

ARKANSAS RIVER CORRIDOR

Appendix G - Civil Engineering

22 August 2016

ARKANSAS RIVER CORRIDOR, TULSA COUNTY, OKLAHOMA

Introduction

The Arkansas River is a water resource serving numerous nationally significant purposes. The river has historically served as a nationally significant resource for aquatic and terrestrial habitat of the nation's wildlife that live, breed, and migrate through the Arkansas River ecosystem. This includes federally endangered Interior Least Tern (Least Tern, *Sterna antillarum*), a nationally significant resource, and two federally threatened bird species, the Piping Plover (*Charadrius melodus*) and the Red Knot (*Calidris canutus rufa*) as well as a plethora of native species and migratory waterfowl that support a healthy and functional riverine ecosystem. Keystone Lake and its dam located along the Arkansas River also play vital roles in supporting the continued provision of many of those multi-purposes. In particular, the lake and dam provide flood risk management benefits, contribute to the eleven reservoir system operation of the McClellan-Kerr Arkansas River Navigation System, provide clean and efficient power through the associated hydropower plant, and provide a source of water for municipal and industrial uses. However, construction, operation, and maintenance of the Keystone Dam, lake, associated hydropower operations, and other multi-purposes have significantly degraded the riverine ecosystem structure, function, and dynamic processes below Keystone Dam on the Arkansas River within Tulsa County, Oklahoma.

Stage of Planning Process

This is a feasibility study. A planning Charette was conducted in October 2013, and an Alternatives Milestone Meeting was completed in September 2015. The study is in the Alternative Formulation and Analysis Phase. Utilizing a reasonable level of detail, the PDT has analyzed, compared, and evaluated the array of alternatives to identify a Tentatively Selected Plan for consideration by the Vertical Team.

Study Authority

The Arkansas River Corridor study is authorized in the Water Resources Development Act (WRDA) of 2007, Section 3132.

Section 3132. Arkansas River Corridor.

- (a) IN GENERAL. – The Secretary is authorized to participate in the ecosystem restoration, recreation, and flood damage reduction components of the Arkansas River Corridor Master Plan dated October 2005. The Secretary shall coordinate with appropriate representatives in the vicinity of Tulsa, Oklahoma, including representatives of Tulsa County and surrounding communities and the Indian Nations Council of Governments.
- (b) AUTHORIZATION OF APPROPRIATIONS. – There is authorized to be appropriated \$50,000,000 to carry out this section.

Non-Federal Sponsor

Tulsa County is the non-federal sponsor for the Arkansas River Corridor feasibility study. An amended feasibility cost-sharing agreement was executed in May 2015.

Purpose

This study is in response to the Section 3132 authorization of the 2007 WRDA. The purpose of this study is to evaluate the aquatic ecosystem restoration components of the October 2005 Arkansas River Corridor Master Plan (ARC Master Plan) and determine if there is a Federal Interest that aligns with the Corps of Engineers ecosystem restoration mission.

CIVIL ENGINEERING APPENDIX

GENERAL DESCRIPTION

Civil engineering efforts were conducted as part of this study with the purpose of developing conceptual engineering designs, sketches, and quantities to provide a foundation for the development of a government estimate as well as a visualization of the selected alternatives. During the study, multiple alternatives were considered and ruled out when evaluated against the level of environmental impact they would potentially provide. Below is a list of the final alternatives considered under the civil engineering efforts as well as sketches and summaries for each alternative:

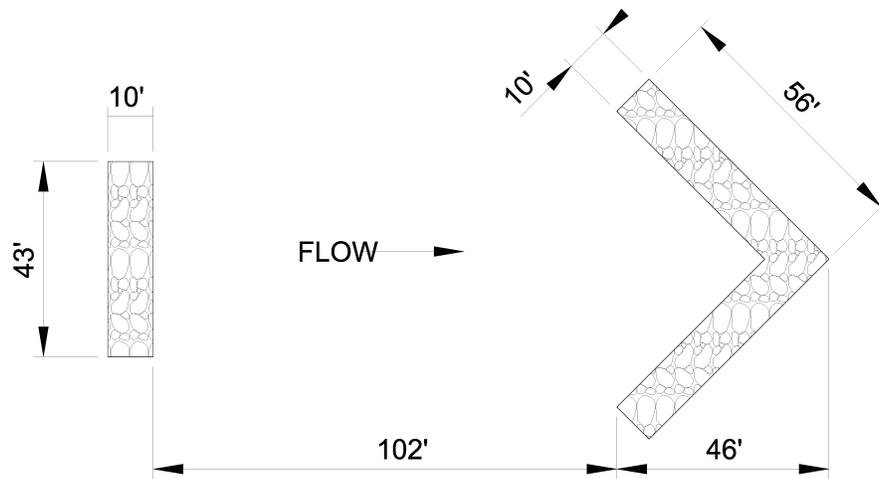
ALTERNATIVES:

