Arkansas River Corridor Projects Baseline Summary

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Introduction

While the Arkansas River has long been a significant natural resource for the surrounding land and its inhabitants, historical alterations have degraded watershed conditions and masked the river's unique potential. The 1964 construction of Keystone Dam, to protect nearby communities from extreme flood events, significantly changed the natural hydrology of the Arkansas River. Additionally, growth and development associated with the Tulsa metropolitan area, and related intensive land use practices, have led to streambank erosion, destruction of riverine wetlands, increased stormwater runoff, and a high degree of sediment transport to the river. As a result, ecosystems native to the Arkansas River area have been compromised, and instream habitats continue to be depleted.

In recent years, however, citizens of Tulsa County have begun to recognize both the potential of the Arkansas River as a resource and the need to address declining water quality and aquatic ecosystems. Due to this increased awareness, a Dialog/Visioning 2025 Citizen's Summit was held in early 2002 to identify potential improvements to the Arkansas River and the Arkansas River Corridor. From this Citizen's Summit, the Arkansas River Corridor Project was initiated and has included a wealth of research, planning, and design initiatives for the beautification and improvement of 42 miles of the Arkansas River Corridor, between Keystone Dam and the Tulsa County/Wagoner County line. Multiple stakeholders are involved in the project, including Tulsa County, the Indian Nations Council of Governments (INCOG), the U.S. Army Corps of Engineers (USACE) and the Tennessee Valley Authority (TVA). The project involves enhancement and restoration at seven key development sites within the 42-mile project reach and includes modification of the existing Zink Dam and the addition of two low water dams, at Sand Springs and South Tulsa/Jenks.

This document details components of the Arkansas River Corridor Project that are proposed for funding by Tulsa County and the USACE, including improvements at Zink Dam, Sand Springs and South Tulsa/Jenks. Supplemental development at these sites, as well as proposed improvements at the four additional key development sites, are not included in the current phase of the project but may be funded and implemented during future phases. This document includes a summary of the current phase of the Arkansas River Corridor Project, including its purpose and need, goals, project elements, project benefits, estimated costs and potential funding sources.

Background

The Arkansas River Dialog/Visioning 2025 Citizen's Summit, which was held to identify a path forward for improvement of the Arkansas River Corridor, resulted in the addition of Proposition 4 to the Tulsa County 2025 sales tax initiative. Approval of Proposition 4 in 2003 authorized $9.5 million in sales tax revenues for: (1) construction of two low water dams downstream of Keystone Dam, (2) Zink Lake shoreline beautification and (3) Zink Lake silt removal improvements. Approval was also the impetus for multiple studies conducted on the Arkansas River Corridor. Since approval of Proposition 4, additional work has been authorized by INCOG and the USACE for the following studies:

- Arkansas River Corridor Master Plan, Phase I Vision Plan (Carter Burgess, 2004)
- Arkansas River Corridor Master Plan, Phase II Master Plan and Pre-Reconnaissance Study (Guernsey et al., 2005)
- Conceptual Planning, Tulsa Wave Whitewater Park (McLaughlin Whitewater Design Group, 2007)
- Vision for the Arkansas River Corridor at Tulsa (TVA, 2008)
- Vision 2025, Arkansas River Corridor, Ecosystem Restoration Plan (Cherokee CRC, 2009)

The Arkansas River Corridor Phase I Vision Plan, initiated by INCOG in 2003, is a preliminary plan to "enhance the river and the citizens' lives" (Carter Burgess, 2004, p. 2). The Phase I Vision Plan evaluated seven major features with the potential to maximize the beneficial use of the Arkansas River Corridor while integrating ideas supported by the community: bridges and crossings, natural features and resources, low water dams, multi-use trails and parks, traffic network and gateways, river-oriented activities and community development opportunities. The Phase I Vision Plan is primarily based on citizen input and is general and basic in conceptual design; however, it provided the necessary framework for the comprehensive Phase II Master Plan (Guernsey et al., 2005).

The Phase II Master Plan addresses economic, physical, environmental, ecological and legal issues related to the Arkansas River Corridor Project. Through the comprehensive Pre-Reconnaissance study, a number of opportunities associated with the Arkansas River and Arkansas River Corridor were identified, including low water dams, mixed-use areas, parks, fishing piers, boating access, new and expanded trails, and bridges. The Master Plan includes conceptual plans, estimated costs, and potential funding sources for seven selected key development sites, construction of two new low water dams and modifications to Zink Dam.

