts database
- US. Coast Guard's (USCG) National Response Center (NRC) database
- The ODEQ Land Protection Division online databases

The Resource Conservation and Recovery Act (RCRA) generators list can be found in the EPA Envirofacts database, and it identifies sites that generate quantities of waste classified as hazardous under the Resource Conservation and Recovery Act, or RCRA. Seven sites were identified within or adjacent to the study area (Table 2). Two sites were classified as small quantity generators (SQG), one site as a conditionally exempt small quantity generator (CESQG), and four sites were listed as having an unknown classification. All of these sites were located in the cities of Mannford and Cleveland, Oklahoma.

Table 2. Sites Sorted by Waste Generation

Site Name	Location	RCRA Status
Care Fusion	400 E. Foster Road, Mannford	SQG
Webco Industries, Inc.	501 Foster Road, Mannford	SQG
Wal-Mart Supercenter #207	772 N. Airport Road, Cleveland	CESQG
Southwest Tube Manufacturing Co.	Industrial Blvd., Mannford	Unknown
City of Cleveland	100 S. Broadway, Cleveland	Unknown
Former Wal-Mart Store #207	1004 N. Broadway, Cleveland	Unknown
Lakeshore Ford and Mercury Dealership	401 N. Broadway, Cleveland	Unknown

There were nine incidents reported to the NRC regarding Keystone Lake between 1982 and 2018. The most recent incident was a gasoline leak at the Keyport Marina (now called the Salt Creek Marina) in 2016. Approximately 200 gallons of gasoline leaked from a ruptured gas line that was quickly repaired and containment boom deployed. In 2013, there was a suspected release of a small amount of aviation fuel because of a helicopter crash near the HWY 64 Bridge. No permanent contamination was found as result of either of these two events.

Records did indicate that abandoned oil wells have periodically leaked into the lake. In August 2004, an abandoned oil well was found leaking petroleum into the lake adjacent to the Appalachia Bay Recreation Area. The well was located approximately 10 feet from the lake and was unsecured and open to the environment. No action was taken, as ownership could not be determined.

The Voluntary Cleanup Program (VCP) is administered by ODEQ and provides a means for private parties and governmental entities to voluntarily investigate, and if warranted, clean up contaminated properties. A listing of VCP sites can be found on the ODEQ website. One active site was identified 16 miles northwest of Keystone Dam, the former Cleveland Refinery located southwest of Cleveland just west of County Road 3660 (Figure 16). The former Cleveland refinery was owned and operated by Kerr-McGee until its closure in 1972, and contaminated groundwater can still be found at the site. Due to the relatively small risk, this site will not be carried forward as a REC.

Figure 16. Former Cleveland Refinery VCP Site

The records search indicated that two wastewater treatment plants are located approximately 5.5 miles west of Keystone Dam (Figure 17). Aerial photography verified the location and presence of the Mannford East Plant at 110 Elk Ridge Dr., and the main Mannford WWTP just east of Basin Road in Mannford. These sites were not carried forward as RECs due to the low probability of the unprecedented flood event.

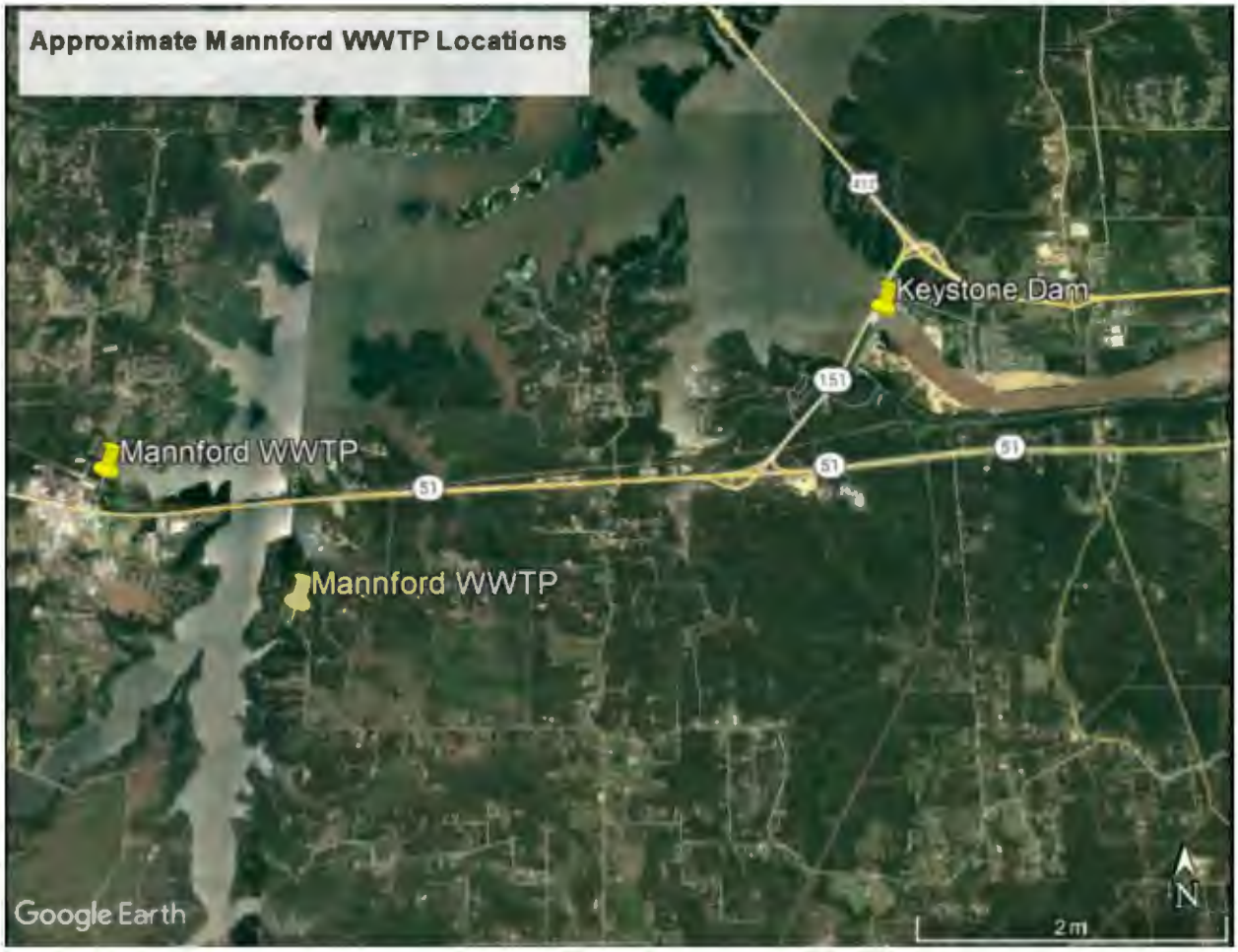

Figure 17. Mannford WWTPs

A search of the Oklahoma Water Resources Board (OWRB) Appendix H Groundwater List also identified an area of restricted groundwater use due to human-induced contamination. The Blackstar Performance site, located just east of Highway OK-48 around 4 miles north of the Highway OK-51 intersection in Terlton, is an area of groundwater contamination within a quarter mile of the Lake. The Tallant groundwater formation in this area is contaminated with chlorinated solvents and can be found anywhere from just below ground surface to 200 feet below ground surface, and potentially deeper. These sites were not carried forward as RECs due to the low probability of the unprecedented flood event.

2.9.1 No Action Alternative

In an unprecedented and catastrophic event under the No Action Alternative, the dam may fail under PFM 30. The No Action Alternative considering a dam failure would have long-term, moderate, direct impacts to downstream resources due to the release of contaminants downstream of Sand Springs and Tulsa.

If considering normal flooding events, there would be no impact to HTRW upstream or downstream of Keystone Dam.

2.9.2 RMP 5a and 5c

A records review was conducted following the guidance of ER 1165-2-132: HTRW Guidance for Civil Works Projects, and portions of ASTM E1527-13: Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process. No sites were found that had RECs, and no sites were found near the Keystone Dam itself. Several HTRW sites around the lake have the potential to be affected by an operating pool raise during a catastrophic event, but as noted in previous sections is very unlikely to occur. Ultimately, the results of the HTRW evaluation are that there are not any HTRW concerns that were carried forward as RECs for this project. This is due, in large part, to their lack of proximity to the project, and/or the sites identified have not been impacted or caused concern during previous inundation events and there is no indication that RMP 5a or 5c will cause HTRW impacts.

2.9.3 RMP 6e

The information discussed above in RMP 5a and 5c is applicable to RMP 6e. Hazardous, toxic, and radioactive waste upstream of the dam is relatively benign in comparison with the heavy industrial development present in the Arkansas River corridor downstream of Keystone Dam. Both the cities of Sand Springs and Tulsa have numerous petrochemical and manufacturing facilities, and environmental contamination in some of these areas can be considered high. If Keystone Dam were to fail, contamination within Sand Springs would be carried into the Arkansas River if those sources were flooded. Impacts from dam failure are dependent upon the contaminant and range from bioaccumulation of contaminants through food chains, impacts to human drinking water, and harm to aquatic organisms and vegetation.

2.9.4 RMP 6g

The information discussed above in RMP 6e is applicable to RMP 6g.

2.9.5 RMP 7

The information discussed above in RMP 5a/5c and 6e is applicable to RMP 7.

2.10 Health and Safety

This section describes the health and safety aspects of the study area by characterizing the existing safety concerns associated with Keystone Dam. Public safety is one of the major design considerations for any new structure in and around the Arkansas River. While subsurface currents created below a dam are often responsible for accidents, the design of flow regime measures have improved greatly, allowing for a greater degree of public safety (Guernsey, C.H. & Company, 2005). Within the study area, Keystone Dam directly provides flood risk reduction to various industrial facilities, neighborhoods, schools, and parks.

The nearest emergency services location is approximately 18 minutes, by vehicle, away from Keystone Dam. Cleveland Area Hospital is upstream of Keystone Dam while 10 other hospitals are located immediately downstream of Keystone Dam (Figure 18).

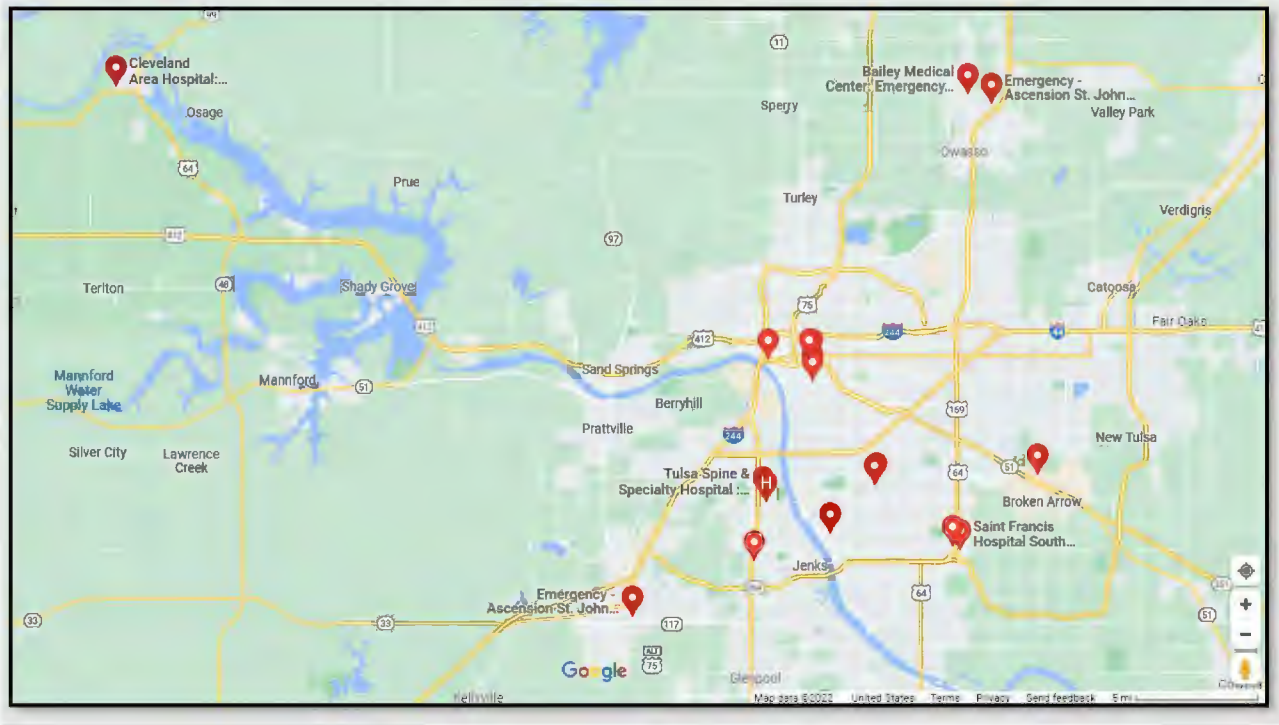

Figure 18. Emergency Services Around Keystone Lake (Source: Google Maps)

2.10.1 No Action Alternative

This resource has the potential to change during the planning horizon of the proposed project in the event of increased flooding compared to existing conditions due to the risk of dam failure. Population downstream of Keystone Dam is anticipated to increase over the planning horizon of this project. Degrading flood risk management infrastructure will increase risk for property, human life, and public safety through damage to surrounding infrastructure such as roads, hospitals, etc. This can lead to limited evacuation routes, increased traffic on remaining evacuation routes, and limited access to emergency and medical services. Continued community awareness, planning, and communication prior to and during flood events would be instrumental in avoiding life threatening situations.

It is expected that if no action is taken, all potential failure modes would continue into the future. Therefore, this alternative would have long-term, moderate, adverse impacts to the population downstream of Keystone Lake threatening individual safety and health, as well as emergency services that would respond.

2.10.2 RMP 5a and 5c

The primary purpose of the dam raise alternatives are to increase life safety through modifications of the dam embankment and stilling basin to ensure continued operation of Keystone Dam during a catastrophic and unprecedented flood event. Construction of a raised dam embankment would help abate dam failure by strengthening the dam and allowing the dam to safely operate. Beneficial long-term effects include more time for evacuations, mobilization of flood fighting resources, and flood fight response downstream of Keystone Dam. However, the temporary closure of HWY 151 for

construction will have impacts on emergency response time if the route is necessary to reach a destination. Coordination with local and county authorities will be essential to ensure emergency responders are aware of the closure and take appropriate steps to reduce life safety risks that may result from increased travel time. It should be noted the dam raise is expected to improve health and safety by improving the conditions of the dam and preventing overall failure which would have life safety impacts downstream of the dam.

Potential staging areas, access points, and haul routes are primarily existing laydown areas and major roadways. Use of these areas during construction would limit safety impacts by minimizing traffic through residential areas and school zones. Construction site safety features like flaggers, fencing, and lighting would also be implemented to further enhance construction site safety. In combination, safety BMPs limit public exposure to construction activities to foster a safe working environment for both local residents and construction crews.

2.10.3 RMP 6e

The primary purpose of the RMP 6e is to increase life safety through creation of a new gated spillway to allow Keystone Dam to operate appropriately during large flood events. Construction of a gated spillway would help abate flooding issues by releasing pressure on Keystone Dam. This RMP has effects similar to RMP 5a and 5c above.

2.10.4 RMP 6g

The primary purpose of the RMP 6g is to increase life safety through creation of a new labyrinth spillway to allow Keystone Dam to operate appropriately during large flood events. Construction of a labyrinth spillway would help abate flooding issues by releasing pressure on Keystone Dam. This RMP has effects similar to RMP 6e above.

2.10.5 RMP 7

The primary purpose of the RMP 7 is to increase life safety through modification of the dam embankment and creation of a new gated spillway to allow Keystone Dam to operate appropriately during large flood events. Construction of a gated spillway and modification of the dam embankment would help abate flooding issues by releasing pressure on Keystone Dam while also strengthening the structure. This RMP has effects similar to RMP 5a and 5c, and 6e above.