- A. Least Tern Island
- B. Cherry Creek Rip Rap and Plantings
- C. Prattville Creek Rock Riffle
- D. Prattville Creek Rock Riffle + Riparian Plantings
- E. Prattville Creek Rock Riffle + Wetland Plantings
- F. Prattville Creek Rock Riffle + Riparian Plantings + Wetland Plantings
- G. I-44/Riverside Wing Deflectors + Rock Riffle
- H. I-44/Riverside Wing Deflectors + Rock Riffle + Riparian Plantings
- I. I-44/Riverside Wing Deflectors + Rock Riffle + Wetland Plantings
- J. I-44/Riverside Wing Deflectors + Rock Riffle + Riparian Plantings + Wetland Plantings

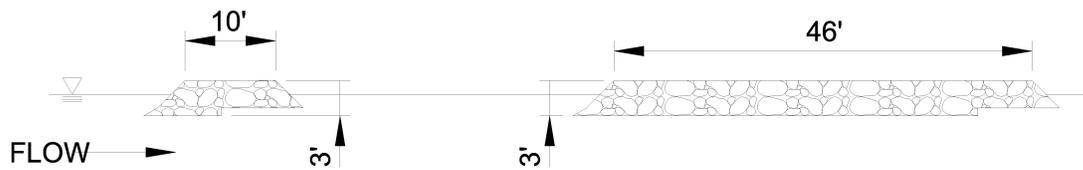
SUMMARY OF ALTERNATIVES

Least Tern Island: In 2003, the Oklahoma State University Biosystems Engineering Senior Design Team was selected by the U.S. Army Corps of Engineers (USACE) Tulsa District to conduct an analysis for the design of a least tern nesting habitat and the optimal location along the Arkansas River for implementation. The preliminary cost estimate was generated using the design criteria provided in the final report titled, "Designing an Island Habitat for the Interior Least Terns". The design criteria and critical features of work are summarized below.

The original analysis considered four separate design configurations and the design team constructed small scale flume models for testing and collecting data. From this analysis, it was recommended that the configuration shown in SK-1 be constructed near 121st street, south of the City of Jenks, Oklahoma at the approximate location shown in SK-2. The final report recommended the use of 30" diameter stones.



LEAST TERN ISLAND PLAN



LEAST TERN ISLAND PROFILE  30" DIAM. RIP RAP

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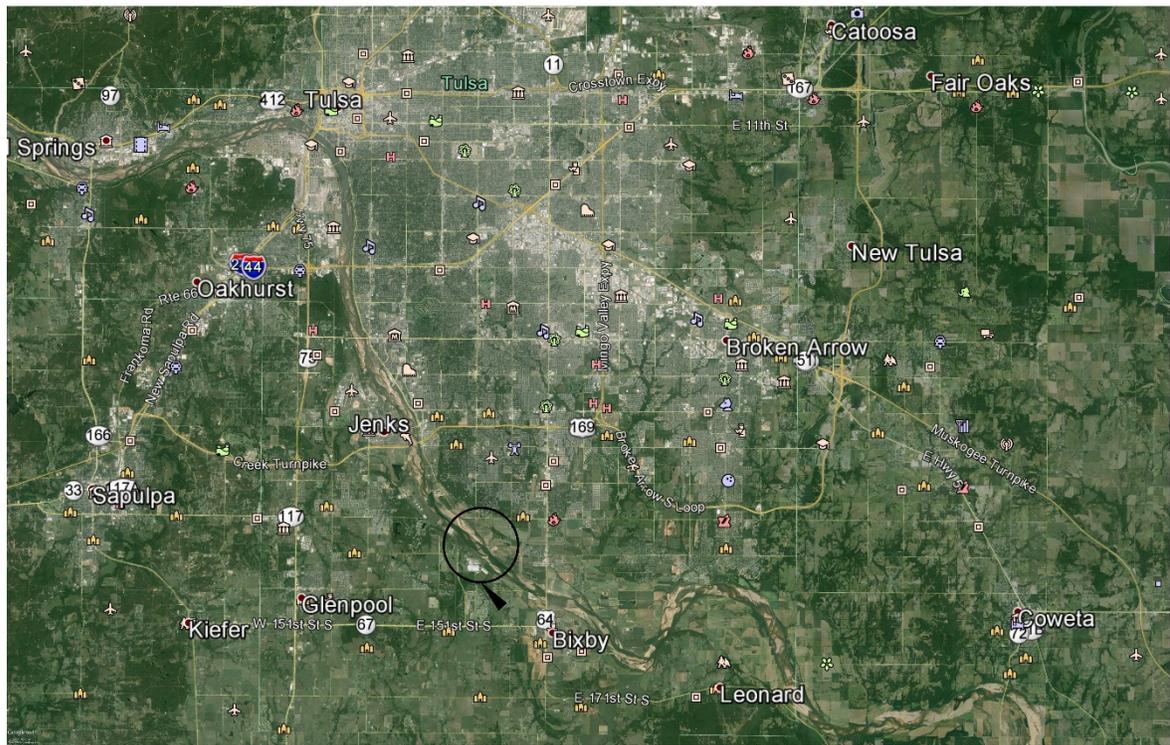