After completion of the Phase II Master Plan, TVA provided a technical review of the low water dam construction and dam modifications proposed in the Phase II Master Plan. The Vision for the Arkansas River at Tulsa (TVA, 2008) outlines the findings and recommendations of this study, which was aimed at identifying a hydraulic system that meets project goals while also ensuring safety and meeting floodplain regulations. The Tulsa Wave Whitewater Park conceptual planning document (McLaughlin Whitewater Design Group,

2007) details potential whitewater recreational opportunities that could be made possible by the modified and newly created low water dams.

Phase III of the Arkansas River Corridor Project includes a baseline environmental study (by Cherokee CRC, 2009) and an associated Ecosystem Restoration Plan (US Army Corps of Engineers, 2009). The Phase III study, which was limited to the Sand Springs and South Tulsa/Jenks low water dam and lake systems, presents ecosystem recommendations for consideration during the development of these project components. The Ecosystem Restoration Plan would be submitted as part of the USACE regulatory permit application process during the next phase of the project.

Project Purpose

The Arkansas River and its major tributaries within the project area have a combination of beneficial use designations, including: emergency water supply; fish and wildlife propagation, warm water aquatic community; agriculture Class I irrigation; primary or secondary body contact recreation; and aesthetics. Oklahoma's final 2006 and draft 2008 Water Quality Assessment Integrated Reports list significant portions of the Arkansas River as impaired due to elevated levels of fecal coliform, *Enterococcus,* and *Escherichia coli (E. coli)* bacteria; lead; cadmium; oil and grease; and total dissolved solids. Potential watershed pollutants include pathogens, pesticides and organic compounds from urban, municipal, commercial and agricultural runoff that affect water quality.

In addition to water quality impairment, the Arkansas River has been substantially impacted by anthropogenic alteration, development of surrounding land use, increased stormwater runoff, and streamflow fluctuations resulting from hydropower operations. The river has been inundated with sediment, and the channel is deeply incised with highly erosive streambanks. The changes to the natural hydrology of the river have resulted in streambank erosion and depletion of habitat for native fish populations. Impacts to habitat and fish populations have affected other Arkansas River ecosystems, including federally endangered and threatened bird species that utilize the river's food sources and corridor.

The Arkansas River will continue to undergo degradation if existing environmental issues are not addressed. The Arkansas River Corridor Project includes restoration components that are intended to mitigate the impacts of growth and development, improve physical habitat and aquatic ecosystems, improve and maintain water quality and enhance public enjoyment of the river. A more detailed description of the project purpose and need will be prepared to support the development of the future environmental impact statement and Section 404 permitting process with the USACE.

Goals

The primary goals driving the Arkansas River Corridor Project are to establish greater connectivity between the river and surrounding communities, address flood damage reduction, improve and protect habitat for interior least terns *(Sterna antillarum athalassos)*, improve recreational opportunities, and improve the riverine system's functionality, primarily through the addition of two new low water dams, at Sand Springs and South

Tulsa/Jenks, and modifications to the existing Zink Dam. Other goals, which have been developed from proposed project concepts, include:

- Providing riverine habitat for small, non-migratory fish, such as shiners, minnows, darter and silversides
- Allowing upstream migration of striped bass, sauger, shovelnose sturgeon and paddlefish and downstream transport of eggs and larvae during the spawning season
- Improving aquatic habitat in the Arkansas River
- Increasing the diversity and abundance of macroinvertebrate and fish assemblages
- Allowing sediment transport downstream of dams and reducing lake sedimentation
- Minimizing impacts to fish species that are a source of food for interior least terns and other bird species
- Developing a recreational whitewater park at Zink Dam, and potentially at Sand Springs and Jenks/South Tulsa Dams

Project Components

The Arkansas River Corridor Project involves restoration components at seven key development sites between Keystone Dam and the Tulsa County/Wagoner County line. Restoration along this 42-mile reach of the Arkansas River would positively affect portions of several communities, including Sand Springs, Tulsa, Jenks, Bixby, and Broken Arrow, and would provide a variety of benefits outlined in the Phase II Master Plan. The current phase of the project includes modification of Zink Dam and the addition of two low water dams, at Sand Springs and South Tulsa/Jenks. These elements have been identified for funding by Tulsa County and the USACE and are detailed in the following section.

