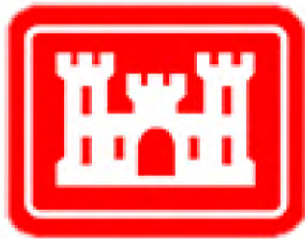


**Draft**  
**Appendix A**  
**Mitigation Plan**

Webbers Falls Pool and Robert S. Kerr Pool  
Emergency Dredging and Open Water Disposal

Arkansas River Basin  
Rogers, Wagoner, Cherokee, Muskogee, Haskell, Sequoyah, and Le Flore  
Counties,  
Oklahoma

August 2021



Tulsa District  
U.S. Army Corps of Engineers

## Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
<b>2</b>	<b>Objectives .....</b>	<b>2</b>
<b>3</b>	<b>Impacted Habitat Types .....</b>	<b>3</b>
<b>4</b>	<b>Site Selection and Baseline Information.....</b>	<b>4</b>
<b>4.1</b>	<b>Preferred Mitigation Sites.....</b>	<b>5</b>
<b>4.2</b>	<b>Cultural Resources Effects and Standby Mitigation Sites .....</b>	<b>10</b>
<b>4.3</b>	<b>Proposed Mitigation Site Protection.....</b>	<b>12</b>
<b>4.4</b>	<b>Mitigation Work Plan .....</b>	<b>13</b>
4.4.1	Grading Plan.....	14
4.4.2	Desired Plant Community .....	15
4.4.3	Control of Invasive Species.....	17
<b>5</b>	<b>Maintenance Plan .....</b>	<b>18</b>
<b>6</b>	<b>Performance Standards .....</b>	<b>19</b>
<b>7</b>	<b>Monitoring.....</b>	<b>21</b>
<b>8</b>	<b>Long-term Management Plan .....</b>	<b>22</b>
<b>9</b>	<b>Adaptive Management Plan.....</b>	<b>22</b>
<b>10</b>	<b>Financial Assurances .....</b>	<b>26</b>
<b>11</b>	<b>References.....</b>	<b>27</b>
<b>12</b>	<b>List of Preparers.....</b>	<b>27</b>

## List of Figures

Figure 1.	McClellan-Kerr Arkansas River Navigation Study Area .....	1
Figure 2.	West of Muskogee Turnpike Mitigation Site.....	5
Figure 3.	E0960 Mitigation Site .....	6
Figure 4.	North I40 Mitigation Site .....	7
Figure 5.	Drake Road Mitigation Site.....	8
Figure 6.	Missouri Pacific Railroad East Mitigation Site.....	9
Figure 7.	Missouri Pacific Railroad West Mitigation Site.....	10
Figure 8.	CR 4530 Standby Mitigation Site.....	11
Figure 9.	Tract 1304 Standby Mitigation Site.....	12

## **List of Tables**

Table 1. Habitat Type, Acres Impacted, Ratio, and Required Mitigation Acreage Associated with the Emergency Action .....	3
Table 2. Desired Plant Community for the Mitigation Plan.....	15
Table 3. Mitigation Plan Costs.....	26

## **List of Attachments**

- Attachment A – Project and Mitigation Area Photos
- Attachment B – Grading Plan
- Attachment C – Security Fence Specifications
- Attachment D – Nationwide Standard Conservation Measures

# 1 Introduction

This Compensatory Mitigation Plan has been prepared by the United States Army Corps of Engineers (USACE), Tulsa District (SWT) to assess and relay the mitigation, monitoring, and adaptive management requirements of the McClellan-Kerr Arkansas River Navigation System (MKARNS) Emergency Action. The Plan has been prepared as part of the after-action assessment of the work conducted by SWT to dredge and dispose of sediment from the MKARNS. Additional information about the work conducted for the Emergency Action can be found in the Draft Environmental Assessment.

The Emergency Action occurred in the Arkansas River Basin in Rogers, Wagoner, Cherokee, Muskogee, Haskell, Sequoyah, and Le Flore counties in Oklahoma (Figure 1).