2.11 Recreation and Visual Aesthetics

2.11.1 Upstream of Keystone Dam

There are a variety of recreation sources around Keystone Lake which include visiting sandstone bluffs, viewing wildlife and utilizing its beaches. In addition to wildlife viewing, recreationalists may also fish for white bass (*Morone chrysops*), largemouth bass (*Micropterus* salmoides), crappie (*Pomoxis annularis*) and catfish (*Ictalurus furcatus*).

There are approximately 17,000 acres open for public hunting. White-tailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), mourning dove (*Zenaida*

macroura), ducks (*Anas platyrhynchos*), geese (*Branta canadensis*), cottontail rabbit (*Sylvilagus*), and squirrel (*Sciurus carolinensis*) are among the principal game species.

Numerous parks have been developed by USACE, and the State of Oklahoma maintains two parks. The cities of Cleveland and Mannford also maintain parks on Keystone Lake. There are nine developed swimming beaches. The parks have campsites, picnic areas, drinking water, restrooms, playgrounds, boat ramps, and courtesy docks.

There are numerous hiking opportunities within the study area. Washington Irving Scenic Nature Trail begins on the northern end of Washington Irving South Public Use Area and winds nearly a mile along sandstone bluffs dotted with gnarled cedars. The trail meanders in and out of wooded areas and passes through rock formations. Two Rivers Scenic Nature Trail begins on the northwest end of Keystone Dam and meanders over a mile near the shoreline. The trail offers panoramic views of Keystone Lake and is often used by fishermen. Similar to Washington Irving Trail this trail passes through heavily wooded areas. While hiking, numerous bird species may be observed. The Keystone Ancient Forest, a Sand Springs nature preserve, is located just to the northeast of the dam and offers spectacular views of Cross Timber habitat with 500-year-old cedars and 300-year-old post oak trees.

Keystone State Park is located just to the west of the dam on Keystone Lake and has three campgrounds and RV sites will full hookups. The state park is located on USACE fee-owned property but is leased by the Oklahoma Department of Tourism and Recreation (ODTR). There are 22 furnished cabins at the State Park which feature microwaves, stoves, refrigerators, and even jacuzzi bathtubs. Within Keystone State Park is Pier 51 Marina, a full-service marina with boat mechanics, boat slips, a restaurant, as well as a boat dealership.

2.11.2 Downstream of Keystone Dam

Recreation within the Arkansas River below Keystone Dam is managed by three separate public agencies: the River Parks Authority (RPA), the City of Tulsa Parks Department, and the Tulsa County Park Department. RPA, which is a public trust created by the City of Tulsa and Tulsa County, manages and oversees the River Parks system of approximately 800 acres of land, including 41 miles of riverfront.

The Arkansas River, and the Keystone and Zink Dam tailrace areas, in particular, are popular destinations for fishing. Access to the tailrace of Keystone Dam is provided from the shorelines of the White Water ORV Park and the Brush Creek Recreation Area on the southern and northern shores, respectively.

Swift Park, a Tulsa County day-use park, provides boat access from the southern side of the river approximately 0.5-miles downstream from Keystone Dam on Old Highway 51, while River City Park in Sand Springs offers a boat ramp on the northern side of the river. Brush Creek, a USACE owned and operated campground, is located directly downstream of Keystone Dam on the northern bank of the river, while the White Water ORV Park is located on USACE lands across the river on the southern bank. River City Park is located on the northern side of the river, just upstream of the Highway 97

Bridge, and is the community park for Sand Springs. It offers a wide range of recreational opportunities, including the River City Trail (bicycle/pedestrian), sports fields, a skate park, disc golf, and rodeo facilities. Chandler Park, a Tulsa County park, is located downstream of the study area on the southern side of the river and provides scenic views of Tulsa and Sand Springs; it also offers rock formations for climbing, a swimming pool, trails, baseball complex, two large playgrounds, restrooms, picnic shelters, an 18-hole disc golf course, a community center, and a large green space (Tulsa County, 2016).

2.11.3 No Action Alternative

Under the No Action Alternative, there would be no impacts on recreational resources aside from general growth in recreation use around Keystone Lake and during a dam failure event. During a failure event, recreational areas downstream would be at risk of damage due to the rise in flood waters.

2.11.4 RMP 5a and 5c

There would be long-term moderate adverse impacts to recreation and visual aesthetics resulting from RMP 5a and 5c. This alternative will have long-term, minor, adverse indirect impacts to fishing opportunities due to the closure of USACE-owned recreation facilities within the immediate vicinity of Keystone Dam. Access to fishing sites, such as those located immediately below the Keystone Dam that are popular locations to fish from shore for hybrid striped bass and paddlefish, also known as spoonbill, will be limited or closed completely due to construction of this alternative. Hunting opportunities are not expected to be impacted by this alternative as Keystone WMAs are between 10 to 20 miles away from the proposed construction site. The closure of HWY 151 will impact the access to recreation sites such as Keystone State Park, Pier 51 Marina, and White Water ORV Park. Although access from the north will be blocked, the public will still be able to visit Keystone State Park and Pier 51 Marina from the south. It is expected White Water ORV Park will be closed throughout construction along the dam embankment for public health and safety purposes. However, there would be no direct adverse impacts to recreational facilities as a result of physical construction of the dam embankment raise aside from closure of access to White Water ORV Park and the potential fishing areas immediately below Keystone Dam.

There will be a long-term, minor, adverse, direct impact on visual aesthetics during construction of this alternative. As excavation occurs on the dam, it will create an unvegetated condition (bare soil) which is typically less attractive to the average individual. In addition, the conversion of grassy mowed areas into staging or laydown areas with gravel will have long-term, minor, adverse, direct impacts on visual aesthetics. Upon conclusion of construction, any construction areas not permanently covered with impervious surfaces will be revegetated. The approximately 10ft raise, although different from the existing condition, is not expected to permanently affect visual aesthetics.

2.11.5 RMP 6e

This alternative would have long-term moderate adverse impacts to recreation and long-term, moderate, direct adverse impacts to visual aesthetics. The blasting associated with excavation of the gated spillway construction site is likely to deter recreationalists from nearby sites and reduce the number of visitors to Keystone State Park and Pier 51 Marina due to the level of noise associated with this effort. In addition, White Water ORV will be closed throughout the duration of construction of this alternative which is likely to last 12 or more years. The excavation of approximately 11,000,000 cys of material from an area adjacent to Keystone Dam would also decrease the overall visual aesthetics of the entire area. This alternative will result in the conversion of crosstimbers habitat to concrete spillway, which is typically considered a less desirable condition. Depending upon the location of disposal, tree clearing may be required resulting in an adverse impact to visual aesthetics.

There would be no impact to the Keystone State Park community building but likely impacts to state park “Staff Only” Service Road loop, Hill Top Get-A-Way, loop overlook and road, and Cabins 17-21 and access road. The closure of the state park structures would lead to lost revenue for ODTR.

2.11.6 RMP 6g

Similar to RMP 6e, this alternative would have long-term, moderate, adverse indirect impacts to recreation and long-term, moderate, direct adverse impacts to visual aesthetics. White Water ORV will be closed throughout the duration of construction of this alternative which is likely to last 10 or more years. The excavation of approximately 5,500,000 cys of material from adjacent to Keystone Dam would also decrease the overall visual aesthetics of the entire area, like RMP 6e.

2.11.7 RMP 7

This alternative is similar to RMP 5a/5c and RMP 6e; however, White Water ORV would be closed for approximately 18 years – the duration of construction. This alternative requires the conversion of crosstimbers habitat to a permanent concrete structure which includes 20,000,000 cys of excavation and disposal.

There are expected direct permanent adverse impacts to the Keystone State Park community building, loop overlook and road, Hill Top Get-A-Way, Gilcrease, Cabins 1-21 and access roads; and possible impacts to Paradise Cottage. Due to the amount of time required for construction, it is expected this alternative has the potential to permanently and indirectly adversely affect recreation within the vicinity of Keystone Dam due to blasting of the right abutment. Indirect noise impacts to recreation has the potential to adversely impact the private owners of Pier 51 Marina due to lost revenue if recreation declines over the period of construction.

2.12 Socioeconomics and Environmental Justice

2.12.1 Demographics

The Area of Interest (AOI) for this section is Census Tract 95; Sand Springs, OK; Mannford, OK; Cleveland, OK; Tulsa, OK; Osage County; Pawnee County; Tulsa County; Oklahoma, and the United States. As shown in Table 3. Population Estimates for Study Area, Region, and Nation

, populations in Census Tract 95, Sand Springs, the City of Tulsa, Tulsa County, Oklahoma, and the United States have all increased substantially from the year 2010 to 2020. At the state and county level, population projections indicate robust growth over the long-term. However, based on information from the U.S. Census Bureau the overall population within Pawnee County and Osage County has decreased between the years 2010 and 2020. This change may be in parallel to the overall population increase in nearby Tulsa County which is likely to have more job opportunities due to the presence of the City of Tulsa.

Table 3. Population Estimates for Study Area, Region, and Nation

Geographical Area	2010	2020	Percent Change (%)
Census Tract 95	4,883	5,321	8.9
Cleveland	3,249	3,185	-1.9
Mannford	3,071	3,186	3.7
Sand Springs	18,455	19,912	7.9
Tulsa City	388,247	402,441	3.7
Pawnee County	16,564	16,402	-0.9
Osage County	47,192	47,074	-0.3
Tulsa County	589,757	650,291	10.3
Oklahoma	3,675,339	3,949,342	7.5
United States	303,965,272	326,569,308	7.4

Source: U.S. Census. ACS 5-Year Estimates Data Profiles (2010 and 2020)

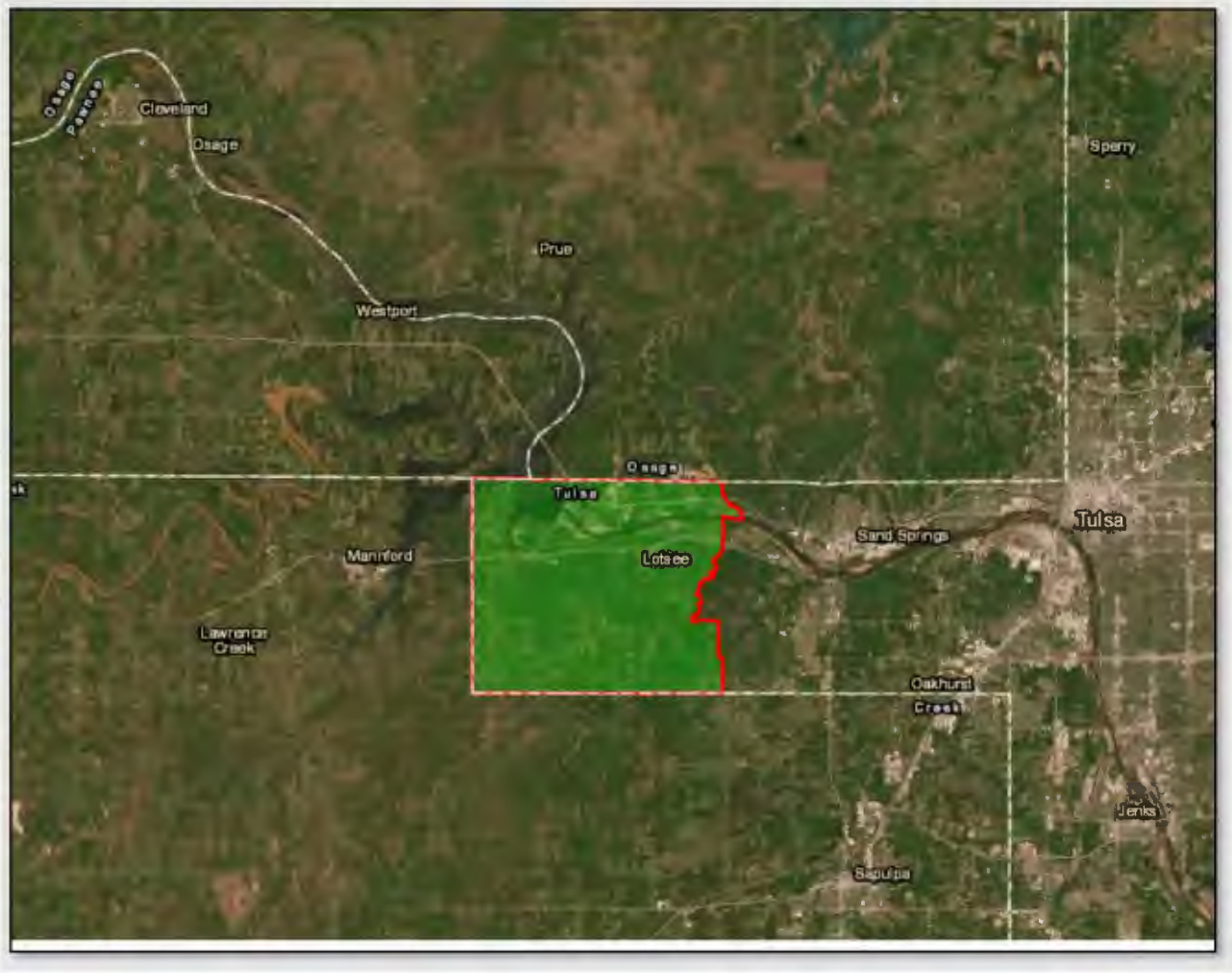

Figure 19. Area of Interest with Focus on Census Tract 95

It is likely that population levels will increase in the future based on historical trends throughout the United States. Table 4 summarizes age distribution for the AOI. Overall, population trends follow regional and national patterns with the exception of ages 45 to 54 in Census Tract 95 which are much higher in comparison to all other areas evaluated.

Table 4. Age Distribution of Population for Study Area, Region and Nation

Area	Age Group (%)												
	<5	5 to 9	10 to 14	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 59	60 to 64	65 to 74	75 to 84	85 and over
Census Tract 95	4.3	7.9	5.7	4.4	3.9	10.1	10.8	17.0	8.2	10.1	11.7	4.5	1.4
Cleveland	5.3	6.1	6.2	7.5	10.8	14.8	13.1	11.3	5.9	5.5	8.2	3.9	1.4
Mannford	7.2	7.8	10.0	7.2	9.6	13.4	11.6	9.1	5.8	4.6	6.4	4.2	3.1
Sand Springs	6.1	7.7	7.1	6.0	6.6	13.4	13.3	11.3	5.9	5.5	9.8	6.0	1.4
Tulsa City	7.0	6.8	7.0	6.4	7.0	15.6	12.5	11.3	6.2	5.9	8.6	4.1	1.7
Pawnee County	5.9	5.7	7.9	6.4	5.1	11.0	11.5	13.2	6.6	7.6	11.2	6.0	1.9
Osage County	4.9	6.0	6.8	6.4	5.1	11.7	11.7	12.7	8.0	7.1	11.6	6.1	2.0
Tulsa County	7.1	6.9	7.1	6.5	6.4	14.7	12.9	11.9	6.2	5.8	8.5	4.3	1.6
Oklahoma	6.6	6.7	6.9	6.7	7.0	13.8	12.5	11.7	6.4	6.0	9.1	4.8	1.8
United States	6.0	6.1	6.5	6.5	6.7	13.9	12.7	12.7	6.7	6.2	9.4	4.7	2.0

Source: U.S. Census Bureau. 2020: ACS 5-Year Estimates Data Profiles

2.12.2 Environmental Justice

Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994) addresses disproportionate human health and environmental impacts that a project or plan may have on minority or low-income communities. Thus, the environmental effects of a plan on such communities, including Native American populations, must be disclosed, and agencies must evaluate projects to ensure that proposed actions do not disproportionally impact minority or low-income communities. If such impacts are identified, appropriate mitigation measures must be implemented. Table 5. Poverty Status for Study Area, Region, and Nation shows the median household and per capita income for the AOI.