**ARKANSAS RIVER CORRIDOR
LEAST TERN ISLAND CONCEPT**

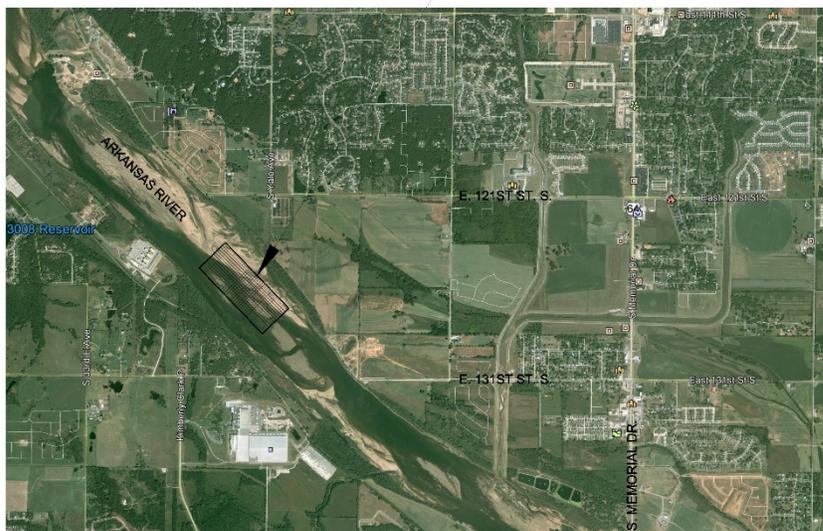
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SCALE: NOT TO SCALE

DATE: 08/15/2016
DRAWING: SK-1





— LEAST TERN ISLAND LOCATION



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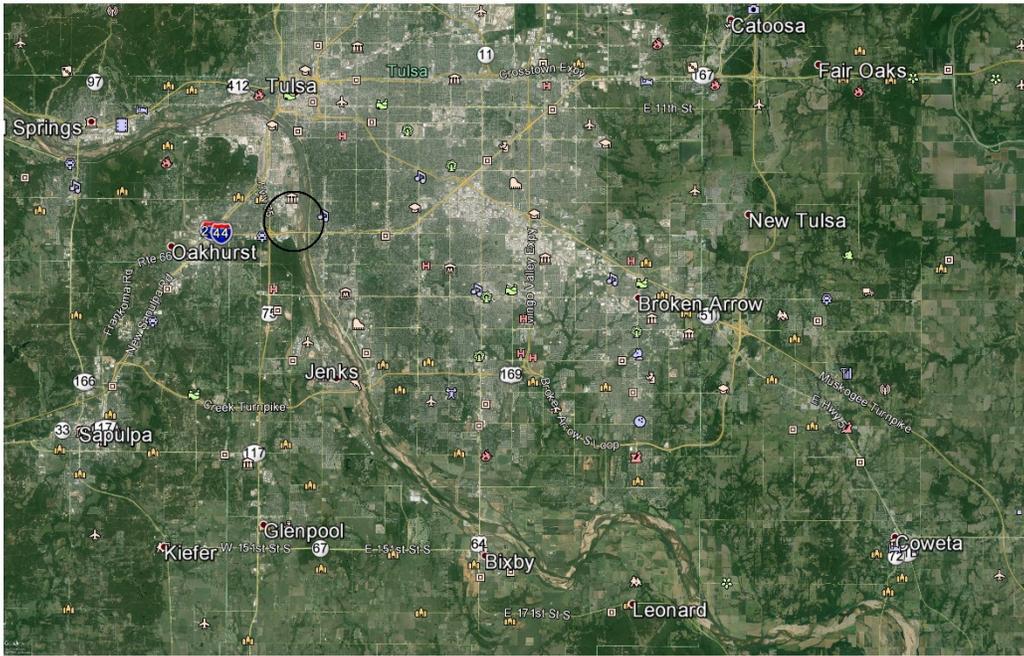
**ARKANSAS RIVER CORRIDOR
LEAST TERN ISLAND CONCEPT**

DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/15/2016
DRAWING: SK-2



Cherry Creek Rip Rap + Plantings: Cherry Creek is located north of I-44 on the west bank of the Arkansas River. This alternative includes the design and placement of riprap along the southern embankment of the Creek as well as riparian plantings along the north and south banks in order to stabilize the embankment and to provide a more natural aquatic habitat for wildlife. A typical section of the riprap design and plantings, shown in SK-3 below, consists of 6” bedding stone placed under 24” diameter riprap with approximately 2,750 brush willow plantings throughout the existing and newly placed riprap.



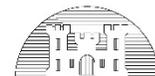
U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

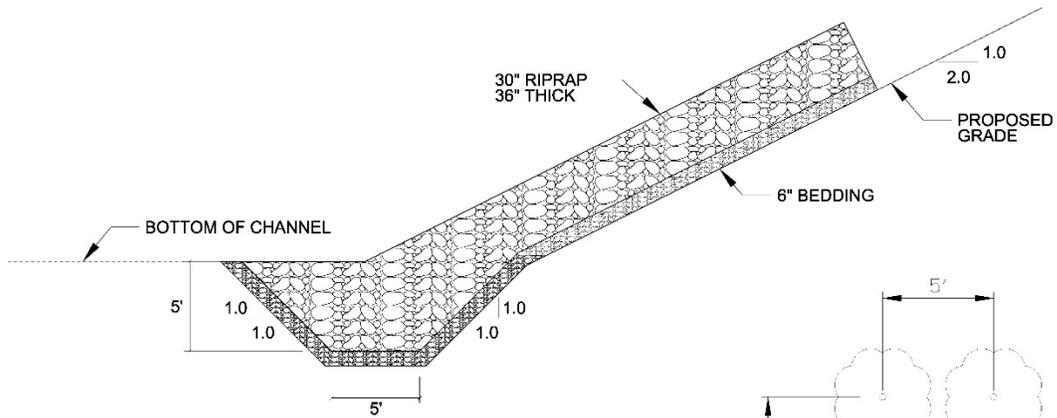
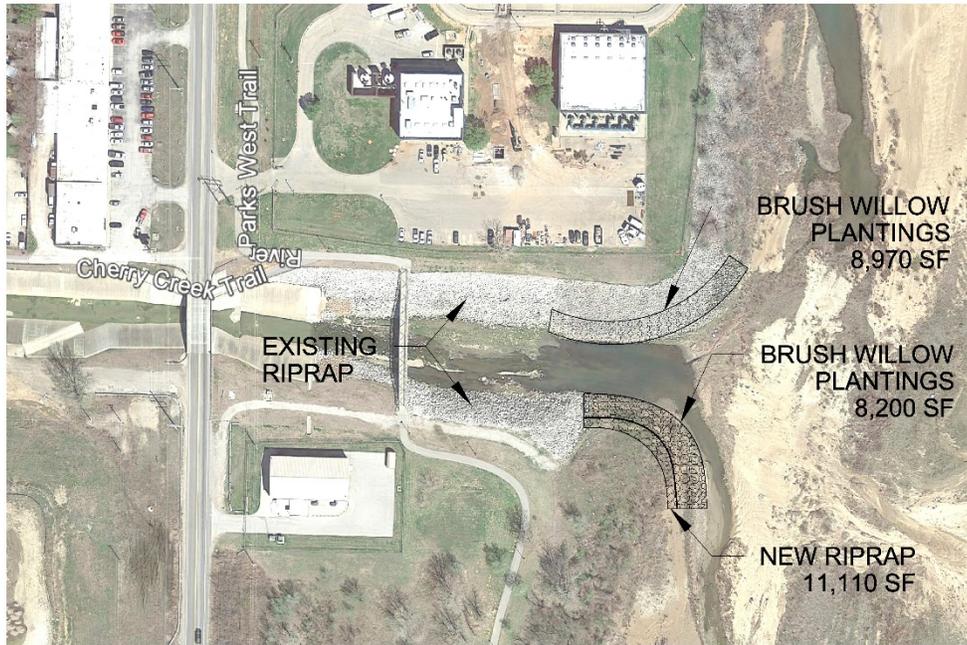
**ARKANSAS RIVER CORRIDOR
CHERRY CREEK RESTORATION**



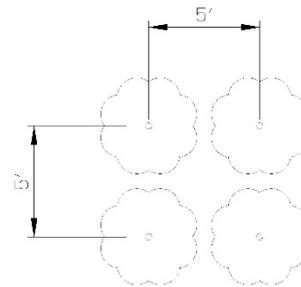
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SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-3