Because Keystone Dam, at the upstream end of the project area, currently blocks sediment transport, sediment is supplied from only three sources in the project reach: the channel bed, the channel banks, and the tributary inputs. The project would aim to minimize the sediment contribution from these sources and would also focus on sediment transport throughout the dam system. The low water dams would be operated in an integrated manner to optimize flow control through each individual dam, as well as through the overall river/lake system along the 42-mile reach of the Arkansas River. Dams would be engineered to eliminate safety hazards and to consider potential impacts from anthropo-genic sources, sedimentation, debris, Zebra mussels and historic flow regimes (Cherokee CRC, 2009, p. 26). Dams would also be engineered with consideration of public safety, fish passage and habitat restoration.

In addition to dam construction and modification, other components of the overall Arkansas River Corridor Project include: boating amenities in dam impoundments, fishing piers, pedestrian bridges, hiking and nature trails, water taxi transportation, whitewater recreation areas, retail development centers and public parks. Public access to all new project components would require linking the existing trail system to new access roads and trails.

Trails, boardwalks and pedestrian bridge concepts would be developed to provide convenient access to river crossings and to improve connectivity between the Arkansas River and nearby communities.

Proposed project components for the three key development sites included in this phase of the project are outlined below.

Zink Dam Modification and Riverfront

Zink Lake is a popular outdoor area that provides recreational opportunities and a festival venue for the Tulsa area. However, due to a lack of initial capital funding, Zink Dam has limited functionality to transport sediment downstream, resulting in sedimentation within Zink Lake and scour near the edges of the dam. Additionally, the dam structure, an ogee weir, has the potential to create an unstable and potentially unsafe hydraulic "roller" effect. Proposed improvements to Zink Lake include the installation of weir gates to improve sediment transport, fish passage, flood reduction and flow attenuation and to correct the roller effect. Various gate types, including Obermeyer, bascule and fuse, would be evaluated during the design phase of the project to identify the optimal design for this dam. Depending on the extent of sediment removal that can be achieved from dam modification, Zink Lake may also be dredged by local sand and gravel operators to remove additional sediment.

Zink Dam would be operated at a fixed or variable pool elevation as needed, made possible by equalizing low flow releases from the Sand Springs Dam. The dam could also be raised by 2 to 3 feet to expand the area of Zink Lake and provide additional recreational opportunities, including boating amenities and, potentially, a whitewater wave park. This would be achieved by the addition of 2-3 ft. high gates installed on the top of the existing dam. Their operation would control water depth as needed for rowing events, whitewater releases, low flow storage and augmentation. The McLaughlin Whitewater Design Group conducted a preliminary engineering analysis on rehabilitating the "Tulsa Wave," a unique whitewater wave effect that forms downstream of Zink Dam, in conjunction with developing a whitewater wave park (2007). Additionally, potential features at Zink Dam could include integration of design concepts that would yield benefits in addition whitewater recreation, in conjunction with fish passage, flow management, and sediment control.

In addition to dam modification, a major goal for the Zink Lake area is to "enhance physical and visual connections between the east and west banks" (Guernsey et al., 2005). The Phase II Master Plan involves improvements to the Zink Lake Riverfront as well as the development of new recreational opportunities. Current proposed project components in the Zink Lake area include:

Improved riparian habitat and shoreline beautification

- Increase lake depth to enhance the boating and rowing opportunities
- Consideration of a whitewater recreation facility and /or improvements to the existing "Tulsa Wave"

- Hiking and nature trails, with overlooks and observation points, on the east bank including maintenance and access
- Gathering place for rowing, whitewater and boat launching activities or observation.