To determine if a project has a disproportionate effect on potential environmental justice communities (i.e., minority or low-income population), the demographics of an affected population within the vicinity of a project must be considered in the context of the overall region. Guidance from the Council on Environmental Quality (CEQ) states that “minority populations should be identified where either 1) the minority population of the affected areas exceeds 50 percent, or 2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997).”

Table 6. Racial Composition for the AOI displays U.S. Census Bureau data summarizing racial characteristics of areas within the AOI. The purpose is to analyze whether the demographics of the affected area differ in the context of the broader region; and if so, do such differences meet CEQ criteria for an Environmental Justice community. Based on the analysis and the results of the EPA’s Environmental Justice Screening and Mapping Tool (EJScreen), minorities and/or low-income populations in the AOI will be not disproportionately affected by any of the alternatives evaluated. A

map of the demographic index of the communities in the vicinity and downstream of the project area is included in Figure 20, below.

The demographic index in EJScreen is a combination of percent low-income and percent minority, the two socioeconomic factors that were explicitly named in Executive Order 12898 on Environmental Justice. For each Census block group, these two numbers are simply averaged together. The formula is as follows: demographic index = (% people of color + % low-income) / 2.

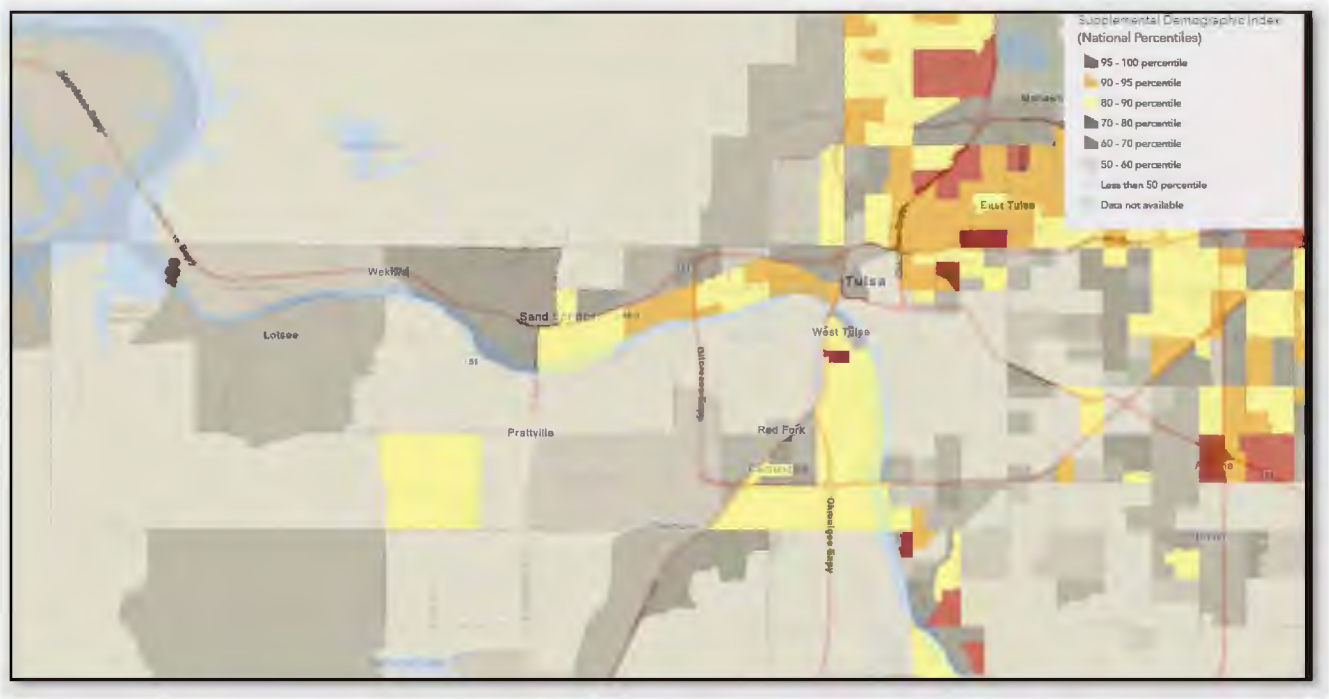

Figure 20. Map of the Demographic Index of the Surrounding Communities (Source: EJScreen)

Table 5. Poverty Status for Study Area, Region, and Nation

Geographical Area	Median Household Income ($)	Percent of Families with Incomes Below Poverty Level (%)	Per Capita Income ($)
Census Tract 95	67,288	10.4	34,553
Cleveland	44,659	15.2	23,184
Mannford	49,583	18.1	21,011
Sand Springs	71,967	13.4	28,043
Tulsa City	47,474	14.1	31,753
Pawnee County	50,991	14.3	25,174
Osage County	50,105	15.7	26,852
Tulsa County	57,024	18.1	36,303
Oklahoma	53,840	13.0	29,873

Geographical Area	Median Household Income ($)	Percent of Families with Incomes Below Poverty Level (%)	Per Capita Income ($)
United States	64,994	11.0	35,384

Source: U.S. Census Bureau. 2020: ACS 5-Year Estimates Data Profiles

Table 6. Racial Composition for the AOI

Area	White	Black	Hispanic or Latino	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some other race	Two or more races
Census Tract 95	83.0	4.6	3.6	19.8	0.5	0.0	2.1	10.1
Cleveland	84.3	6.8	9.0	8.7	5.9	0.3	3.2	8.3
Mannford	84.2	1.5	4.3	17.4	0.0	0.3	0.5	3.8
Sand Springs	87.2	3.3	4.3	14.7	1.1	0.0	0.8	6.2
Tulsa City	71.0	17.9	17.1	9.8	4.1	0.3	6.6	6.7
Pawnee County	87.4	1.7	3.2	19.6	0.7	0.0	1.0	9.2
Osage County	75.3	12.5	3.8	21.7	0.6	0.1	1.4	10.6
Tulsa County	76.8	12.5	13.1	11.0	4.2	0.3	5.0	7.2
Oklahoma	79.2	9.2	10.9	13.6	3.0	0.3	4.0	7.2
United States	75.1	14.2	18.2	1.8	6.8	0.4	7.4	2.8

Source: U.S. Census Bureau. 2020: ACS 5-Year Estimates Data Profiles

Details on the labor force and unemployment rates for Oklahoma and the AOI are displayed in Table 7. Civilian Work Force and Employment below. The 2020 annual average unemployment rate in Oklahoma was 5.1%. The unemployment rates in the City of Tulsa and Osage Counties were higher at 6.2% and 6.0% respectively. Census Tract 95 and Pawnee County were lower at 3.1% and 3.9% while the City of Sand Springs and Tulsa County were comparable to Oklahoma at 4.7% and 5.4% respectively.

Table 7. Civilian Work Force and Employment

Geographic Area	Civilian Labor Force	Number Employed	Number Unemployed	Unemployment Rate (%)
Census Tract 95	2,565	2,485	80	3.1
Cleveland	1,295	1,263	32	2.5
Mannford	1,376	1,331	45	3.3
Sand Springs	9,336	8,854	439	4.7

Tulsa City	205,112	192,368	12,744	6.2
Pawnee County	6,938	6,665	273	3.9
Osage County	20,855	19,594	1,261	6.0
Tulsa County	333,520	315,476	18,044	5.4
Oklahoma	1,874,598	1,779,157	95,441	5.1
United States	164,759,496	155,888,980	8,870,516	5.4

Source: U.S. Census Bureau. 2020: ACS 5-Year Estimates Data Profiles

Individuals employed within the AOI are most likely to utilize car, truck, or van while commuting to work. A small number of individuals with the smaller segments of the AOI work from home, but most people have a mean travel time to work between 18.6 and 29.0 minutes.

Table 8. Individuals Commuting to Work

Geographical Area	Car, Truck, Van – Drove Alone	Car, Truck, Van - Carpooled	Public Transportation	Walked	Other Means	Worked from Home	Mean Travel Time to Work (Minutes)
Census Tract 95	1,825	267	0	24	15	330	29.0
Cleveland	1023	143	5	0	25	66	25.9
Mannford	1149	133	0	0	4	45	26.4
Sand Springs	7544	696	0	91	51	400	20.5
Tulsa City	150,744	19,285	1,374	3,366	3,926	10,334	18.6
Pawnee County	5,516	495	13	68	103	418	30.0
Osage County	16,094	1,725	28	159	168	1,109	24.9
Tulsa County	251,892	29,541	1,477	4,242	4,658	17,400	20.0
Oklahoma	1,441,754	171,404	6,556	30,002	24,303	92,204	22.0
United States	115,127,720	13,605,122	7,044,886	3,954,692	2,780,139	11,153,095	26.9

Source: U.S. Census Bureau. 2020: ACS 5-Year Estimates Data Profiles

2.12.3 No Action Alternative

Socioeconomic resources are not expected to drastically change during the planning horizon of this project within the AOI compared to the existing conditions.

The No Action Alternative will not change the socioeconomics of the existing condition. An unprecedented dam breach would adversely affect any communities, including low-income and minority, downstream of Keystone Dam.

2.12.4 RMP 5a and 5c

Table 6 above displays U.S. Census Bureau data summarizing racial characteristics of areas adjacent to planned construction sites. The purpose is to analyze whether the demographics of the affected area differ in the context of the broader region; and if so, do such differences meet CEQ criteria for an Environmental Justice community. Based

on the analysis, minorities and low-income populations in the study area will not be disproportionately affected.

The proposed project is not expected to have adverse or disproportionate impacts on the general, minority, or low-income populations. The benefits of the proposed project are expected to be proportional for all residents in the AOI and the proposed project is of such limited nature and extent that it does not have the potential to alter the demographics or the economy at a local or regional scale. The project area does not contain a higher percentage of minority or low-income families. Due to the closure of HWY 151, there may be long-term adverse impacts to individuals who must take the route to reach their homes and/or places of work in a timely manner. The closure is expected to divert approximately 2,092 individuals per day (individuals that may utilize private transportation within Census Tract 95). The diversion caused by the closure of HWY 151 has the potential to increase 20 miles or 22 minutes to the average commute for individuals traveling to their place of work, assuming a starting point of HWY 64 (immediately north of Keystone Dam/HWY 151) and an ending point of HWY 51 (immediately south of Keystone Dam/HWY 151). Low-income users of HWY 151 will have a greater burden as compared to users at other income levels, potentially 200 additional miles over a 5-day week, resulting in an increased percentage of income used to travel. Assuming the average commuter has a vehicle that can drive 25 miles per gallon and the average price per gallon in Oklahoma is currently $2.87, there will be an increase in cost per week of $22.96, totaling $91.84 per month in addition to the normal commute cost. USACE will work to minimize the disruption to traffic patterns in the AOI.

This alternative would result in a short-term positive benefit to the community directly and indirectly due to the increase in construction crews necessary to complete the project. This alternative is expected to bring new construction jobs to the area which will provide additional employment opportunities to the area. Additionally, the new work force would support local businesses, such as restaurants and stores, benefiting the local economy for the duration of the project.

In the case of a catastrophic flood event, this alternative would reduce the probability of dam failure and associated disruption to social activities in the region. By providing protection, RMP 5a and 5c enhance the socioeconomics of the populations living and working in the area. Communities upstream of Keystone Dam may experience temporary flooding conditions while water is held by the upgraded dam, but as noted there is an extremely low probability of occurrence.

The enhanced protection of life and property in the flood risk management areas would have permanent beneficial effects on socioeconomics. Numerous benefits to the local economy and residents may be realized through reduced flood response, clean up, and recovery costs. Most importantly, the dam raise alternatives would increase life safety for residences and business protected by the dam, while avoiding induced damages to downstream areas.

The SWPA is responsible for a portion of costs associated with RMP 5a and 5c. Although SWPA is a responsible party as part of the cost-share, funding this project

could result in a rate increase to their customers. The customers include individuals in Kansas, Louisiana, Oklahoma, Arkansas, Texas, and Missouri. The rate increases to customers are unknown at this point in time but is assumed there will be an adverse effect on individuals utilizing power from SWPA.

2.12.5 RMP 6e

The enhanced protection of life and property in dam-protected areas would have permanent beneficial effects on socioeconomics in the case of a catastrophic flood event. RMP 6e would increase life safety for residences and business protected by reducing stress on Keystone Dam via the new gated spillway, while avoiding induced damages to downstream areas.

RMP 6e would entail the partial removal of features located in Keystone State Park leased areas. This alternative would require the removal of structures and any above ground utilities in sections of the park. Removing state park structures, their utilities, and other infrastructure would have permanent, moderate, indirect, adverse, impacts to individuals whose livelihoods are dependent upon Keystone State Park. Adverse indirect impacts from noise have the potential to affect Pier 51 Marina due to the loss of recreationalists if the noise proves to be bothersome. A decline in recreationalists in the vicinity of the project area is assumed to reduce income for private and state/Federal recreation facilities. The impacts of revenue loss would have a greater effect on private entities because there is no guarantee of funding from state/Federal organizations.

The long-term closure of HWY 151 is expected to have similar effects as RMP 5a and 5c; however, the effects would be longer in duration which could have larger implications to individual income resulting from an increase in the duration of commuting time which can impact the amount of money each commuter will have to spend on gas.

The beneficial socioeconomic effects associated with the increase in construction workforce and local economic impacts are expected to be consistent with RMP 5a and 5c listed above. These beneficial impacts would be longer in duration than 5a and 5c given the longer construction timeframe.

2.12.6 RMP 6g

The effects listed above for RMP 5a/5c and 6e are applicable to RMP 6g.

2.12.7 RMP 7

The effects listed above for RMP 5a/5c and 6e are applicable to RMP 7.

2.13 Cultural, Historical, and Archaeological Resources

Under NEPA and Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), USACE must consider potential impacts to historic properties and cultural resources associated with the proposed undertaking. These include buildings, structures, sites, districts, and objects eligible for or included in the National Register of Historic Places NRHP, cultural items, Native American sacred sites, archaeological artifact collections, and archaeological resources. Keystone Dam is located within the Muscogee (Creek) Nation reservation. Consultation with the Muscogee (Creek) Nation,

the Advisory Council on Historic Preservation (ACHP), the Oklahoma State Historic Preservation Officer (SHPO), Oklahoma Archeological Survey (OAS), the Osage Nation and other federally recognized tribes has been on going throughout the planning process for this study, with all comments received addressed appropriately. Copies of consultation correspondence are included in Appendix H-5.

Because potential impacts to cultural resources cannot be fully determined prior to completion of this EA, USACE is developing a programmatic agreement (PA), in accordance with 36 CFR 800.14. A copy of the Draft PA, which stipulates the responsibilities of all signatories under Section 106 of the NHPA is included in Appendix H-6. The Draft PA outlines the process by which USACE will finalize the Area of Potential Effect (APE), perform a cultural resource survey, and evaluate resources for inclusion in the NRHP. Further, the PA outlines the process for assessing effects, making an effects determination and consultation with the Muscogee (Creek) Nation, the ACHP, SHPO, OAS, and the Osage Nation, who are Signatories and Invited Signatories to the agreement. For any alternative selected, aside from the No Action Alternative, USACE will be implementing the PA prior to the PED phase to ensure compliance with Section 106 of the NHPA.

A brief summary of previous investigations and previously recorded resources in the vicinity of the study area is provided below, along with a preliminary analysis of effects under the alternatives considered for this dam safety modification study. Additional details on the cultural history of the region and background research can be found in Appendix H-6.