TYPICAL RIPRAP CROSS SECTION



BRUSH WILLOW SPACING

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

**ARKANSAS RIVER CORRIDOR
CHERRY CREEK RESTORATION**



DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-4

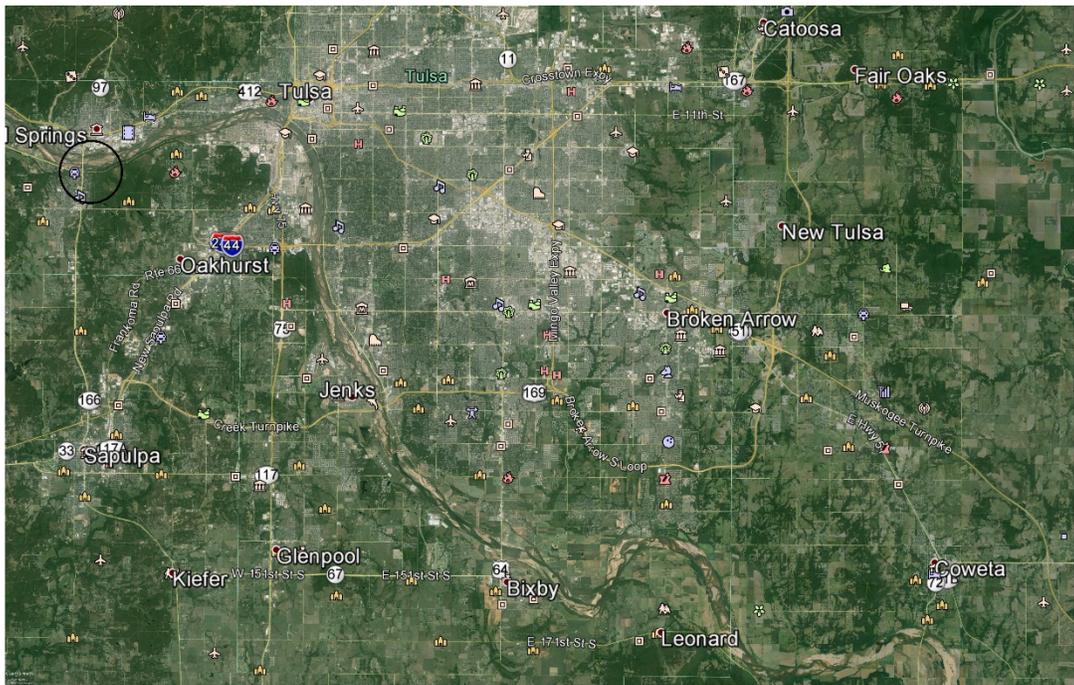


Prattville Creek Rocked Riffle and Riprap: Prattville Creek is located east of Highway 97 on the south bank of the Arkansas River in Sand Springs, Oklahoma. The ground elevation is at approximately 634 feet with a mouth width of approximately 80' (according to Google Earth). This alternative includes the construction of a rocked riffle structure made of size 24" riprap with a 6" thick aggregate bedding as well as lining the southern embankment with size 12" riprap. The preliminary design details are shown in SK-5 and SK-6 below. The calculated total for the size 24" riprap was calculated to be approximately 600 ton and the calculated total for the size 12" riprap was approximately 1,810 ton.

Prattville Creek Rock Riffle + Riparian Plantings: This alternative includes the design and construction of the rocked riffle and riprap listed in the above alternative, with the addition of riparian type plantings. For this area, the riparian plantings are comprised of Red-Osier Dogwood trees and Brush Willows which have a minimum height of 3'-4' and a minimum caliper of 1". It is calculated that this alternative will require approximately 15,600 plants across the creek's embankment in order to restore the native habitat for wildlife. Design drawings for the plantings and rock structures are shown in SK-5 and SK-6 below.

Prattville Creek Rock Riffle + Wetland Plantings: This alternative includes the design and construction of the rocked riffle and riprap listed in the above alternative, with the addition of wetland type plantings. For this area, the wetland plantings are comprised of ornamental grasses. It is calculated that this alternative will require approximately 6,960 plants across the creek's embankment in order to restore the native habitat for wildlife. Design drawings for the plantings and rock structures are shown in SK-5 and SK-6 below.

Prattville Creek Rock Riffle + Riparian Plantings + Wetland Plantings: This alternative includes the design and construction of the rocked riffle and riprap listed in the above alternative, with the addition of the riparian planting alternative and the wetland planting alternative. Design drawings for the plantings and rock structures are shown in SK-5 and SK-6 below.