This Plan describes the ecological objectives, the methods to accomplish the objectives, baseline and mitigation site information, performance standards associated with accomplishing the objectives, monitoring, adaptive management, and long-term maintenance.



**Figure 1. McClellan-Kerr Arkansas River Navigation Study Area**

Tulsa District Regulatory Office (RO), in implementing USACE or permit applicant obligations under Section 404 of the Clean Water Act (CWA) or Section 10 of the Rivers and Harbors act, utilizes regulations under 33 Code of Federal Regulations (CFR) Part 332. The purpose of 33 CFR 332 is “to establish standards and criteria for the use of all types of compensatory mitigation, including on-site and off-site permittee-responsible mitigation, mitigation banks, and in-lieu fee mitigation to offset unavoidable impacts to waters of the United States authorized through issuance of Department of the Army (DA) permits pursuant to section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344) and/or sections 9 or 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401, 403).”

While Part 332 is written as a forward looking mitigation planning tool, predicated on the idea that permit applicants will complete mitigation analysis as part of the 404 permit process, SWT RO regularly applies these regulations as part of the Section 404 CWA permit process. Application of part 332 through standard RO processes are in place to allow for determinations of appropriate mitigation strategies and requirements on an after-the-fact basis. Because this project is being funded with supplemental Operations and Maintenance funding, the use of 33 CFR 332 is legally sufficient regarding mitigation.

## 2 Objectives

The mitigation of the Emergency Action will require a multitude of actions to adequately compensate the ecosystem of the MKARNS. In coordination with SWT RO, Table 1 displays the ratio required to compensate the adverse impacts as well as the resulting acres required to mitigate the action.

There has been a major temporal loss associated with impacts to forested wetlands and the amount of time that the mitigation will take to fully develop, SWT RO recommended that the impacts to this habitat type should be higher than the normal 1.5:1 ratio minimum typically required based on the *Compensatory Mitigation for Losses of Aquatic Resources* [33 CFR 332]. For restoration or enhancement, a 4.5:1 ratio would result in a net gain of 8.4 acres of forested wetlands for a total of 10.8 acres. Preservation is not applicable to this habitat type because the area impacted was already preserved/protected as a State Wildlife Management Area (WMA) under ODWC.

The information above also applies to emergent wetlands. For restoration or enhancement, a minimum of 2.5:1 ratio would be appropriate. This ratio would result in a net gain of 47.1 acres of emergent wetland for a total of 78.5 acres. Preservation is not applicable to this habitat type because the areas associated with the adverse impact were located within a State WMA or the Sequoyah National Wildlife Refuge (NWR).

The SWT RO Mitigation and Monitoring Guidelines addresses “Lake Impacts” which will require a minimum mitigation ratio of 1:1 where the area of impact exceeds 1/10<sup>th</sup> of an acre. Mitigation may be achieved through enhancements of existing lake areas, environs, water quality, or aquatic habitat function (creation of threatened and endangered species habitat, maintenance herbicide spraying, etc.). It is not necessary to physically manipulate the adjoining landscape to enlarge open water areas.

Although open water disposal did occur, the transport of this material was an unavoidable natural phenomenon and sediment was moved from one place within the MKARNS to another to allow continued navigation within the channel. This action created new interior least tern (*Sterna antillarum athalassos*) nesting habitat, replaced lost nesting sandbar islands, and increased the degree of aquatic habitat heterogeneity (e.g., water depths, shallow water habitat, flow refugia) relative to that present before the 2019 flood. The open water impacts as described are considered self-mitigation by the SWT Operations Division. The interior least tern was a listed species at the time of the flood and nesting habitat creation was a major focus of dredge disposal during the planning and mitigation phases of the emergency dredging. Therefore, open water mitigation will not occur as a result of the Emergency Action and will not be described in further detail.