A review of OAS maps and site records indicated 12 previously recorded sites within a 1-mile buffer of the dam and spillway construction and staging area, as well as tracts of land that remain un-surveyed. This review found at least 4 previous terrestrial cultural resource surveys that took place within (or partially within) the study area. The majority of the proposed dam and spillway construction area has been surveyed as part of the effort to document sites prior to Keystone Lake’s inundation in 1952 and to document sites along the shoreline from 1979-1980. While these early surveys offer some insight to the type of cultural materials present in the area, the level of effort was often limited to surface inspection of a few select locations and does not meet modern standards for intensive investigation. One utility corridor was surveyed in 1992, and one survey for ODOT was conducted in 2012 within a small portion of the dam and spillway construction area as well. Currently, 12 known terrestrial archaeological sites have been identified within 1 mile of sites associated with the final array of alternatives.

All 12 identified archaeological sites are considered unevaluated for the NRHP and therefore must be treated as eligible. No historic properties or districts listed on the NRHP are present within the alternative construction areas or within 1 mile of those areas. Notably one NRHP listed historic property, the Old Fort Arbuckle site, is located approximately 1.5 miles downstream of Keystone Dam. One cemetery, site 34TU38, is located within 1 mile of the dam and spillway construction area.

Table 9. Known Sites within 1 mile of the Dam and Spillway Construction and Areas

Site Number	Site Type	NRHP Eligibility	Date Recorded	Description
34TU1	Prehistoric Lithic Scatter and Historic Scatter	Unknown	1952	Currently inundated, elevation approximately 700 ft
34TU29	Historic Quarry	Unknown	1979	Above flood control pool
34TU30	Historic Farmstead	Unknown	1979	Above flood control pool
34TU31	Historic Habitation	Unknown	1979	Above flood control pool
34TU32	Historic Road	Unknown	1979	Partially inundated, elevation approximately 723-750 ft
34TU33	Prehistoric Rock Shelter	Unknown	1979	Above flood control pool
34TU34	Historic Quarry	Unknown	1979	Above flood control pool
34TU35	Historic Habitation	Unknown	1979	Partially inundated, elevation approximately 740-765 ft
34TU36	Historic Habitation	Unknown	1979	Partially inundated, elevation approximately 738-760 ft
34TU37	Historic Farmstead	Unknown	1979	Downstream of dam
34TU38	Historic Cemetery	Unknown	1979	Downstream of dam
34TU39	Historic Farmstead	Unknown	1979	Downstream of dam

As the full project area has not been subjected to a modern cultural resources survey, there is a potential for encountering newly identified historic properties within the final developed APE for this project. Additionally, the majority of known sites present or within 1 mile of the project area have not been fully evaluated for the NRHP. The NRHP status of the built environment at Keystone State Park has not been evaluated.

2.13.1 Keystone Dam

Keystone Dam was constructed between 1956-1964 and began producing electricity in 1968. During consultation for the Keystone Dam Bridge Replacement project from 2011-2012, the Keystone Dam was found to be eligible for the NRHP under Criterion A as it is directly associated with the economic development of Tulsa and surrounding communities in eastern Oklahoma as well as its association with the Cold War. It is also eligible under Criterion C for its association with the Cold War as a nuclear fallout shelter.

2.13.2 Keystone State Park

Keystone State Park is leased by the Oklahoma Tourism and Recreation Department from USACE for use as a public park and is within the western portion of the project area. The lease was initiated in 1966, and currently consists of 431 acres of contiguous

property featuring modern and primitive campgrounds, a marina, day use recreational areas, a community center, and 22 cabins. The built environment of Keystone State Park has not been evaluated for the NRHP.

2.13.3 No Action Alternative

The primary considerations concerning cultural resources are threats from direct impacts to intact archeological sites and direct and indirect impacts to historic structures from new construction and/or improvements.

There would be no foreseeable surface or subsurface impacts in the FWAC to known cultural resources within the study area, aside from natural erosional forces and fluctuating lake levels that occur over time. Under a catastrophic event of dam failure, there would be expected direct moderate adverse impacts to cultural resources within the immediate vicinity of the dam (including the structure itself) and resources downstream.

2.13.4 RMP 5a and 5c

The construction of RMP 5a and 5c would have negligible adverse impacts to cultural resources. The preliminary project area of potential effect includes the maximum horizontal footprint of all areas of direct and indirect impacts from construction of the embankment raise and modifications to the service spillway and the stilling basin, and all terrestrial horizontal and vertical ground disturbance activities, all of which have undergone significant previous disturbance during the dam's original construction. Under a catastrophic event, a raised water elevation may inundate historic properties. The physical characteristics of the NRHP-eligible Keystone Dam which were determined to retain integrity and convey the dam's historical significance under National Register Criterion C for the dam's Cold War Era design include the main shelter area, the associated airlock, decontamination chamber, restrooms, and storage areas. The proposed dam alterations would not impact these features, and the dam's eligibility under Criterion A for its association with the economic development of Tulsa and eastern Oklahoma would not be impacted. While it is not anticipated that this alternative would adversely affect Keystone Dam, the USACE would make a formal determination of effect in consultation with the Signatories and Invited Signatories of the PA when the design reaches approximately 35%.

Known archaeological resources previously identified and recorded within one mile of the project area are prehistoric and historic in nature. Additional archaeological resources may be encountered when the finalized APE is surveyed to identify historic properties. Impacts to historic properties will be avoided, minimized, and mitigated in accordance with the programmatic agreement included in Appendix H-6.

2.13.5 RMP 6e

The construction of the RMP 6e would have long-term, moderate, direct adverse impacts to cultural resources. The preliminary project area includes the maximum horizontal footprint of all areas of direct and indirect impacts from construction of the new spillway and gate construction, modifications to the existing spillway basin, disposal

areas for fill, and all terrestrial horizontal and vertical ground disturbance activities. Construction may involve blasting that could affect cultural resources present. This is the second-smallest shoreline alteration of the proposed alternatives, and therefore will constitute a lesser number of cultural resources that may be affected by the project. RMP 6e requires habitat mitigation, which would require a cultural resources survey for the potential mitigation area.

Many of the impacts for Alternative 6e on cultural resources will be similar to Alternative 5a and 5c. The most substantial differences are potential moderate impacts to cultural resources from blasting during construction and the size of disposal areas for fill. Fill will be disposed at Keystone Lake as shoreline protection for recreation areas when possible. Cultural resources surveys will be required for RMP 6e, and the scope of these cultural resource investigations will be determined in consultation with the Signatories and Invited Signatories of the PA developed for this study.

2.13.6 RMP 6g

Similar to RMP 6e, this alternative would have long-term, moderate, direct adverse impacts to cultural resources.

2.13.7 RMP 7

Similar to RMP 5a/5c and 6e, this alternative would have long-term, moderate, direct adverse impacts to cultural resources. This alternative is larger in scale by comparison and would require a much larger survey for construction areas associated with excavation, disposal, and habitat mitigation.

2.14 Aquatic Resources

2.14.1 Hydrology and Floodplains

Upstream of Keystone Dam

There are two major rivers that drain into Keystone Lake, the Arkansas and Cimarron Rivers. The 1,469-mile Arkansas River, with its headwaters in the high Colorado Rocky Mountains, flows through Colorado, Kansas, and Oklahoma, finally emptying into the Mississippi River in Arkansas. The Cimarron River enters Keystone Lake from the west-southwest, while the Arkansas River enters in from the northwest. Other tributaries, such as the Salt Fork, also drain into the lake, affecting the lake levels, sedimentation, pollution, minerals, and nutrients in the reservoir.

The floodplains around Keystone Lake were inundated by the construction of Keystone Dam. The floodplains within the conservation pool elevation of 723.0 ft mean sea level (msl) are permanently inundated. The floodplains along the Arkansas River and its tributaries between the conservation pool and top of the flood control surcharge pool (757.0 ft msl) may become inundated at various frequencies. As a result, habitable structures and other similar development features around the lake are limited by floodpool elevations.

Downstream of Keystone Dam

Based on U.S. Geological Survey (USGS) daily average discharge data following the construction of Keystone Dam in 1964, the median daily average flow of the Arkansas River downstream of the Keystone Dam is approximately 4,000 cubic feet per second (cfs) at the Tulsa gage (located on the 11th Street Bridge near downtown Tulsa), and approximately 5,200 cfs at the Haskell gage (located on the HWY 104 Bridge near Haskell, Oklahoma). The annual mean flow at these locations is approximately 8,400 and 10,100 cfs, respectively. Instantaneous annual peak flows near Haskell are typically about 3,000 cfs greater than those measured at the Tulsa gage. However, the magnitude of the difference has varied widely. For example, the peak flow rate at Haskell exceeded that at Tulsa by 29,000 cfs during the event of March 3, 1990. Conversely, during the event of October 5, 1986, the peak at Haskell was 48,000 cfs less than the peak at Tulsa.

The Federal Emergency Management Agency (FEMA) Flood Insurance Study for Tulsa County and incorporated areas lists several peak discharges associated with a probability of occurrence in any given year for the Arkansas River in the Tulsa area (FEMA, 2016). These peak discharges are:

- 10-percent (10-year event): 90,000 cfs
- 2-percent (50-year event): 155,000 cfs
- 1-percent (100-year event): 205,000 cfs
- 0.2-percent (500-year event): 490,000 cfs

The 10-year event of 90,000 cfs is equal to the maximum lake regulating discharge normally expected from Keystone Lake. The channel capacity downstream of Keystone Dam is currently estimated at 105,000 cfs. The current release range from Keystone Dam is 0 to 105,000 cfs. However, releases may be modified to meet requirements of the Arkansas River system operating plan. When the Arkansas River is below channel capacity, and releases from Keystone Dam are increasing, the maximum increase is 15,000 cfs, and the minimum time between changes is 2 hours. When the Arkansas River is below channel capacity, and releases from Keystone Dam are decreasing, the maximum decrease is 15,000 cfs, and the minimum time between changes is 3 hours.

Monthly mean flows in the Arkansas River are typically higher during the spring and summer months compared to the fall and winter. From March through July, the long-term average monthly mean flows exceed 10,000 cfs at both Tulsa and Haskell. From August through February, the long-term average monthly mean flows are less than 8,000 cfs. The smallest difference in a given month between the long-term maximum and minimum monthly mean flows occurred in December and was nearly 17,000 cfs. Conversely, the largest difference occurred in May and exceeded 80,000 cfs. The monthly mean flows at Arkansas City are slightly higher during the spring and summer months compared to fall and winter. However, the relative magnitude of the flow difference between seasons is much less dramatic than observed at Tulsa and Haskell.

A characteristic of the river hydraulics are high-frequency, large amplitude flow fluctuations resulting from the operation of Keystone Dam. Flows regularly fluctuate up to nearly two orders of magnitude within time intervals as short as 24 hours.

Another effect of Keystone Dam on the Arkansas River has been a reduction in the downstream sediment supply. The mean annual suspended sediment concentration decreased by 82% from 1,970 mg/L (1931-1964) to 350 mg/L (1965-1995) at the Tulsa gage. Similarly, the mean annual suspended sediment flux decreased by 73% from 14.7 to 4.0 megatonnes after completion of the dam. The Haskell gage station exhibited a similar post-dam pattern of annual fluxes, with the Haskell station always having a greater annual flux than that measured at the Tulsa station.

2.14.2 Surface Water

Wetlands Upstream of Keystone Dam

Keystone Lake, as with any other lake that is dammed, has water levels that can frequently fluctuate for short and long periods at a time. Because of this, the type and acreage of wetlands can vary from year to year. Within Keystone Lake, wetlands are typically found near rivers and creeks, within areas with low topographic relief, and from a diversion in a river course.

Wetlands Downstream of Keystone Dam

The wetlands below Keystone Dam within and along the Arkansas River can be divided into emergent herbaceous and riparian shrub wetlands (Figure 21). Emergent wetlands are characterized by rooted, herbaceous hydrophytes, typically in flooded soils. They can be found along the edge of the Arkansas River and in depressional areas in the floodplain. Emergent wetland habitats provide food and shelter for fish and a number of other species, including macroinvertebrates, which make up the foundation of the aquatic food chain. These wetland areas also provide habitat for a variety of amphibians, reptiles, birds, and insects. Frogs and salamanders use these wetland areas for breeding grounds and for egg-laying. Ducks and migratory birds use them for resting areas on migration routes and for nesting. Abundant aquatic insects provide a food source for fish, aquatic invertebrates, amphibians, reptiles, and birds, and break down organic material present in riverine and riparian wetland areas common throughout the study area. Since these wetland communities are found in the lower elevations of the river, or are associated with more permanent open water habitats, they have been the most susceptible to the impacts from the disruptive and unnatural flow regime regarding the construction and operation of Keystone Dam.

Riparian shrub wetlands are open, occasionally flooded areas dominated by shrub and hardwood saplings mixed with emergent herbaceous vegetation. Riparian shrub wetlands provide shelter, food, and nesting habitat for a variety of wildlife. These wetland communities are found at elevations slightly above the emergent wetland communities and adjacent to the riverbanks where less frequent inundation by flows and reduced scour allows for the shrub and sapling strata to become established.

The frequent and extreme river fluctuations from hydropower operations have a drying effect on wetland habitats that serve as nurseries for juvenile fish and habitat for migrating waterfowl, producing an overall reduction in the diversity of the species utilizing these habitats. The periods of high flows followed by low flows further affect the geomorphology of the river producing increased streambank erosion and the destruction of riverine wetlands and oxbow habitats, further reducing the availability of productive habitats. Wetland habitats located within the active river channel are dominated by emergent herbaceous communities. These communities are more prone to structural instability from rapid changes in the flow regime making their size and placement in the river corridor more transient. Wetland soils and emergent vegetation are subject to habitat smothering from changes in river geomorphology. Frequent desiccation also reduces the formation of wetland soils and selects for early successive invasive species such as Johnson grass (*Sorghum halepense*) which impact vegetation strata.

It should be noted that the emergent wetlands outlined in Figure 21 below are located within an offroad vehicle park and are likely to be heavily impacted or no-longer existent. Wetland surveys will be conducted prior to construction to identify areas of concern. Wetland impacts will be avoided to the greatest extent practicable.

Figure 21. Wetlands that May Occur within the Immediate Project Area

Open Water Habitats Upstream of Keystone Dam

The hypereutrophic condition of Keystone Lake negatively impacts spawning beds and egg survivability of aquatic organisms in the lake. Constant water fluctuations dry or flood spawning beds, cause habitat disruption, and have the potential for degrading water quality. Despite these conditions, the overall fish habitat in Keystone Lake is in good condition.

The open water habitat at Keystone Lake is the result of an impoundment across the Arkansas River downstream of its confluence with the Cimarron River. Flood pool storage filled is 43,078 acre-ft which is equivalent to 0.04 inches of runoff over the entire drainage basin. Flood pool storage empty is 1,029,442 acre-ft which is equivalent to 0.86 inches of runoff over the entire drainage basin. Streambed elevation at Keystone Lake is 650 ft msl. At conservation pool, the lake is approximately 73 ft deep on average.

Fish habitat consists of extensive shorelines made up of rock or sand. Rocky shorelines consist of sandstone gravel, rock boulder, and bedrock. Riprap also provides fish habitat and can be found along the dam and on the sides of HWY 51 at Salt Creek and HWY 412 at the confluence. A small area of riprap can be found upstream from Cowskin Bay. There are limited amounts of dead standing timber which are confined to a few cove areas as the impoundment ages. In general, vegetative cover is limited by the vast amount of rocky shoreline.

Primary substrate in Keystone Lake is sandstone, loamy silt, and clay. Each year (water levels allowing) local anglers in cooperation with USACE and the Oklahoma Department of Wildlife Conservation (ODWC) create brush piles in different areas of the lake and add brush to previous piles. This action provides additional fish habitat within the lake.