Sand Springs Low Water Dam and Riverfront

The site proposed for construction of Sand Springs Dam is located downstream of Oklahoma Highway 97, at least 150 feet upstream of the confluence of Prattville Creek to avoid erosion impacts (Cherokee CRC, 2009). The dam would be approximately 11 to 12 feet high and would create a lake extending 5 miles upstream of the dam, to the Shell Creek area. Maintaining of a minimum downstream flow would be achieved by alternating the storage and release from the top 2 to 3 feet of the lake of the flows from Keystone Dam, and during periods of non-generation at Keystone Dam.. Assuming a daily release from Keystone Dam, Sand Springs Dam would allow between 400 and 1,000 cubic feet per second of flow and provide sufficient water for daily activities in the Tulsa and Jenks area (Cherokee CRC, 2009, p. 11).

Based on TVA guidance, an adjustable dam would be designed to allow for seasonal changes in flow and the creation of either a lake or river system (TVA, 2008). Sand Springs Dam would be designed to allow for a river system during the typical spawning season of the local fishery (March to June) and to allow for a lake system, providing recreational opportunities, during other months. Changes in dam height would be made possible by weir gates, such as Obermeyer, bascule or fuse gates. The seasonal river system would allow upstream fish migration as well as downstream transport of eggs and larvae to sustain fish propagation. The river system would also prevent land bridging and allow downstream sediment transport to maintain nesting island habitats for interior least terns. Additionally, when the lake is impounded, the bald eagle (*Haliaeetus leucocephalus*) population would be able to use both the lake and the area downstream of the dam for feeding.

While Sand Springs Lake would reduce downstream erosion, additional streambank stabilization methods would be used to protect streambanks during the spring season, when the dam is lowered. Streambank stabilization would involve a mix of bank "armor" and bio-remediation measures, as appropriate. "High risk areas" that could compromise the functioning of the dam, such as Prattville Creek, would be prioritized for erosion control. Eroding streambanks would also be prioritized for stabilization based on field reconnaissance of physical parameters and results of modeling analyses. Additionally, 3 acres of the creek would be converted to a created wetland to provide habitat for aquatic ecosystems and water quality improvement through vegetative filtering. Native planting to replace vegetation removed during project implementation, including the planting of American sycamores (*Platanus occidentalis*), or other tall trees, would provide additional habitat for bald eagles.

The Phase II Master Plan primary development goal of the Sand Springs Riverfront is "to provide a riverfront destination for retail and commercial services, and to improve the appearance of the City...and to provide recreational opportunities and aesthetic improvements to the area" (Cherokee CRC, 2009, p. 8). Development proposed in the Sand Springs area for the current phase of the project includes:

- New Low Water Dam with pedestrian bridge and fishing piers along w/ potential whitewater recreation opportunity.
- Boat ramp on the south bank to access the river below the dam, for public use, fish harvesting, and emergency access
- Hiking and nature trails and overlooks on the north and south banks

South Tulsa/Jenks Low Water Dam and Riverfront

The proposed South Tulsa/Jenks Dam would be constructed approximately 3,500 feet downstream of the Creek Turnpike and upstream of the Polecat Creek confluence. The low water dam would be approximately 8 to 9 feet in height and would create an impoundment approximately 3 miles long to afford boat access to the Creek Nation. South Tulsa/Jenks Dam would be operated at a fixed pool elevation, made possible by flow from Sand Springs Dam. As with Sand Springs Dam, TVA recommends an adjustable dam design in the South Tulsa/Jenks area, to allow for a river or lake system and to support fish passage. The South Tulsa/Jenks Dam design would be similar to the Sand Springs Dam design.

Erosion control methods would be used on nearby river reaches to reduce sedimentation and protect stream banks. These would consist of bank "armor" as well as vegetation measures to assure protection while maintaining both view and access. Bank stabilization measures would be implemented to protect Vensel Creek, primarily when the dam is lowered, and to protect Arkansas River embankments upstream and downstream of Jenks RiverWalk. For ecosystem restoration, the USACE recommends the planting of native shrubs and trees near the commercial development upstream of the Creek Turnpike and continued preservation of the existing Habitat Restoration and Bald Eagle Preserve near the 96th Street Bridge (Cherokee CRC, 2009).