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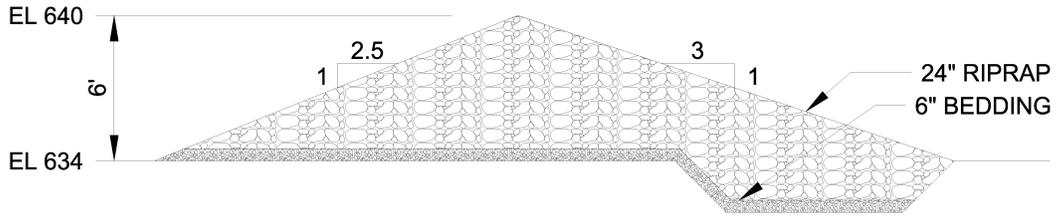
**ARKANSAS RIVER CORRIDOR
PRATTVILLE CREEK**



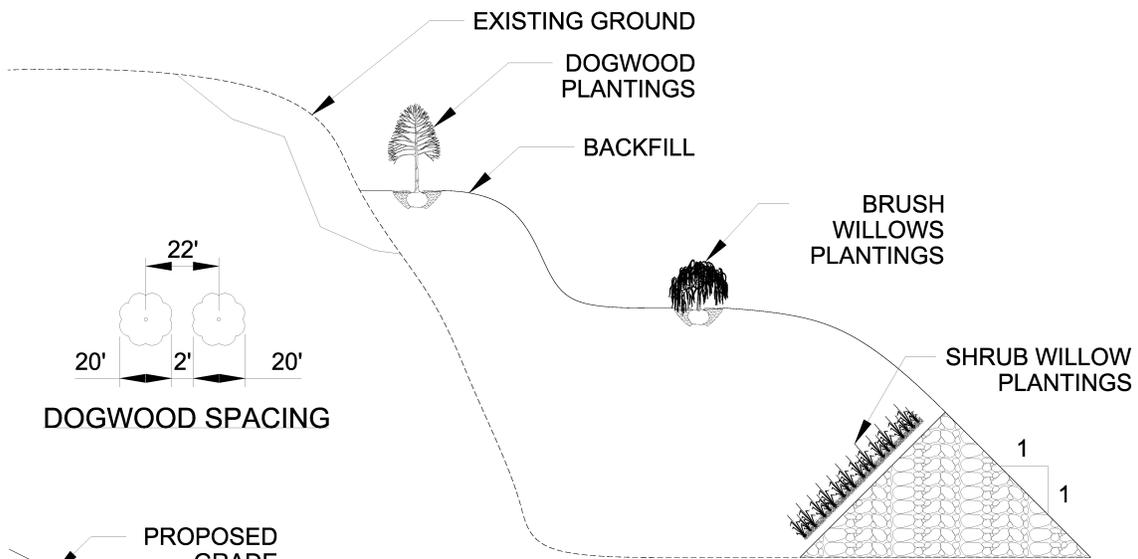
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DATE: 08/16/2016
DRAWING: SK-5