The ODWC is the lead agency for fisheries management throughout the state, including Keystone Lake. In 1965 a stocking program for striped bass was started at Keystone Lake and continued until 1969 (total of 2,724,800 fish stocked, of which 11 were adults). The striped bass population is now stable and self-sustaining, but suffers annual die-offs as a result of the water quality issues. Fishing regulations for Keystone Lake are published annually and available to the public in the Oklahoma Fishing Guide through the ODWC.

Open Water Habitats Downstream of Keystone Dam

Open water habitats in the main stem of the Arkansas River channel include riffle, run and pool complexes, and isolated pools. The riffle, run and pool complexes are features typical of a prairie river system. They are braided and relatively nonpermanent features that become repositioned within the river channel during higher-flow conditions. Isolated pools of open water are less common throughout the study area. They include features created through natural processes such as oxbows, which are relics of meandering riffle, run and pool complexes, and those created through anthropogenic activities such as sand mining and at locations below stormwater outfalls entering the river. Many of these isolated pools are temporary as braided riffle, run and pool complexes meander under various river flow conditions and as riverine sandbars shift and are redeposited.

The more persistent pools are found adjacent to the river channel banks and are connected to other surface waters under higher river stages. Many of these have emergent and shrub wetland vegetation, creating a littoral fringe that helps to stabilize the substrate. Water quality within the more persistent pools is typically low due to stormwater inputs and little to no mixing with other surface waters. Substrates within these pools includes sand and organic sediments.

The open water habitats within the Arkansas River support a valuable recreational and subsistence fishery to area residents. Additionally, populations of smaller fishes that are suitable forage species for shore birds and wading birds are relatively abundant in these habitats. These smaller forage fishes are most abundant in pool runs, marshes, temporary and permanent isolated pools within the river channel and the lakes. Their local seasonal abundance depends on river flows, connections of pools to other river channel surface waters, and water quality. Listed bird species that forage in the open water habitats include the interior least tern (*Sternula antillarum athalassos*), piping plover (*Charadrius melodus)*, and red knot (*Calidris canutus rufus)*.

A seasonal fisheries survey of the study area conducted by ODWC biologists from October 2006 through September 2007 reported the occurrence of 41 species of fish in 12 families (Cherokee CRC, 2009). Of these reported species, four are listed as invasive exotics: grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), white perch (*Morone americana*), and flathead catfish (*Pylodictis olivaris*). The families represented by the most species were sunfish (*Lepomis spp*.; nine species), carp (family Cyprinidae) and minnows (eight species), and suckers (seven species). The principal sport fishes collected included largemouth bass (*Micropterus salmoides*), spotted bass (*Micropterus punctulatus*), striped bass (*Morone saxatilis*), channel catfish (*Ictalurus punctatus*), flathead catfish, white crappie (*Pomoxis annularis*), a variety of sunfish, and sauger (*Sander canadensis*). Occurrences (2015) of paddlefish in the Arkansas River in Tulsa County have also been reported.

Overall native fish populations have been adversely impacted from the construction of Keystone Dam through a combination of the changes in flows and the introduction of non-native game fish which better tolerate the altered aquatic ecosystem following the construction of Keystone Dam. Wetland and open water nursery habitats for juvenile fish have been reduced from periods of desiccation followed by higher flows which destabilize wetland soils and vegetation strata. Introduced game fish species are more tolerant of the altered in-stream aquatic habitats (USACE and TVA, 2009).

2.14.3 Groundwater

Upstream of Keystone Dam

The Vamoosa-Ada and the Arkansas River Aquifers are located beneath Keystone Lake. The Vamoosa-Ada Aquifer spans across the Arkansas River south to the Cimarron River on the western end of the lake. The Arkansas River Aquifer is located beneath the lake on the northwestern end and beneath the Arkansas River and on the downstream side of the dam.

Oklahoma's Groundwater Monitoring and Assessment Program (GMAP) includes a network of approximately 750 wells on Oklahoma's 21 major aquifers and sampled on a five-year rotation (Oklahoma Water Resources Board [OWRB], 2017). Assessments of Oklahoma's groundwater include both a baseline monitoring network and a long-term (trend) monitoring network within each of the state's major aquifers. The 1,381 mi^2 Arkansas River aquifer (Alluvial & Terrace) which extends from north central to east central Oklahoma, has an estimated capacity of 946,000 acre-feet for which its primary uses are irrigation, public supply, domestic, and industrial (OWRB, 2015). The 2,320 mi^2 Vamoosa-Ada Aquifer which extends from the Canadian River to the Kansas State line, has an estimated 36 million acre-feet available for use (D'Lugosz, J and McClaflin, R.,1986).

Downstream of Keystone Dam

The area below Keystone Dam is within the Arkansas River aquifer, described above, has an estimated capacity of 946,000 acre-feet for which its primary uses are irrigation, public supply, domestic, and industrial (OWRB, 2015).

The alluvial aquifer along the Arkansas River ranges in thickness from 20 to 40 feet. The alluvium consists of relatively permeable coarse sand and fine gravel overlying bedrock, which is in turn overlain by floodplain deposits of silt and fine sand (Marcher and Bingham, 1971). Bedrock is composed of low-permeability shale. It is reasonable to assume there is little groundwater transfer between the shallow alluvial aquifer and deep regional aquifers in the study area (CH2M Hill, 2010). Based on depth-to-water data from some well completion reports in the area, the water table generally ranges from about 8 to 29 feet below grade. Wells within the area are used for commercial, domestic, industrial, irrigation, and public use purposes.

2.14.4 Water Quality

The Oklahoma Department of Environmental Quality (ODEQ) sets and implements standards for surface water quality to improve and maintain the quality of water in the state based on various beneficial use categories for the water body. The Water Quality in Oklahoma 2020 Integrated Report, which is a requirement of the Federal Clean Water Act Sections 305(b) and 303(d), evaluates the quality of surface waters in Oklahoma and identifies those that do not meet uses and criteria defined in the Oklahoma Water Quality Standards (WQS). The Water Quality in Oklahoma 2020 Integrated Report describes the status of Oklahoma natural waters based on historical data and assigns waterways to various categories depending on the extent to which they attain the WQS.

Upstream of Keystone Dam

Keystone Lake is evaluated in four segments in the ODEQ 2020 303(d) List:

1) Keystone Lake, Arkansas River Arm (OK621200010050_00)
2) Keystone Lake (OK621200010020_00)
3) Keystone Lake, Cimarron River Arm, Upper (OK620900010090_00)
4) Keystone Lake, Cimarron River Arm, Lower (OK620900010020_00)

Three of the four segments have an impairment in turbidity while only Keystone Lake, Cimarron River Arm, Upper (OK620900010090_00) has an impairment in fish bioassessments.

Downstream of Keystone Dam

Water quality is strongly influenced by land uses. In general, waters in the Arkansas River have relatively high levels of turbidity and suspended solids. Decreased water quality within the Arkansas River (OK120420010130_00) led to the listing of this segment in the ODEQ 2020 303(d) List as impaired by Enterococcus.

2.14.5 No Action Alternative

Surface and ground water resources of the area are not expected to considerably change in the FWAC. Most of the lands protected by the dam have already been developed. Federal, state, and local laws and regulations are in place to limit, prevent, and account for impacts to these resources.

Water quality of Keystone Lake is not expected to worsen. Various local, state and federal agencies continue to address water quality needs of the area. As such, an increase in water quality can be expected as pollution sources are addressed and wastewater treatment technology advances.

No change in current conditions of ground and surface waters and water quality are expected in the No Action Alternative. Local and state authorities continue to monitor and implement water conservation and water quality efforts to maintain or enhance existing resources.

2.14.6 RMP 5a and 5c

All required best management practices (BMPs) would be in place including a storm water pollution prevention plan and BMPs identified in the OKR10 authorization from ODEQ prior to construction to prevent erosion and sedimentation of waterways and prevent accidental fuel spills from contaminating water.

To limit adverse impacts to habitat, water quality, and maintain the benefits vegetation buffers provide to water quality of adjacent water bodies, native vegetation (to be determined during the PED phase) would be replanted within areas temporarily impacted by staging, laydown, and haul routes. Plantings would provide soil stabilization, future shade, and habitat temporarily lost during construction. Unless in an area previously designated for operations and maintenance, no mowing would occur within these restored construction sites, similar to surrounding natural areas.

Within areas immediately downstream of Keystone Dam, impacts to existing habitat quality is expected to be negligible to moderate as the site is already degraded by the proximity to the dam. As the segment of the Arkansas River adjacent to Keystone Dam is listed as impaired, the temporary loss of embankment vegetation is not expected to change its impairment status. In general, changes in flow due to placement of cofferdams for construction are expected. No changes in water quality are expected.

There will be long-term, minor, direct impacts to approximately 15 acres of aquatic habitat resulting from construction of the dam raise alternative. Impacts are associated with the construction of cofferdams which will be constructed under wet conditions. Following construction of the cofferdam, the area impounded will be dewatered to allow modification of the stilling basin. Upon completion of the project, the cofferdam would be removed.

This cofferdam will be designed to be erodible to maintain the safety and integrity of the dam upon a flooding event which would require the use of all gates to release water. In this type of event, the cofferdam would wash out as to not impede or impound the release of water. This would create a temporary increase in sedimentation to the river flow as the cofferdam is washing out. However, given the nature of a flooding event this expected size, the turbidity of the river is expected to be very high and any additional sedimentation from the cofferdam would be a negligible and temporary addition. The larger components of the cofferdam, including cobble and gravel will be dispersed along the river bottom. The materials will be natural materials native to the local area and will be free of construction debris and other man-made materials. While there may be temporary impacts due to the relocation of the materials, the material will provide structure and habitat to the river bottom similar to current and historic conditions of the river.

No permanent aquatic impacts at Keystone Dam are anticipated. No mitigation would be required for aquatic impacts because all temporary structures including the cofferdam, and access roads and bridges will be removed from Waters of the U.S upon the completion of construction.

Groundwater conditions would not change, a SWPPP would be put in place as well as numerous other precautions such as locating fueling stations away from aquatic habitats as directed by ODEQ’s OKR10 construction authorization.

Potential impacts to water quality associated with the construction of the dam raise alternatives include the potential for erosion and sedimentation during construction activities. During this period, stormwater runoff could carry sediment offsite into receiving water and possibly result in temporary increases in Total Suspended Solids (TSS). A SWPPP would be prepared to implement erosion and sedimentation control BMPs to minimize any detrimental effects to water quality during construction. The impacts to receiving waterways downstream would be temporary and minor as long as appropriate BMPs are followed.

A concrete batch plant is expected to be established within the 1/100 year floodplain on approximately 20 acres. This batch plant will be constructed on terrestrial soils but, due to the location, a berm would be required to ensure washout does not occur due to extreme flood events in accordance with ODEQ’s OKG11MT General Permit “General Wastewater Disposal Permit for Mobile Concrete Batch Plants.” Berms associated with this concrete batch plant must be 1H:3V if in use for longer than 180 days. Discharge of wastewater is not allowed under this permit.

2.14.7 RMP 6e

Risk Management Plan 6e would have the same effects on aquatic resources as RMP 5a and 5c. However, impacts to wetlands would be increased due to the placement of a new 804 ft gated spillway in the right dam abutment. There are approximately 5 acres of freshwater emergent wetlands that would be permanently impacted from construction of a new spillway, which would require mitigation of 1 Average Annual Habitat Units (AAHUs). However, temporary aquatic impacts would be expected on an additional 45 acres of aquatic habitat upstream from construction/blasting on the right abutment and 15 acres of disturbance from the cofferdam/dewatering downstream of Keystone Dam.

Due to the necessity for underwater blasting, there is a higher potential for water quality impacts with the aquatic areas surrounding the right abutment. This would be expected to have an adverse impact on aquatic wildlife as well. These species would most likely avoid the sound range of underwater blasting. Blasting could be a detriment to the health of aquatic species, confusing them and leading to life loss.

2.14.8 RMP 6g

Risk Management Plan 6g would have the same effects on aquatic resources as RMP 5a/5c and 6e above. However, temporary aquatic impacts would be expected on an additional 36 acres of aquatic habitat upstream from construction of the new spillway.

2.14.9 RMP 7

Risk Management Plan 7 would have the same effects on aquatic resources as RMP 5a/5c and 6e above. However, temporary aquatic impacts would be expected on an additional 55 acres of aquatic habitat upstream for construction of a new spillway.

2.15 Terrestrial Resources

2.15.1 Wildlife

Upstream of Keystone Dam

The major wildlife habitats found upstream of Keystone Dam are upland forests, bottomland forests, and tallgrass prairie. Each of these vegetative types provides habitat for a variety of organisms. The transition zones between these areas are especially productive. Principal wildlife species found within these habitat types include bobwhite quail (*Colinus virginianus*), grey and fox squirrels (*Sciurus carolinensis* and *Sciurus niger*), cottontail rabbits (*Sylvilagus spp*.), white-tailed deer (*Odocoileus virginianus*), songbirds, waterfowl, wild turkeys, raccoons (*Procyon lotor*), bobcats (*Lynx rufus*), and various birds of prey, including the bald eagle (*Haliaeetus leucocephalus*).

USACE has licensed 12,280 acres of land to ODWC for wildlife management. These lands are part of the 21,592-acre Keystone Wildlife Management Area (WMA) operated by ODWC in portions of Creek, Osage, and Pawnee Counties in north-central Oklahoma. Located near the towns of Cleveland, Mannford, and Oilton, the Keystone WMA is composed of the Arkansas and Cimarron rivers and adjacent floodplains and bottomlands. The remaining wildlife management lands not managed by ODWC are managed by USACE. Management efforts focus on producing native wildlife foods, as well as nesting and foraging habitat. Prescribed burns are conducted when conditions

permit. Supplemental forage is provided through management of farming leases where needed to support the needs of species of greatest conservation need. Wetland development units are managed to provide additional waterfowl habitat and hunting opportunity. Hunting and fishing activities are regulated by federal and state laws.

Downstream of Keystone Dam

Downstream of Keystone Dam various insects can be found like true flies (order Diptera), mayflies (order Ephemeroptera), caddisflies (order Trichoptera), dragonflies, damselflies (order Odonata), and Beetles (order Coleoptera). Many species of reptiles and amphibians inhabit the riparian bottomland forests and emergent wetlands along the Arkansas River, with amphibians being more prevalent in the bottomland swamp areas and other aquatic habitats. Bird species commonly found in forested habitats surrounding the study area include pileated woodpecker (*Dryocopus pileatus*), belted kingfisher (*Ceryle alcyon*), wood duck (*Aix sponsa*), herons and egrets (*Ardea spp*. and *Egretta spp*.), barred owl (*Strix varia*), and red-shouldered hawk (*Buteo lineatus*). Birds common in the wetland areas are similar to those that occur in upland forested habitats, particularly waterfowl such as herons, egrets, and cormorants (*Phalacrocorax spp*.).

2.15.2 Vegetation

It should be noted, the areas immediately surrounding Keystone Dam have been heavily degraded and are disturbed through regular maintenance such as mowing and high-intensity recreation such as off-roading.

Upstream of Keystone Dam

The major wildlife habitats of Keystone Lake are upland forests, bottomland forests, and tallgrass prairie. Each of these vegetative types provides habitat for a variety of organisms. The transition zones between these areas are especially productive.

Three basic vegetation zones can be found in Keystone Lake. The upland forest, Post Oak-Blackjack (Cross Timbers regions) types, represents a mixture of forest and grassland ecosystems characteristic of most of the lake shoreline and recreation areas. The Cross Timbers region is a transition area between the once-prairie, now winter-wheat growing regions to the west, and the forested low mountains of eastern Oklahoma. The region does not possess the arability and suitability for crops such as corn and soybeans that are common in the Central Irregular Plains to the northeast. The Cross Timbers stretch across Oklahoma from north to south, with portions extending into Kansas to the north and Texas to the south and are sometimes described as containing some of the most extensive tracts of ancient forests in the eastern United States. Included in this ecoregion for Keystone Lake is the Keystone Ancient Forest, with 300-year-old post oaks and 500-year-old cedars. This forest type exists because of its limited commercial value for timber production and is protected through its designation of an Environmentally Sensitive Area by USACE. Transitional "cross-timbers" (little bluestem grassland with scattered blackjack oak [*Quercus marilandica*] and post oak trees [*Quercus stellata*]) is the native vegetation, and rangeland and pastureland comprise the predominant land cover.