In total, there were 10 acres of bottomland hardwood forest, 2.4 acres of forested wetland, 31.4 acres of emergent wetland, and 288.2 acres of open water habitat impacted by the Emergency Action. Because this action was used to address the sedimentation of the MKARNS, many adverse impacts were unavoidable.

**Table 1. Habitat Type, Acres Impacted, Ratio, and Required Mitigation Acreage Associated with the Emergency Action**

Habitat Type	Impacted Acres	Mitigation Ratio	Required Mitigation Acres	Mitigation Method
Bottomland Hardwood	10	1.5:1	15	Creation
Forested Wetland	2.4	4.5:1	10.8	Creation
Emergent Wetland	31.4	2.5:1	78.5	Creation
Open Water	288.2	1:1	288.2	Self-Mitigating

The objective of the bottomland hardwood and wetland mitigation is to create a minimum 15 acres of former bottomland hardwood forest, 10.8 acres of forested wetland, and 78.5 acres of emergent wetland in an area that would not be adversely impacted by creation of this habitat and would be self-sustaining upon completion of mandatory monitoring and adaptive management guidelines. The objectives of SWT Operations Division to compensate the loss of bottomland hardwood and wetland habitat are listed below.

- Establishment of native plant communities for wildlife.
  - Bottomland hardwood - Planting of herbaceous vegetation, shrubs, and trees
  - Forested Wetland - Planting of emergent wetland vegetation along with shrubs and trees
  - Emergent wetland - Planting of emergent wetland vegetation
- Develop and maintain hydrologic characteristics for created habitats

### 3 Impacted Habitat Types

Habitat types impacted by the Emergency Action include bottomland hardwood, forested wetlands, emergent wetlands, and open water. A description of each habitat type is discussed below.

The bottomland hardwood forest community occurs within the floodplain of the Arkansas River or in riparian areas immediately adjacent to small streams. The dominant bottomland hardwood trees include cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), pecan (*Carya illinoensis*), box elder (*Acer negundo*), river birch (*Betula nigra*), black willow (*Salix nigra*), silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), sugarberry (*Celtis laevigata*), water oak (*Quercus nigra*), overcup oak (*Quercus lyrata*), and willow oak (*Quercus phellos*). Bald cypress (*Taxodium distichum*) is also common.

Emergent wetlands provide food and shelter for fish and wildlife species, including macroinvertebrates, which make up the foundation of the aquatic food chain, and habitat for various amphibians, reptiles, birds, and insects. Frogs and salamanders use emergent wetlands for breeding grounds and 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. Since these wetland communities are found in lower elevations, or are associated with more permanent open water habitats, they have been the

most susceptible to disruptive and unnatural flow regimes resulting from the construction and operation of the lock and dam system within the MKARNS. Emergent wetland vegetative species within the project areas included cattail (*Typha spp.*), smartweed (*Polygonum spp.*), nutsedge (*Cyperus spp.*), soft rush (*Juncus effusus*), and other unidentified rushes.

Forested wetlands are open, occasionally flooded areas dominated by shrub and hardwood saplings mixed with emergent herbaceous vegetation. Forested wetlands provide shelter, food, and nesting habitat for a variety of wildlife. These wetland communities are found at elevations slightly above emergent wetland communities and adjacent to riverbanks where less frequent inundation by flows and reduced scour allows shrub and sapling strata to establish. Forested wetland tree species included American sycamore, elm (*Ulmus spp.*), green ash, and black willow. Emergent wetland vegetation within the forested wetland habitats included soft rush, and shrubby species like buttonbush (*Cephalanthus occidentalis*).

Open water areas are characterized by deep water where light does not generally penetrate all the way to the bottom of the river or lake. The productivity of this zone largely depends upon the organic content of the sediment, the amount of physical structure, and in some cases upon the rate of fish predation. Sandy substrates contain relatively little organic matter (food) for organisms and poor protection from predatory fish. Higher plant growth is typically sparse in sandy sediment, because the sand is unstable and nutrient deficient. A rocky bottom has a high diversity of potential habitats offering protection (refuge) from predators, substrate for attached algae (periphyton on rocks), and pockets of organic "ooze" (food). A flat mucky bottom offers abundant food for benthic organisms but is less protected and may have a lower diversity of structural habitats, unless it is colonized by higher plants. The euphotic zone is also found within this deep-water region and is the layer of water below the surface where sunlight is still sufficient for photosynthesis to occur.