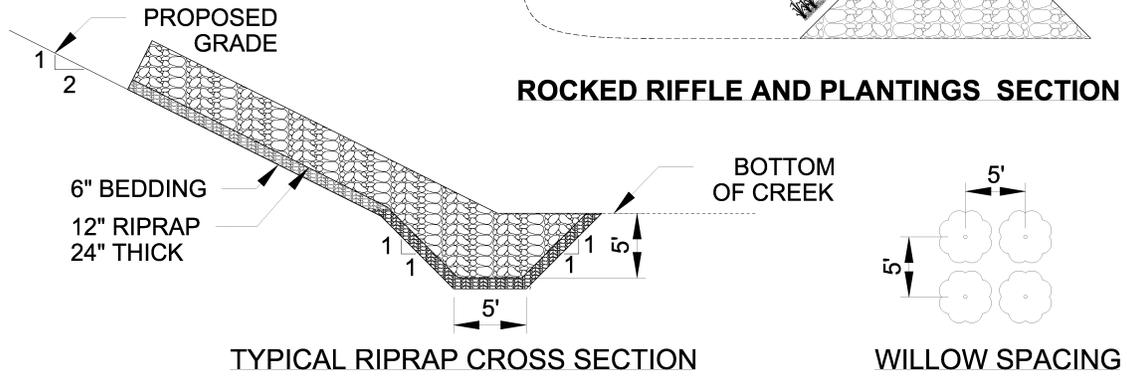




ROCKED RIFFLE CROSS SECTION



ROCKED RIFFLE AND PLANTINGS SECTION



TYPICAL RIPRAP CROSS SECTION

WILLOW SPACING

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

**ARKANSAS RIVER CORRIDOR
PRATTVILLE CREEK**



DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-6

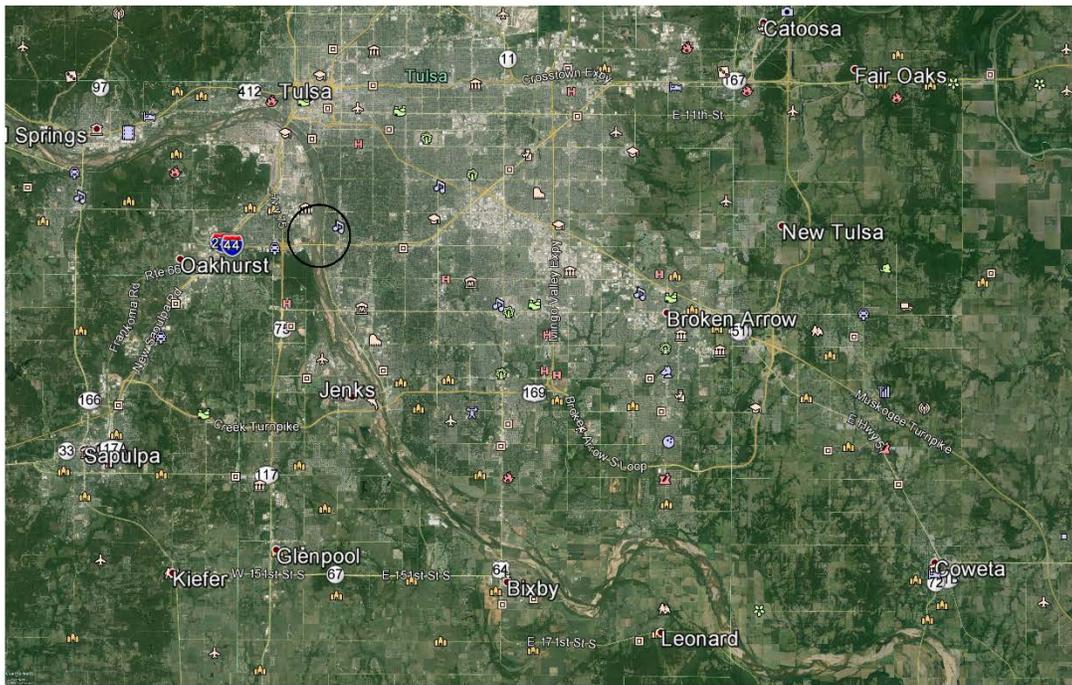


I-44/Riverside Wing Deflectors + Rock Riffle: Three slack water side channels exist along the eastern bank of the Arkansas River at the northwest corner of the intersection between Riverside Drive and Interstate 44. This alternative includes the design and construction of rocked riffle structures and stone wing deflectors within these channels in order to help control erosion and restore the native habitat for wildlife. The rocked riffle design is similar to that of the Cherry Creek structure and can be seen in SK-8 and SK-9 below. The wing deflectors are comprised of size 24" riprap structures which protrude 1/5th of the width of the river at an angle of 20 degrees as shown in SK-8. The combination of these designs prevent the river flows from eroding away the embankment. The preliminary design considered a river flow of 12,000 cubic feet per second (cfs) to 15,000 cfs. The structure is designed to be overtopped during higher flow events.

I-44/Riverside Wing Deflectors + Rock Riffle + Riparian Plantings: This alternative includes the design and construction of the rocked riffle and wing deflectors listed in the above alternative, with the addition of riparian type plantings. For this area, the riparian plantings are comprised of Red-Osier Dogwood trees and Brush Willows which have a minimum height of 3'-4' and a minimum caliper of 1". It is calculated that this alternative will require approximately 11,100 plants across the creek's embankment in order to restore the native habitat for wildlife. Design drawings for the plantings and rock structures are shown in SK-7, SK-8, and SK-9 below.

I-44/Riverside Wing Deflectors + Rock Riffle + Wetland Plantings: This alternative includes the design and construction of the rocked riffle and wing deflectors listed in the above alternative, with the addition of wetland type plantings. For this area, the wetland plantings are comprised of ornamental grasses. It is calculated that this alternative will require approximately 9,000 plants across the creek's embankment in order to restore the native habitat for wildlife. Design drawings for the plantings and rock structures are shown in SK-7, SK-8, and SK-9 below.

I-44/Riverside Wing Deflectors + Rock Riffle+ Riparian Plantings + Wetland Plantings: This alternative includes the design and construction of the rocked riffle and wing deflectors listed in the above alternative, with the addition of the riparian planting alternative and the wetland planting alternative. Design drawings for the plantings and rock structures are shown in SK-7, SK-8, and SK-9 below.