The principal tree species found on bottomland hardwood habitat in Oklahoma are northern red oak (*Quercus rubra*), black oak (*Quercus velatina*), chinquapin oak (*Quercus muehlenbergi*), overcup oak (*Quercus lyrata*), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), black willow (*Salix nigra*), black walnut (*Juglans nigra*), pecan (*Carya illinoensis*), river birch (*Betula nigra*), winged elm (*Ulmus alata*), slippery elm (*Ulmus ruba*), hackberry (*Celtis laevigata*), sassafras (*Sassafras albidum*), hawthorn (*Crataegus sp.*), redbud (*Cercis canadensis*), honey locust (*Gleditsia triacanthus*), red maple (*Acer rubrum*), box elder (*Acer negundo*), dogwood (*Cornus florida*), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvania*), swamp privet (*Forestiera acuminata*), and buttonbush (*Cephalanthus occidentalis*).

The tall prairie grass vegetation type is a very desirable native grass ecosystem. Better soils in the rolling plains area of the lake support desirable grasses such as big bluestem (*Andropogon gerardi*), Indian grass (*Sorghastrum nutans*), purple top (*Tridens flavus*), and little bluestem (*Andropogon scoparius*). Unfortunately, at the time of Federal acquisition, virtually no virgin vegetation remained in the area and the quality of existing vegetation was degraded by erosion, fires, and historic overgrazing. However, 50 years of Federal ownership has resulted in beneficial tall prairie grass vegetative succession.

Downstream of Keystone Dam

The vegetation communities below the Keystone Dam can be best described as a mixture of upland and riparian forests, scrub shrub, and grasses, which can then be divided between the Central Irregular Plains and Cross Timbers ecoregions. The inconsistent flow of water from the dam results in an immature riparian forest within the Arkansas River flood zone. Because of this inconsistency, the faster growing grasses, and shrubs thrive on the sandbars in the Arkansas River. However, these communities are easily washed away with a major flood.

There is a mix of undeveloped land, farmland, industry, and urban lands. Upland forests typically dominate in areas that are undeveloped and away from the river. Grasslands and riparian forests dominate the sandy soils below Keystone Dam. Species such as cottonwood, black willow, and hackberries are the dominate species within the river. Within the upland forests the dominate species found include: chinkapin oak, post oak (*Quercus stellata*), blackjack oak, northern red oak, winged elm, white ash, persimmon (*Diospyros virginiana*), hickory (*Carya spp*.), cedar (*Juniperus spp*.), hackberry, sugarberry (*Celtis laevigata*), redbud, cottonwood, black willow, and black walnut (Guernsey, C.H. and Company, 2005).

2.15.3 Invasive Species

An invasive species is defined as a plant or animal that is non-native (or native nuisance) to an ecosystem and whose introduction causes, or is likely to cause, economic and/or environmental harm, or harm to human health. Invasive species can thrive in areas beyond their normal range of dispersal. These species are characteristically adaptable, aggressive, and have high reproductive capacity. Their vigor, along with a lack of natural enemies or controls, often leads to outbreak

populations with some level of negative effects on native plants, animals, and ecosystem functions and are often associated with disturbed ecosystems and human activities.

The Arkansas River basin has been identified as a major pathway for the introduction of aquatic nuisance species. The following vegetative species are considered special concerns in Oklahoma: alligator weed (*Alternanthera philoxeroides*), Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), purple loosestrife (*Lythrum salicaria*), salvinia (*Salvinia molesta*), and water hyacinth (*Eichhornia crassipes*). Due to its proximity to the McClellan-Kerr Arkansas River Navigation System, the Keystone study area is particularly vulnerable to the transport by boaters of these invasive plants, as well as some invasive animal species.

Salvinia and water hyacinth have been documented to occur in Keystone Lake but are not yet at population levels that allow them to have widespread impacts on the lake. Salvinia refers to a genus of perennial, aquatic ferns from South America that are common in water gardens and aquarium industries. In Oklahoma, giant salvinia has established in ponds, lakes, and slow-moving streams. It prefers nutrient rich waters and forms extensive mats that can completely cover water surfaces, resulting in the degradation of natural habitats by shading native plants, reducing available dissolved oxygen, and creating large amounts of decaying plant material. Giant salvinia can clog water intakes, which interferes with irrigation, water supply, and electrical generation. Human transport aids in the spread of this species, with plants adhering to anything entering infested waters including boats, trailers, vehicular wheels, intakes, and gear. Water hyacinth is common in Gulf Coast states, and its presence has caused massive problems with navigation, water-based recreation, canal systems, pumping stations, and water intakes. While the risk of establishment in Oklahoma is low due to cold winter air temperatures, its continued popularity in water gardens poses the threat that it could adapt to colder temperatures or become established in thermal refugia.

In addition to aquatic invasive plants, Oklahoma has a total of 28 invasive plant species on the Oklahoma Invasive Plant Council watch list. Invasive terrestrial plants known to occur on Keystone Lake lands include Japanese honeysuckle (*Lonicera japanica*), Chinese lespedeza (*Lespedeza cuneata*), Japanese climbing fern (*Lygodium japonicum*), kudzu (*Puearia lobata*), and autumn olive (*Elaeagnus umbellata*). The zebra mussel (*Dreissena polymorpha*) is an invasive, freshwater invertebrate that has a high filtration rate, high reproductive rate, strong byssal threads for substrate attachment, and a limited number of natural predators. Due to these characteristics, zebra mussels are able to populate an aquatic ecosystem relatively quickly and out-compete native mussel populations. Economic impacts caused by the invasive species include fouling water intake pipes, cooling systems, filtration systems, and boat engine cooling systems.

Other invasive animals include red imported fire ants (RIFA, *Solenopsis invicta*), house sparrows (*Passer domesticus*), and common starlings (*Sturnus vulgaris*). Although native, brown-headed cowbirds (*Molothrus ater*) have become problematic due to their expanding range associated with agriculture and human development. The high amount

of urban landscaping in the immediate area would speed up the spread of many common landscape plants.

2.15.4 Future Without Action Conditions

Natural resources present in the study area are expected to persist in the future, particularly those adapted to residential and urban areas like starlings and ornamental plants. Species that do not tolerate human disturbance have likely left the area, seldom visit, or use areas on the dam in early morning and overnight to avoid human disturbances. Natural vegetation has been largely removed or altered except in areas outside the left and right dam abutments.

A catastrophic dam breach would create long-term, moderate, direct and indirect, adverse impacts upstream and downstream of the dam. Habitat loss is expected to occur downstream due to the substantial release of floodwater which has the potential to uproot herbaceous vegetation, shrubs, and trees and would take an extended period of time to reestablish. In addition, the loss of open water habitat would most likely change the existing habitat types present which may lead to loss of any bottomland hardwood habitat or other habitats heavily dependent upon the presence of a regular water source upstream of the dam.

2.15.5 RMP 5a and 5c

There will be negligible impacts to vegetative communities from construction activities associated with the implementation of the RMP 5a or 5c. Staging, laydown, and haul routes are expected to avoid large swaths of crosstimbers habitat within the project area and will be established on previously disturbed or regularly mowed locations. All staging, laydown, and haul routes, if not originally utilized, will have road base removed and vegetation reestablished. Some shrubs and trees may require removal, as part of these construction areas, but this work is expected to be minimal. To minimize impacts to migratory and non-migratory birds, removal of trees would be conducted primarily between October and March, outside of the nesting season of migratory birds. Similarly, if tree removal is proposed to be conducted within the nesting season of migratory birds, the project area would be surveyed for active nests to ensure preservation of nests prior to construction.

Implementation of the dam raise alternatives are anticipated to have minor and localized effects to wildlife populations in the vicinity of the project. Noise from construction would affect small mammals and birds in the project area. Depending on the species affected, construction may result in their displacement to surrounding areas. Similar habitat is located in the surrounding area where displaced wildlife could find suitable habitat. Noise from construction is anticipated to temporarily disturb feeding behavior of wading birds and other aquatic and semi-aquatic bird species inhabiting the project area; however, suitable feeding habitat is present nearby.

Implementation may result in the displacement of terrestrial vertebrate species such as small mammals, amphibians, and reptiles to surrounding areas. Adjacent natural areas would provide suitable refuges for terrestrial vertebrates during construction activities. Following construction activities, the impacted areas would be allowed to re-vegetate

naturally and would continue to provide foraging and nesting habitat for terrestrial vertebrate communities. No permanent adverse impacts to wildlife populations are anticipated.

2.15.6 RMP 6e

Similar to RMP 5a/5c, there would be negligible impacts resulting from staging, laydown, and haul routes. Construction noise will create a higher level of impact due to blasting of the right abutment for creation of a new spillway. Approximately 80 acres of upland forest would be permanently, adversely, and directly impacted from construction of the new spillway leading to a loss of 46 AAHUs. Mitigation would be required for RMP 6e. A Mitigation Plan would be prepared to describe proposed mitigation measures, as well as evaluation criteria to determine success. In addition to the loss of 80 acres for the new spillway, there is the potential of 155 acres of habitat loss from the disposal of excavated material. The disposal would be focused on restoring the Keystone Lake shoreline, pre-disturbed locations, and as a last resort upland habitat. These locations are not known at this point in time but would be declared in a supplement to this EA if selected for implementation.

2.15.7 RMP 6g

This RMP is similar to RMP 5a/5c and 6e; however, there would be permanent impacts to 40 acres of upland habitat from construction of a new spillway resulting in a loss of 23 AAHUs. There would be approximately 70 acres required for disposal of excavated material.

2.15.8 RMP 7

This RMP is similar to RMP 5a/5c and 6e; however, there would be permanent impacts to 120 acres of upland habitat from construction of a new spillway resulting in a loss of 70 AAHUs. It is assumed RMP 7 would require 294 acres of land to dispose excavated material.

2.16 Federally Listed Threatened and Endangered Species

According to the U.S. Fish and Wildlife Service (USFWS), there are three federally listed threatened and endangered species, one candidate species, and two species proposed for listing that have the potential to occur in the Keystone Lake DSMS area. These species are listed in Table 10.

Table 10. Federally Listed Threatened and Endangered Species with the Potential to Occur within the Study Area

Name	Scientific Name	Federal Listing	Habitat Present
	Birds		
Piping Plover	*Charadrius melodus*	T	N
Red Knot	*Calidris canutus rufa*	T	N
	Mammals		
Tricolored Bat	*Perimyotis subflavus*	PE	Y
	Insects		
American Burying Beetle	*Nicrophorus americanus*	T	Y
Monarch Butterfly	*Danaus plexippus*	C	Y
	Reptiles		
Alligator Snapping Turtle	*Macrochelys temminckii*	PT	Y

C: Candidate, T: Threatened, PT: Proposed Threatened, E: Endangered, PE: Proposed Endangered, Y: Habitat is Present, N: Habitat is Not Present

2.16.1 Piping Plover

The piping plover is a small shorebird approximately seven inches in length with a wingspan of approximately 15 inches and weighs from 1.5 to 2 ounces (USACE, 2012 and USFWS 2011). It is sand colored on its back with white undersides. It is distinguished from similar species by its bright orange legs. During the breeding season, the plover has a single black band across its breast and forehead, which are absent during the winter.

Piping plover breeding habitat is comprised of open, sparsely vegetated areas with alkali or unconsolidated substrate (USACE, 2012 and USFWS, 2000). On rivers they nest in association with sandbars and bare islands (USACE, 2012 and USFWS, 2011). During migration periods they use beaches and alkali flats. They feed mainly on freshwater, marine, and terrestrial invertebrates.

2.16.2 Red Knot

The study area is located within the probable migratory path of the red knot, between breeding in the Arctic tundra and winter habitats in the southern U.S. and Central and South America. Red knots forage along sandy beaches and mud flats, and this species may use the study area for temporary stopover and foraging. The sandbars and bare gravel islands along the Arkansas River within the study area could provide suitable habitat during the red knot’s spring and fall migrations.

2.16.3 American Burying Beetle

The American burying beetle (ABB) is the largest species of its genus in North America measuring from 0.98 to 1.4 inches in length (USACE, 2012 and USFWS, 1997). It has a shiny black body with smooth and shiny black elytra with bright orange-red markings. The antennae are large, abruptly clubbed, and orange at the tip. It is a member of the Family Silphidae, which are known as the carrion or burying beetles due to their behavior of burying vertebrate carcasses which are used for brood chambers for their young. The typical habitat types the beetle uses include oak-pine woodlands, open fields, oak hickory forests, open grasslands, and edge habitat. Suitable habitat is present within the study area/project areas.

2.16.4 Tricolored Bat

The tricolored bat is a small insectivorous bat that is distinguished by its unique tricolored fur and often appears yellowish to nearly orange.

This species is known to occur across the eastern and central United States. During the winter, tricolored bats are often found in caves and abandoned mines but have been known to roost in culvert pipes associated with roads, especially in the Southern United States or in areas where caves are less common. During the rest of the year, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead deciduous hardwood trees, but may also be found in Spanish moss, pine trees, and occasionally human structures (USFWS, 2022).

The decline in the Tricolored bat population is due to the impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats across the continent. It is estimated that White-nose syndrome has caused more than a 90 percent decline in tricolored bat colonies across the species range. The tricolored bat was proposed for listing as endangered on September 13, 2022 (87 FR 56381).

2.16.5 Monarch Butterfly

The monarch butterfly is one of the most recognizable species in North America with its iconic orange and black markings. During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.) and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of nine to eighteen days, feeding on milkweed and sequestering toxic cardenolides as a defense again predators. The larva pupate into chrysalis before emerging six to fourteen days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months.

On December 15, 2020, the USFWS announced that listing the monarch as endangered or threatened under ESA is warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants (85 FR 81813). The monarch is now a candidate species under ESA; its status will be reviewed each year until a listing decision is made.

Threats to the monarch include loss of milkweed and nectar resources (i.e., breeding and migratory habitat) from conversion and development of grasslands and widespread use of herbicides), exposure to insecticides, availability and quality of overwintering habitat, and climate change.

Within the study area, there are grasslands, fields, and wetlands that could support milkweed and nectar flowering species in the fall and spring that monarchs could use along their migration paths.

2.16.6 Alligator Snapping Turtle

The alligator snapping turtle (AST) is the largest freshwater turtle in North America. Adult males can reach up to 29 inches long and can weigh up to 249 pounds. The alligator snapping turtle is identifiable by its gray/brown inner mouth with black splotches; it's tremendously long tail; large, curved beak; triangle-shaped head; and a rough brown shell with three spine rows. Alligator snapping turtles are known to eat a wide range of plants and animals. However, their primary prey is fish which they hunt for by sitting on the bottom and using a worm like appendage to lure prey (USFWS 2023).

The alligator snapping turtle can be found throughout freshwater systems. It generally prefers deeper beds of rivers and lakes where it can stay submerged for up to 50 mins while it hunts for prey (Smithsonian). During breeding, females will travel to sandy shores to lay their clutches of eggs.

The Alligator snapping turtle was federally listed as proposed threatened on November 15, 1994. Currently, this species is known to or is believed to occur in Alabama, Arkansas, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, Tennessee, and Texas. The main causes for the decline in population of this species is a result of historic overharvesting, water pollution, bycatch from fishing gear, and extensive habitat alteration.