The Phase II Master Plan primary development goal of the South Tulsa/Jenks area is the "creation of a retail and entertainment district on both sides of the river" (Cherokee CRC, 2009, p. 16). Proposed development in the South Tulsa/Jenks area, for the current phase of the project, includes:

- Low Water Dam with pedestrian bridge and fishing piers along w/ potential whitewater recreation opportunity.
- Boat ramp for public use, fish harvesting, and emergency access
- Constructed habitat beyond the upper reach of the lake and/or downstream of the dam to provide nesting habitat for interior least terns
- Ecosystem restoration with integrated hiking and nature trails

Projected Benefits

Through the creation of an integrated system of dams that optimize the functionality of the Arkansas River, in conjunction with beautification of its shorelines, the Arkansas River Corridor Project has the potential to restore and enhance aquatic, riparian, and terrestrial habitats as well as to improve the quality of life in nearby communities. Table 1 summarizes

the anticipated benefits of the project to Tulsa County communities; aquatic and riparian ecosystems; and water quality. Selected key benefits are described below.

The Arkansas River supports a prominent fishery providing valuable recreational opportunities to area residents. The Arkansas River Corridor Project design phase would include an evaluation of the upstream and downstream fish passage needs of migratory riverine species of potential interest to the Oklahoma Department of Wildlife Conservation (ODWC), the U.S. Fish and Wildlife Service (USFWS) and other stakeholders. Based on a review of life cycles, seasonal habitat needs and the availability of potentially suitable habitat, low water dams would be engineered with consideration of fisheries management goals and objectives for striped bass, paddlefish, sauger, shovelnose sturgeon and other native riverine species in the project area. Adjustable dams would allow for increased flow and upstream migration during the spring spawning season to promote fish propagation and protect other riverine ecosystems.

The USFWS has identified one federally threatened bird species, the piping plover (*Charadrius melodus*), and one federally endangered species, the interior least tern, that utilize the Arkansas River Corridor in the project area. In addition, the bald eagle, which was removed from the federal list of threatened and endangered species in 2007, maintains a habitat in the project area. The project would improve the habitat conditions of the interior least tern by preventing land bridging and protecting nesting islands from riparian predators, and plantings and preservation in riparian areas would increase the available habitat for the piping plover and bald eagle. The increase in fish assemblages associated with the project would also contribute to food resources available to threatened and endangered bird species.

Other benefits of the Zink, Sand Springs, and South Tulsa/Jenks low water dams and corresponding lakes include waterfront beautification, recreational opportunities such as fishing, boating, and potential whitewater sports, flow attenuation, flood reduction, downstream sediment transport, improvement of downstream habitat, mitigation of flashy river flows due to hydropower releases and protection of smaller non-migratory fish species.

TABLE 1
Expected Benefits of First Phase of Arkansas River Corridor Project

Expected Benefit	Project Component Related to Benefit
Community Benefits	
Improve the aesthetics of riverfront areas	Creation of new lake systems; pedestrian bridges and riverfront access; erosion control measures
Increase recreational opportunities	Creation of river/lake systems for fishing and boating; whitewater sporting venue from dam releases; boat access and fishing piers for accessible fishing; expansion of hiking and nature trails
Provide connectivity between communities and the resources of the Arkansas River	New road, trail and bridge systems

TABLE 1
Expected Benefits of First Phase of Arkansas River Corridor Project

Expected Benefit	Project Component Related to Benefit
Reduce flood-related hazards	Creation of integrated dam system engineered in compliance with Federal Emergency Management Agency (FEMA) regulations, to allow downstream flow without impacting the 100-year flood elevations
Increase habitat for recreationally important species, such as trout, bass, sunfish and catfish	Creation of weir pools
Ecosystem Benefits	
Allow upstream migration of fish species, such as striped bass, sauger, shovelnose sturgeon and paddlefish during critical seasons	Adjustable dams, with weir gates, that allow for lake or river systems
Allow downstream transport of eggs and larvae from spawning habitat to nursery habitat	Adjustable dams that allow for river systems and maintained minimum flow during spawning season
Improve and maintain habitat for smaller non-migrating fish species (shiners, minnows, darters, silversides)	Minimum flows provided by dams; mitigation of flashy flow caused by hydropower operations
Protect least tern nesting areas	Minimum flows provided by dams to eliminate land bridging; downstream sediment transport provided by dams; protection of nesting islands through the creation of river/lake system
Increase the foraging areas for bird species, such as least tern, bald eagle and piping plover	Seasonal dams to allow continued spawning of minnow species; minimum flows provided by dams to increase the habitat for fish that contribute to least tern food resources
Increase aquatic habitat	Construction of created wetlands
Improve habitat for bald eagles	Riparian planting of American sycamores or other tall trees
Restore and maintain ecosystems	Preservation of riparian areas, native plantings, expansion of parks and nature areas
Provide stable habitat during low flow conditions	Minimum flows provided by dams; mitigation of flashy flow caused by hydropower operations; addition of weir pools
Aid fish production to benefit predators found along the Arkansas River Corridor, such as bald eagle, piping plover and interior least tern	Minimum flows provided by dams; mitigation of flashy flow caused by hydropower operations; addition of weir pools
Water Quality Benefits	
Improve water quality to restore the river to meet its designated use	Riparian preservation and plantings to reduce stormwater runoff; streambank stabilization
Reduce streambank erosion and instream sedimentation	Streambank stabilization methods
Improve the riverine system's functionality and restore the river to a more natural state	Integrated network of dams