U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

**ARKANSAS RIVER CORRIDOR
I-44/RIVERSIDE LOCATION**



DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-7





U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

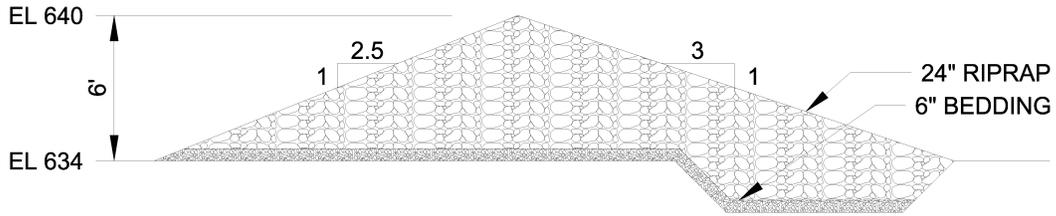
**ARKANSAS RIVER CORRIDOR
I-44/RIVERSIDE LOCATION**



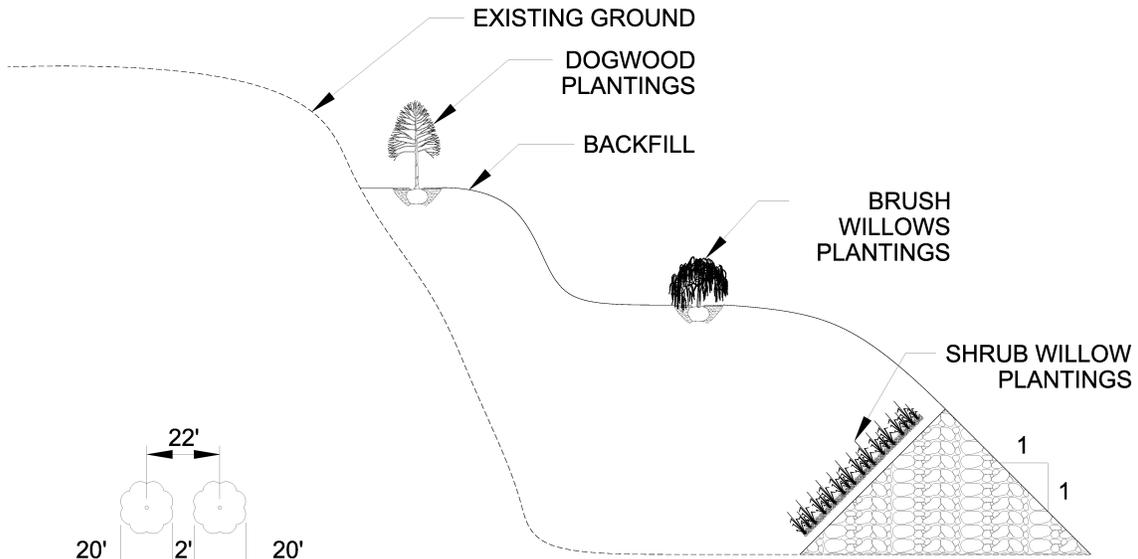
DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-8

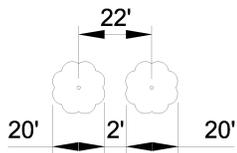




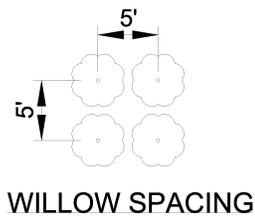
ROCKED RIFFLE CROSS SECTION



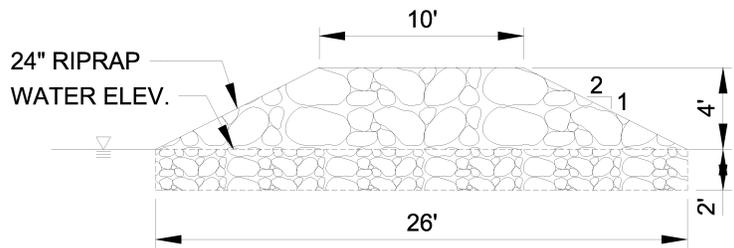
DOGWOOD SPACING



ROCKED RIFFLE AND PLANTINGS SECTION



WILLOW SPACING



TYPICAL WING DEFLECTOR CROSS SECTION

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

**ARKANSAS RIVER CORRIDOR
I-44/RIVERSIDE LOCATION**



DESIGNER: N/A
SCALE: NOT TO SCALE

DATE: 08/16/2016
DRAWING: SK-9