Due to the channelized nature and strong currents associated with the river just below the dam, it is unlikely that AST would be present within the study area.

2.16.7 No Action Alternative

Habitat for federally listed threatened and endangered species that exist today would persist into the future with the No Action Alternative; however, a catastrophic dam breach would create long-term, moderate, direct and indirect, adverse impacts upstream and downstream of the dam. A dam breach, if it did occur, could devastate the habitats necessary for red knot, piping plover, ABB, tri-colored bat, and monarch butterfly. Red knot, piping plover, tri-colored bat may be able to escape an immediate event but would be displaced due to loss of sandbars and trees along the Arkansas River channel. Drowning of individual ABB would most likely occur due to their lack of mobility. The same could be expected for monarch butterfly, and milkweed would also be destroyed within the path of a dam breach event.

2.16.8 RMP 5a and 5c

The Biological Assessment (BA) (Appendix H-4) includes a more thorough discussion of the Federally listed threatened and endangered species. The impacts have been evaluated and will be submitted to USFWS for concurrence.

Tri-colored bat and alligator snapping turtle are both, at the time of this report, proposed for listing species. Part 402 of the ESA, Section 402.10 – Conference on Proposed Species or Proposed Critical Habitat requires each federal agency to confer with the USFWS on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. It is assumed that the proposed project is unlikely to jeopardize the continued existence of the tricolored bat or the alligator snapping turtle given the species mobility and because direct and indirect effects are localized to the project site, thereby having no effect on the species outside of the immediate area.

Monarch butterfly are candidate species; therefore, no determination will be made for this alternative.

It was assumed that the dam raise alternatives would have "no effect" on the following Federally listed species:

- piping plover and
- red knot,

It was determined by USACE and will be submitted for concurrence to USFWS that the dam raise alternatives “may affect, but is not likely to adversely affect” the following Federally listed species:

- ABB

Presence of the ABB is assumed within undisturbed areas, specifically upland forest and scrub-shrub habitat. All project locations are expected to occur on impervious surfaces or areas regularly maintained or mowed.

To reduce potential impacts to the ABB, onsite conservation measures within the temporary construction areas include replanting the area with native grasses, where appropriate, allowing the grass height to remain at least 8 inches tall, and limit mowing and other ground disturbances. Additionally, no pesticides or insecticides will be used within or adjacent to undisturbed areas.

Bald eagles use forested habitat around the Keystone Dam for roosting, nesting, and foraging. While the construction of RMPs 5a and 5c are not expected to have direct take of bald eagles, indirect impacts to nests may occur. To comply with the Bald and Golden Eagle Protection Act, a Bald Eagle Management Plan would be developed during the PED phase in coordination with state and federal resource agencies. If necessary, bald eagle surveys would be conducted and coordinated with the USFWS Oklahoma Ecological Services Office and USFWS Southwest Region Migratory Bird Office during the PED phase. This information will be used to develop impact avoidance and minimization plans and if necessary, obtain a bald eagle take permit prior to construction. If the need arises to remove a bald eagle nest, a Nest Take application

must be submitted to the Migratory Bird Permit Office. Additional monitoring could be required during construction to limit and document bald eagle disturbance.

2.16.9 RMP 6e

This alternative is similar to RMP 5a/5c. However, it is expected there would be a “may affect, likely to adversely affect” ABB due to the large-scale tree clearing associated with the construction of the spillway and disposal of material. This large-scale land clearing would also have a high potential for adverse impacts on the tri-color bat and monarch butterfly.

2.16.10 RMP 6g

This alternative would yield the same impacts as described by RMP 6e.

2.16.11 RMP 7

This alternative would yield the same impacts as described by RMP 6e.

2.17 Summary of Alternative Disturbance

A summary of action alternative pertinent terrestrial/aquatic disturbances is shown in Table 11.

Table 11. Summary of Pertinent Alternative Disturbances

Construction Impact	RMP 5a and 5c	RMP 6e	RMP 6g	RMP 7
Duration	8+ years	12+ years	10+ years	18+ years
Staging/Laydown (terrestrial) Footprint	10 acres	10 acres	10 acres	10 acres
Permanent (terrestrial) Footprint	---	80 acres	40 acres	120 acres
Temporary Impacts (aquatic) from Cofferdam	15 acres	15 acres	15 acres	15 acres
Temporary Impacts (aquatic) from Spillway Construction	---	45 acres	36 acres	55 acres
Material Excavated	35,0000 cy	11,000,000 cy	5,500,000 cy	20,000,000 cy
Material Disposal on USACE property	0 acres	155 acres	70 acres	295 acres
Terrestrial Mitigation Need	---	46 AAHUs	23 AAHUs	70 AAHUs
Emergent Wetland Mitigation Need	---	1 AAHU	1 AAHU	1 AAHU

Section 3 Tentatively Selected Plan – RMP 5a

Based on the comparison of the final array of plans, the TSP is RMP 5a (Dam Raise with Modification of the Existing Stilling Basin). This plan meets study objectives of addressing dam safety issues and deficiencies; defining, estimating, and communicating risk; addressing non-breach and incremental risk through permanent flood risk management measures; and reducing incremental dam safety risk to tolerable levels. This alternative also avoids or minimizes impacts to the ecological resources and human environment in the project area. Implementation of the TSP is temporary in duration and limited in spatial extent and is not anticipated to impact the overall project area.

The features of work of RMP 5a include:

- Modify existing service spillway
    - Demolish existing spillway bridge
    - Construct concrete baffle
    - Construct new spillway bridge
    - Construct dam raise and parapet wall
- Construct embankment raise (earthen/parapet wall combination)
- Modify existing service spillway stilling basin
    - Construct stilling basin divider walls, cofferdam, basin dewatering system, and instrumentation
    - Stabilize right training wall with anchors
    - Install 2 ft slab overlay (continuous reinforcement and water stops) with post-tensioned anchors in stilling basin
    - Remove and replace existing baffle blocks and strengthen endsill

3.1 Special Avoidance and Minimization Measures for the TSP

A summary of avoidance, minimization, and restoration measures for the TSP are included below. No compensatory mitigation is warranted because there would be no permanent loss of aquatic or terrestrial habitats.

- A Stormwater Pollution Prevention Plan must be prepared by the future contractor, a Notice of Intent submitted to the Oklahoma Department of Environmental Quality and authorization obtained under General Permit No. OKR10 for Storm Water Discharges from Construction Activities, conduct onsite posting and periodic self-inspection, and follow and maintain requirements of the SWPPP.
- A General Wastewater Disposal Permit for Mobile Concrete Batch Plants General Permit No. OKG11MT must be obtained from ODEQ. The Authorization will allow the owner/operator to treat and dispose of wastewater in temporary total retention surface impoundment(s) at the job site under this permit. The authorization must be obtained prior to commencing operation of the mobile concrete batch plant. This permit has a five (5) year term.

- To limit adverse impacts to habitat, water quality, and maintain the benefits vegetation buffers provide to water quality of adjacent water bodies, native vegetation (to be determined during the PED phase) would be replanted within areas temporarily impacted by staging, laydown, and haul routes.
- Plantings would provide soil stabilization, future shade, and habitat temporarily lost during construction.
- Unless in an area previously designated for operations and maintenance, no mowing would occur within these restored construction sites, similar to surrounding natural areas.
- The project area (specifically any areas that require shrub and/or tree clearing) will be surveyed for migratory birds or their nests during the nesting season or will be avoided in the nesting season (01 March to 01 September).
- To avoid and minimize direct impacts to bat species, tree removal would be conducted during the winter (November 15 thru March 31) when bats are hibernating in caves and no additional temporary nighttime lighting without limiting light beam focus to work and staging areas.
- Ensure operators, employees, and contractors working in areas of known or presumed bat habitat are aware of all environmental commitments and applicable BMPs.
- Modify phases and aspects of the project such as temporary work areas and alignments to the extent practicable to avoid tree removal in excess of what is required to implement the project safely.
- Ensure tree removal is limited to specifications in project plans and ensure that contractors are aware of clearing limits, and how such limits are marked such as bright colored flagging and fencing.
- Lighting equipment would face downward to limit light pollution.
- To reduce impacts to the ABB, onsite conservation measures within the temporary construction areas include replanting the area with native grasses, where appropriate, allowing the grass height to remain at least 8 inches tall, and limit mowing and other ground disturbances. Additionally, no pesticides or insecticides will be used within or adjacent to undisturbed areas.
- A Bald Eagle Management Plan would be developed during the PED phase in coordination with state and federal resource agencies.
    - If necessary, bald eagle surveys would be conducted and coordinated with the USFWS Oklahoma Ecological Services Office and USFWS Southwest Region Migratory Bird Office during the PED phase.
    - This information will be used to develop impact avoidance and minimization plans and, if necessary, obtain a bald eagle take permit prior to any construction occurring.
    - If the need arises to remove a bald eagle nest, a Nest Take application must be submitted to the Migratory Bird Permit Office.
    - Additional monitoring could be required during construction to limit and document bald eagle disturbance.

Section 4 Cumulative Impacts

There is the potential for the most severe environmental degradation to be from the combination of effects of multiple, independent actions over time. As defined in the CFR, 40 CFR 1508.1 (CEQ Regulations), cumulative effects are the “effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” Some authorities contend that most environmental effects can be seen as cumulative because almost all systems have already been modified. Principles of cumulative effects analysis, as described in the CEQ guide Considering Cumulative Effects under NEPA, are:

- Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.
- Cumulative effects are the total effects, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions.
- Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.
- It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.
- Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.
- Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.
- Cumulative effects may last for many years beyond the life of the action that caused the effects.
- Each affected resource, ecosystem, and human community must be analyzed in terms of the capacity to accommodate additional effects, based on its own time and space parameters.

Past, present, and foreseeable projects include:

- Oklahoma Department of Transportation’s (ODOT) MKARNS Mooring Modernization Project: It will replace existing structures that were not designed for extreme flood events, enhance harbor safety by eliminating damage to infrastructure due to loose barges, expand the capacity for vessels within the waterway, and prepare ports for increased freight demand within the MKARNS (ODOT, 2020). The project is expected to be completed in 2027.
- MKARNS 12ft Channel Deepening Project: This project will deepen the navigation channel to a minimum navigable depth of 12-ft throughout the MKARNS. This would require placing rock structures to scour the channel, dredging the channel, and utilizing in-water and upland dredge disposal sites throughout the project area. Additionally, some lock modifications are planned to

accommodate the increase in vessel size that the deepened channel would allow.

- Arkansas River Corridor Project: This is a planned environmental restoration project that will restore more natural flow regimes to approximately 40 miles of the Arkansas river from Sand Springs, OK to Bixby, OK. This project will include installation of backwater areas, migratory bird islands, and pool structures.

- Implementation of the Tulsa-West Tulsa levee repair project downstream of Keystone Dam. This project was authorized by Section 1202 of the Water Infrastructure Improvements for the Nation Act (WIIN Act of 2016, Public Law 114-322), the study is an integrated feasibility report and environmental assessment completed by the U.S. Army Corps of Engineers (USACE), Tulsa District (SWT). This project entails repairing a large portion of the 20 miles of earthen levees along the left and right bank of the Arkansas River that were constructed by USACE in the mid-1940s as authorized in the 1941 Flood Control Act to protect residential and industrial property from frequent flooding along the Arkansas River and associated tributaries in the City of Tulsa, Oklahoma and the City of Sand Springs (an incorporated area adjacent to the City of Tulsa). This levee system extends from Sand Springs downstream along the Arkansas River to Tulsa. Keystone Dam is about 8 miles above Tulsa, and flood discharges from Keystone have direct and substantial impacts to the levee system. This project is fully funded with construction anticipated to start in FY2025-26.

- Unavoidable pool drawdown resulting from the barges sinking and crashing into the Webbers Falls Pool Lock and Dam, leading to substantial environmental and economic impacts to the MKARNS in May 2019.

Topics such as transportation, socioeconomic and environmental justice, recreation and visual aesthetics, land use, climate, climate change, and greenhouse gases, air quality, geology, topography, and soils, utilities, noise, hazardous materials and solid waste, and health and safety, are not addressed because the cumulation of those impacts are negligible and would not have long-term or permanent impacts to address on a larger scale. The effects associated with topics listed above are not expected to exceed the consequences described in Section 2.

4.1 Cultural, Historical, and Archaeological Resources

In assessing cumulative effects on known historic properties (or properties that are treated as eligible until formally evaluated) within the project area there is the potential for cumulative effects from modification of the spillway and spillway basin and raising the embankment. Future planning around the Keystone Dam should make a reasonable and good faith effort to account for adverse effects that are reasonably foreseeable, may occur later in time, be farther removed in distance, or cumulative and appropriately avoid or mitigate them.

Cultural resources investigations will be conducted prior to construction in the dam and spillway construction footprint, staging areas, borrow, and fill disposal locations to

identify, delineate, and avoid or mitigate archaeological sites. Any adverse effects to historic properties will be mitigated.

Mitigating adverse effects upon potential archaeological or historical sites that may be within the project area will result in minor cumulative impacts to cultural resources.

4.2 Aquatic Resources

Other past, present, and future activities, including continued and future wastewater and stormwater discharges, mooring modernization, and the projected maintenance or construction of nearby streets, highways, interstates, and associated bridges over the Arkansas River, would affect water quality. There are no major cumulative effects expected given the scope of the TSP relative to the impacts.

Activities associated with this project, other future development or construction projects, and population growth along the Arkansas River would produce cumulative changes in the number of impervious surfaces and runoff in the system. All projects would adhere to local, State, and Federal stormwater control regulations and BMPs which are designed to limit inputs to surface water. Consequently, impacts to surface water would be minimal.

4.3 Terrestrial Resources

The temporary impact of the TSP (10 acres), when combined with impacts to terrestrial habitat associated with population growth in the study area, could have cumulative impact on terrestrial habitat. However, as the total loss of terrestrial land amounts to less than 1% of the total terrestrial habitat in the study area, and the majority of areas that would be impacted are heavily disturbed old field habitats that are not of high quality, cumulative impacts to terrestrial resources would be minor.

4.4 Federally Listed Threatened and Endangered Species

Impacts to Federally listed threatened and endangered species are assumed to be cumulative because the listing is presented on a nationwide basis. The ABB is assumed to be impacted by the TSP. There will be 10 acres of temporary impacts from staging and laydown areas, as well as additional impacts to surface area on the Keystone Dam embankment and any expansion of existing or new haul routes. This small area in comparison to other land base and critical habitat contributes to a minor adverse cumulative impact to Federally listed threatened and endangered species.

4.5 Irreversible and Irretrievable Commitment of Resources

NEPA 40 CFR 1502.16 requires that environmental analysis include identification of “any irreversible and irretrievable commitments of resources which would be involved in the TSP should it be implemented.” Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable period. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored because of the action (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site).

The TSP would result in the direct and indirect commitment of resources. These would be related mainly to construction components. Energy typically associated with construction activities would be expended and irretrievably lost under the TSP. Fuels used during the construction and operation of dredging equipment, barges, placement equipment (e.g. bulldozers, backhoes, etc.) and support vehicles would constitute an irretrievable commitment of fuel resources. Capital and labor resources, as well as, stone material would also be considered an irretrievable and irreversible commitment of resources. The use of such resources would not adversely affect the availability of such resources for other projects both now and in the future.

Benthic communities will be removed and lost along with sediment during cofferdam installation. Benthic communities will take several years to recover. Slow moving or non-motile fish, wildlife, invertebrates, and plant (aquatic and terrestrial) species would be entrained in the materials during dewatering activities associated with cofferdam installation. These losses would be irretrievable as well. However, most impacts to the species' population, would be insignificant. These impacts would have occurred with all construction alternatives evaluated.