#### **4 Site Selection and Baseline Information**

Several rationales were considered while identifying potential sites for compensatory mitigation, which include:

- Site should be owned by USACE and available for bottomland hardwood and wetland mitigation.
- Site must be easily accessible by vehicle, all-terrain vehicle, or utility terrain vehicle.
- Site must either be large enough or be within close proximity to other mitigation sites.
- Site must be within the Arkansas River Watershed and be within close proximity to habitats adversely impacted by emergency dredging.
- Site must have appropriate soil characteristics, topography, and hydrologic conditions to achieve objectives for bottomland hardwood, forested wetland, and emergent wetland habitats.
- Site must be able to remain self-sufficient upon implementation of mitigation.

The proposed mitigation sites are within proximity of the bottomland hardwood and wetland impact areas, so replacement of lost habitat functions and values would occur locally. Photos of the impacted project areas and proposed mitigation areas can be found in Attachment A – Project and Mitigation Area Photos.

#### 4.1 Preferred Mitigation Sites

The sites described below meet these conditions and were chosen for consideration for their suitability in meeting the rationales and needs of the compensatory mitigation. The field investigation into the mitigation sites provided awareness of the most appropriate habitat type for each area. As shown in Figure 2 through Figure 7, each site was segmented into one of the three habitat types based on the soil, existing vegetation, and topography.

- **West of Muskogee Turnpike** (Figure 2) – This site is west of the Muskogee Turnpike Toll Road or Highway 351 in Muskogee, Oklahoma. It can be accessed by North York Street and N4310. The site is located on USACE fee-owned property and is currently utilized by the general public for illegal haying activities. The site is a total of 11.2 acres. The site has Verdigris silt loam, 0 to 1 percent slopes, frequently flooded soils (California Soil Resource Lab [CSRL], 2008). The site is low-lying in elevation between approximately 496 feet (‘) mean sea level (msl) and 504’ msl. It borders the southern edge of a small tributary of the Arkansas River and is approximately 370’ from the Arkansas River.