TABLE 1
Expected Benefits of First Phase of Arkansas River Corridor Project

Expected Benefit	Project Component Related to Benefit
Increase dissolved oxygen concentrations necessary for small fish species	Minimum flows provided by dams
Decrease sedimentation in impoundments	Modified and new dams engineered with consideration of sandy nature of substrate and soil in floodplains

Estimated Project Cost and Potential Funding Sources

Approval of Proposition 4 of the Tulsa County 2025 sales tax initiative in 2003 authorized $9.5 million in sales tax revenues for partial funding of the Arkansas River Corridor Project. The Phase II Master Plan provides preliminary cost estimates for the project that can be used for initial planning purposes. Table 2 outlines the cost estimate for elements of the first phase of the project based on the Master Plan (2005) and updates provided in the TVA Report (2007). While Proposition 4 revenue would provide resources for a portion of the Arkansas River Corridor Project, other potential funding sources would need to be identified to develop multiple project phases.

"A variety of possible development tools and funding sources have been identified including cost-share scenarios with federal, state and local entities, funding from non-governmental organizations, and the establishment of tax increment financing districts. River oriented development could also generate its own revenue stream through enhanced property values and induced sales tax, thus adding value to the Greater Tulsa area, and attracting visitors from near and far" (Guernsey et al., 2005, p. ES-3). A variety of potential funding sources is outlined in the Phase II Master Plan (Guernsey et al., 2005, p. 219), including:

- Section 206, Water Resources Development Act of 1996
- Section 22, Water Resources Development Act of 1974
- Section 208, Flood Control Act of 1954
- Section 14, Flood Control Act of 1946
- Section 1135, Water Resources Development Act of 1986
- Section 205, Flood Control Act of 1948
- Section 206, Flood Control Act of 1960

These funding sources, as well as others, should be evaluated for portions of the Arkansas River Corridor Project that remain unfunded and for potential sponsorships during future project phases.

TABLE 2
Estimated Construction Costs for Components of the First Phase of Arkansas River Corridor Projects

Project Improvements	Source	
	Master Plan 2006	**TVA Sept 2007**
Sand Springs		
Low Water Dam (11 ft)	$ 17.459	$ 40,514
Pedestrian Bridge	$ 3.400	$ 7.870
Fish passage / Recreation		
Habitat Restoration / Bank Stabilization		
Right-of-Way		
Zink Lake		
Weir Modification & Gates	$ 2.100	$ 5.819
Tulsa Whitewater Park (4/07)	$ 1.500	$ 1.500
Shoreline Beatification		
Fish passage / Recreation		
Habitat Restoration / Bank Stabilization		
Right-of-Way		
Jenks / South Tulsa		
Low Water Dam (8 ft)	$ 17.459	$ 27.634
Pedestrian Bridge	$ 3.400	$ 7.870
Fish Passage / Recreation		
Habitat Restoration / Bank Stabilization		
Right-of-Way		
Total Project	$ 45.318	$ 91.207

Note- Shading indicates elements not included past project cost estimates.

References

Carter Burgess. 2004. Final Arkansas River Corridor Master Plan, Phase I Vision Plan. Prepared for Indian Nations Council of Governments (INCOG).

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