Section 5 Environmental Compliance

This EA has been prepared to satisfy the requirements of all applicable environmental laws and regulations and has been prepared in accordance with the CEQ's implementing regulations for NEPA, 40 CFR Parts 1500 – 1508, and 33 CFR Part 230.

5.1 National Environmental Policy Act

The NEPA was signed into law on January 1, 1970. It requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. Section 102 in Title I of the Act requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of all alternatives to major federal actions affecting the environment.

Preparation of this EA is in compliance with NEPA. The final array of alternatives was assessed before choosing a TSP. The selection of RMP 5a was given consideration because the impacts would occur on pre-disturbed locations.

5.2 Fish and Wildlife Coordination Act of 1958, as amended

The Fish and Wildlife Coordination Act (FWCA) requires Federal agencies that impound, divert, channelize, control, or modify waters of any stream or other body of water to consult with the USFWS and appropriate state fish and game agencies to ensure that wildlife conservation receives equal consideration in the development of such projects. From the initial stages of the Keystone DSMS the USFWS, ODWC, and ODEQ were asked for their input and concerns regarding the alternatives. All agencies provided comments throughout the NEPA process, and the USFWS provided valuable information regarding existing habitat conditions and habitat mitigation options for the final array of alternatives.

A Fish and Wildlife Coordination Act Report (CAR) will be included as an Attachment to Appendix H-5 as part of the Final EA. The CAR will describe potential impacts to natural resources as well restoration measures that have been prepared regarding the TSP.

5.3 Endangered Species Act of 1973, as amended

USACE will request formal consultation with USFWS and submit a BA to the USFWS Oklahoma Ecological Services Office (Appendix H-4). The adverse effects and any potential incidental take for ABB have been addressed through an existing programmatic Biological Opinion with USACE and SWPA and no additional formal consultation for the TSP is necessary. Additional discussion of potential impacts to the species evaluated are found in Appendix H-4.

5.4 Executive Order 13186, Migratory Birds and Their Habitats

Sections 3a and 3e of EO 13186 direct Federal agencies to evaluate the impacts of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential adverse impacts on migratory birds. Impacts associated with the concrete batch plant, staging, laydown, and haul routes will be compliant with this EO because there is not any large-scale tree removal expected and if it does occur, the avoidance and minimization measures described in Section 3.1 would be implemented.

5.5 Migratory Birds Treaty Act

The importance of migratory nongame birds to the nation is embodied in numerous laws, executive orders (EO) and partnerships. The Fish and Wildlife Conservation Act (Nongame Act) of 1980 demonstrates the Federal commitment to conservation of nongame species. Amendments to the Nongame Act adopted in 1988 and 1989 direct the USFWS to undertake activities to research and conserve migratory nongame birds. The EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds directs Federal agencies to promote the conservation of migratory bird populations, including restoring and enhancing habitat. The Migratory Nongame Birds of Management Concern is a list maintained by the USFWS. The list helps fulfill a primary goal of the USFWS to conserve avian diversity in North America. Additionally, the USFWS Migratory Bird Plan is a draft strategic plan to strengthen and guide the agency's Migratory Bird Program.

The nonregulated “take” of migratory birds is prohibited under this act in a manner similar to the prohibition of “take” of threatened and endangered species under the Endangered Species Act. Avoidance and minimization will be implemented with the TSP. The area will be surveyed for migratory birds or their nests before any shrubs or trees are cleared during the nesting season or will be avoided in the nesting season completely.

5.6 Bald and Golden Eagle Protection Act of 1940

The bald eagle is protected by the Bald and Golden Eagle Protection Act even though it has been delisted under the Endangered Species Act. This law, originally passed in 1940, protects the bald eagle and golden eagle (as amended in 1962) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport,

export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668(a); 50 CFR 22).

"Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb (16 U.S.C. 668c; 50 CFR 22.3). The 1972 amendments increased civil penalties for violating provisions of the Act to a maximum fine of $5,000 or 1-year imprisonment with $10,000, or not more than two years in prison for a second conviction. Felony convictions carry a maximum fine of $250,000 or 2 years of imprisonment. The fine doubles for an organization. Rewards are provided for information leading to arrest and conviction for violation of the Act.

Bald eagles use large trees downstream of Keystone Dam in the study area for roosting, nesting and foraging. Although the TSP is not anticipated to have direct take of bald eagles, indirect impacts to nests may occur if construction occurs near active nests and roost sites. To comply with the Bald and Golden Eagle Protection Act, a Bald Eagle Management Plan will be developed during the PED phase in coordination with state and Federal resource agencies; and if necessary, surveys will be conducted and coordinated with the USFWS Oklahoma Ecological Services Office and USFWS Southwest Region Migratory Bird Office. Information will be used to develop impact avoidance and minimization plans; and if needed, obtain a bald eagle take permit prior to construction. Additional monitoring may be necessary during construction to limit and document bald eagle disturbance.

5.7 Clean Water Act of 1977

USACE, under direction from the U.S. Congress, regulates discharge of dredged and fill material into waters of the United States (WOTUS), including wetlands. Although USACE does not issue itself permits for construction activities affecting WOTUS, it must satisfy legal requirements of the Act. A Clean Water Act (CWA) Section 404(b)1 Analysis has been completed and will be submitted to the ODEQ for review and comment regarding Water Quality Certification. The CWA Section 404(b)1 Analysis further examines impacts to WOTUS (see Appendix H-3).

The TSP is the Least Environmentally Damaging Practicable Alternative compared to the construction alternatives evaluated. Practicable is defined as meaning the alternative is available, and capable of being done after taking into consideration cost, existing technology, and/or logistics in light of the overall purpose regarding identification of the Least Environmentally Damaging Practicable Alternative (LEDPA), per 40 CFR 230.10(a). When considering the lack of protection provided by the No Action Alternative it was determined to be not practicable.

Construction that disturbs upland areas (land above Section 404 jurisdictional waters) is subject to the NPDES requirements of Section 402(p) of the Clean Water Act. In Oklahoma, ODEQ is the permitting authority and administers the NPDES. Operators of construction activities that disturb 1 or more acres must prepare a SWPPP, submit a Notice of Intent to ODEQ and obtain authorization under General Permit OKR10 for Storm Water Discharges from Construction Activities, conduct onsite posting and periodic self-inspection, and follow and maintain requirements of the SWPPP. During

construction, operators must assure that measures are taken to control erosion, reduce litter and sediment carried offsite (silt fences, hay bales, sediment retention ponds, litter pick-up, etc.), promptly clean-up accidental spills, use BMPs onsite and stabilize sites against erosion before completion.

5.8 National Historic Preservation Act of 1966, as amended

Federal agencies are required under Section 106 of the NHPA to “take into account the effects of their undertakings on historic properties” (cultural resources with information potential, and thus significance) and consider alternatives “to avoid, minimize or mitigate the undertaking’s adverse effects on historic properties” [(36 CFR 800.1(a-c)] in consultation with the SHPO and appropriate federally recognized Indian Tribes (Tribal Historic Preservation Officers [THPO]) [36 CFR 800.2(c)]. In accordance with this and other applicable regulations, including NEPA, the Native American Graves Protection and Repatriation Act, and ER 1105-2-100, USACE has reviewed the Oklahoma State Files and archaeological survey reports to better determine the existing conditions and potential to impact cultural resources.

Because potential impacts to cultural resources cannot be fully determined prior to completion of this EA, USACE is developing a PA in accordance with 36 CFR 800.14. USACE will be implementing the PA prior to the project’s construction, engineering and design phase to ensure compliance with Section 106 of the NHPA.

Cultural resources surveys will be performed and reported in accordance with USACE SWT requirements, and in coordination with the Oklahoma SHPO and Tribal Nations who have an interest in the locations or whose ancestral or historic homelands include the proposed locations. All surveys will be conducted by professional archaeologists meeting the requirements established in Secretary of the Interior's Standards and Guidelines (36 CFR Part 61), under Archaeological Resources Protection Act permits issued by SWT, and in accordance with all relevant laws, regulations, and executive orders.

5.9 Archaeological Resources Protection Act

The ARPA of 1979 compels federal land-holding agencies to protect archaeological sites and artifacts on government land from looting, vandalism, and trafficking, enforce penalties, both Civil and Criminal, against violators of the Act, and better manage archeological sites on public land.

ARPA compliance for the impacts of the DSMS will be attained by the issuance of ARPA permits required for all cultural resources investigation on SWT lands, and by monitoring of construction, ongoing mitigation activities, and site conditions. Archaeological Resources Protection Act permitting requirements allow SWT oversight of proposed cultural resources survey work plans, methodologies, fieldwork, and reporting.

5.10 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act, passed in 1990, directs federal land-holding agencies to protect Native American burials and burial sites on

federal fee lands. This Act additionally sets out procedures for conducting inventories and repatriations of Native American human remains and funerary objects.

There is a possibility that human remains, or funerary features could be inadvertently discovered during cultural resource investigations or during an extended drawdown of the reservoir during construction. USACE will comply with NAGPRA and its implementing regulations.

If an inadvertent discovery is made during on-going activity on Federal lands, such as cultural resources investigations or any actions associated with compensatory mitigation, all activity must cease within a predefined perimeter around the inadvertent discovery, and a reasonable effort made to protect the discovery. The agency must be notified immediately by phone, and the medical examiner and law enforcement must be called to make a determination that the remains are not modern, and the location is not a crime scene. Once this determination has been made, the agency will secure and protect the discovery location and notify the appropriate Tribes of the discovery.

Activity resulting in the inadvertent discovery may resume thirty days after the Federal agency acknowledges receipt of written confirmation and notification or upon execution of a binding agreement between the Federal agency and the affiliated Tribe(s) that provides a recovery plan for excavation or removal. To avoid potential delays and provide greatest protection to human remains or funerary features, a NAGPRA Plan of Action may be executed between the Federal agency and Tribal Nations (those in whose aboriginal or historical homelands the work is being performed, and those who express an interest in the area).

5.11 Clean Air Act of 1977

The CAA requires Federal agencies to review air emissions from projects receiving Federal funds or permits to ensure conformity with State Implementation Plans in non-attainment areas. Oklahoma is currently in attainment for air emissions, and the TSP is not expected to alter attainment status. Therefore, the TSP is expected to be in compliance with the CAA and does not require a General Conformity Determination.

5.12 Farmland Protection Policy Act (FPPA) of 1980 and 1995 and CEQ Memorandum dated August 11, 1980

The FPPA’s and the CEQ Memorandum’s purpose is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. The TSP will not have any permanent adverse impacts on Prime Farmlands.

5.13 Executive Order 13045, Protection of Children from Environmental Health Risk and Safety Risk

Executive Order 13045 directs Federal agencies to analyze their policies, programs, activities, and standards for any environmental health or safety risks that may disproportionately affect children, including risks to health or safety that are attributable to products or substances that a child is likely to come in contact with or ingest, such as air, food, water, recreational waters, soil, or products they might use or be exposed to.

As it relates to the project area, there are no schools or daycares and swimming is prohibited within the immediate vicinity of the dam.

5.14 Executive Order 11990, as amended, Protection of Wetlands

Executive Order 11990 directs Federal agencies to take action in the conservation of wetlands. Agencies should take part in avoiding possible degradation or destruction of wetlands and promote wetland health.

The TSP will comply with EO 11990 to minimize degradation or destruction of Federal wetlands and improve the circumstances for natural wetlands and their benefits on the environment. There will be no net loss of wetland habitat.

5.15 Executive Order 11988, as amended, Floodplain Management

Executive Order 11988: Floodplain management was enacted May 24, 1977, in furtherance of the NEPA of 1969, as amended (42 U.S.C. 4321 et seq.), the National Flood Insurance Act of 1968, as amended (42 U.S.C. 4001 et seq.), and the Flood Disaster Protection Act of 1973 (Public Law 93-234, 87 Star. 975). The purpose of the EO was to avoid, to the extent possible, long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

The EO states that each agency will provide and 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 for: 1) acquiring, managing, and disposing of Federal lands and facilities; 2) providing Federally undertaken, financed, or assisted construction and improvements; and 3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

There will be no net loss of floodplain as a result of the TSP. The Alternative would neither increase nor decrease the floodplain capacity within the study area. Therefore, the TSP is in compliance with EO 11988.

5.16 Executive Order 13112 and 13751, Invasive Species

Executive Order 13112 recognizes the contribution native species make to the well-being of the natural environment and directs Federal agencies to take preventive and responsive action to the threat of the invasion of non-native plants and wildlife species in the United States. This EO establishes processes to deal with invasive species, and among other items, establishes that Federal agencies “will not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.”

Executive Order 13751 of 2016 amends EO 13112 to maintain the National Invasive Species Council (Council) and the Invasive Species Advisory Committee, expands the membership of the Council; clarifies the operations of the Council; incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into Federal efforts to address invasive species; and strengthens coordinated, cost-efficient Federal action.

It is expected that the TSP will not promote the establishment of invasive species within the project area. Restoration enacted as a result of the TSP would reduce the abundance of invasive plant species through herbicide or physical controls, as well as replacing those areas with native vegetation. Therefore, the TSP is in compliance with EO 13751.

5.17 Executive Order 12898, Environmental Justice

Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low- Income Populations, Feb. 11, 1994, requires all Federal agencies to identify and address disproportionately high and adverse effects of its programs, policies, and activities on minority and low-income populations. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. Data were compiled to assess the potential impacts to minority and low-income populations within the study area. No adverse impacts to environmental justice are expected as a result of the TSP.

Section 6 Public and Agency Coordination

In accordance with 40 CFR §§ 1501.7, 1503, and 1506.6, the Tulsa District will initiate public involvement and agency coordination activities to solicit input on the Draft EA process, as well as identify issues related to the TSP. The Tulsa District will continue to coordinate with local, state and Federal agencies, tribes, the public and interested parties through comment periods, email exchanges, social media, and news releases as the EA progresses to final phases.

USACE began its public involvement process with a public scoping comment period to provide an avenue for public and agency stakeholders to ask questions and provide comments. A public meeting was held on February 12, 2020, at the Case Community Center, 1050 W Wekiwa Road, Sand Springs, Oklahoma 74063. A summary of the public comments received and USACE response are included in Appendix H-5. Approximately 14 comments were received from the general public. The City of Sand Springs, Town of Mannford, and Southwestern Power Administration also submitted comments.

Agency coordination has been conducted using formal and informal forms of communication including teleconferences, email, phone calls, and webinars. Resource agencies have indicated BMPs should be incorporated into the project to reduce adverse effects. In addition, measures to reduce impacts to migratory birds, threatened and endangered species, and bald eagles should be properly evaluated and

incorporated during the preconstruction, engineering, and design and construction phases.

The agencies below were actively invited to participate in the scoping process of the EA and were notified of major changes and results of site assessments for the TSP.

- USFWS,
- ODWC,
- ODEQ,
- ODOT, and
- SWPA

6.1 Native American Tribes

The Tribal Nations below were actively invited to participate in the scoping process of the EA and were invited to participate in the programmatic agreement. The Muscogee (Creek) Nation, within whose reservation the project is located, and The Osage Nation, who have significant cultural resources in the region, have elected to participate in the programmatic agreement. The Cherokee Nation stated that they did not foresee the project impacting Cherokee cultural resources but wish to be notified if significant resources are identified. The Delaware Nation declined to participate and deferred their comments to the Muscogee (Creek) Nation. No response was received from the other five federally recognized tribes. USACE will continue to consult with federally recognized tribes with expressed interest throughout the duration of the project. No concerns have been raised by federally recognized tribes or other consulting parties at the time of the Draft EA release.

- The Muscogee (Creek) Nation
- The Osage Nation
- The Cherokee Nation
- The Alabama-Quassarte Tribal Town
- The Apache Tribe of Oklahoma
- The Cheyenne and Arapaho Tribes
- The Delaware Nation
- The United Keetoowah Band of Cherokee
- The Wichita Nation

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