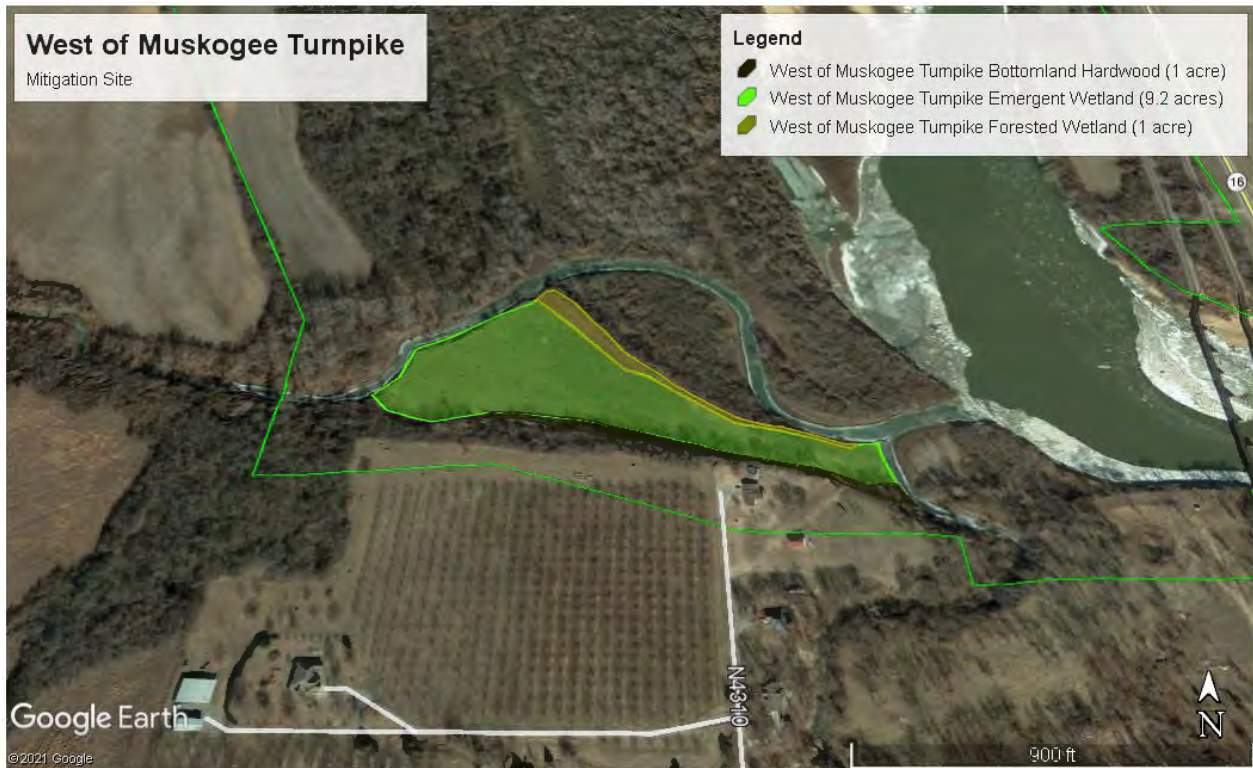


Figure 2. West of Muskogee Turnpike Mitigation Site



- **E0960** (Figure 3) – This site is west of U.S. Highway 10 and can be accessed by E0960 in River Bottom, Oklahoma. The site is located on USACE fee-owned property and is a total of 58.2 acres. Approximately half of the site has been maintained for agriculture use while the other half is still somewhat natural and undisturbed. The site has Kiamatia fine sandy loam, 0 to 2 percent slopes, frequently flooded; Kiamatia fine sandy loam, 0 to 2 percent slopes, rarely flooded; Roxana very fine sandy loam, 1 to 3 percent slopes, rarely flooded; Roxana very fine sandy loam, 0 to 1 percent slopes, rarely flooded; and Severn very fine sandy loam, 2 to 6 percent slopes, rarely flooded soils (CSRL, 2008). The site ranges in elevation from approximately 491' msl to 502' msl. The site is immediately adjacent to the Arkansas River on its eastern boundary.



**Figure 3. E0960 Mitigation Site**

- **North I40** (Figure 4) – This site is 0.3 miles north of Interstate Highway 40 and can be accessed by E1050 Road in Webbers Falls, Oklahoma. The site is located entirely on USACE fee-owned property but has been adversely impacted by illegal agricultural activities in the past. It is a total of 24.5 acres with some areas located within existing agricultural leases and another section located in a low-lying area with limited wetland vegetation. The site has Severn very fine sandy loam, 2 to 6 percent slopes, rarely flooded; Roxana very fine sandy loam, 1 to 3 percent slopes, rarely flooded; and Roebuck clay, 0 to 1 percent slopes, frequently flooded soils. The site is approximately 470' msl to 474' msl and is immediately southwest of the Arkansas River.



**Figure 4. North I40 Mitigation Site**

- **Drake Road** (Figure 5) – This site is 1.5 miles south of Interstate Highway 40 and can be accessed by South Kerr Boulevard to Drake Road near Salisaw, Oklahoma. It is about 18.9 acres and located on USACE fee-owned property. It is illegally grazed by the public and has been adversely effected by those actions. The proposed mitigation site has Mason silt loam, 0 to 1 percent slopes, rarely flooded soil. The entire site is approximately 467' msl to 472' msl and is adjacent to Salisaw Creek.



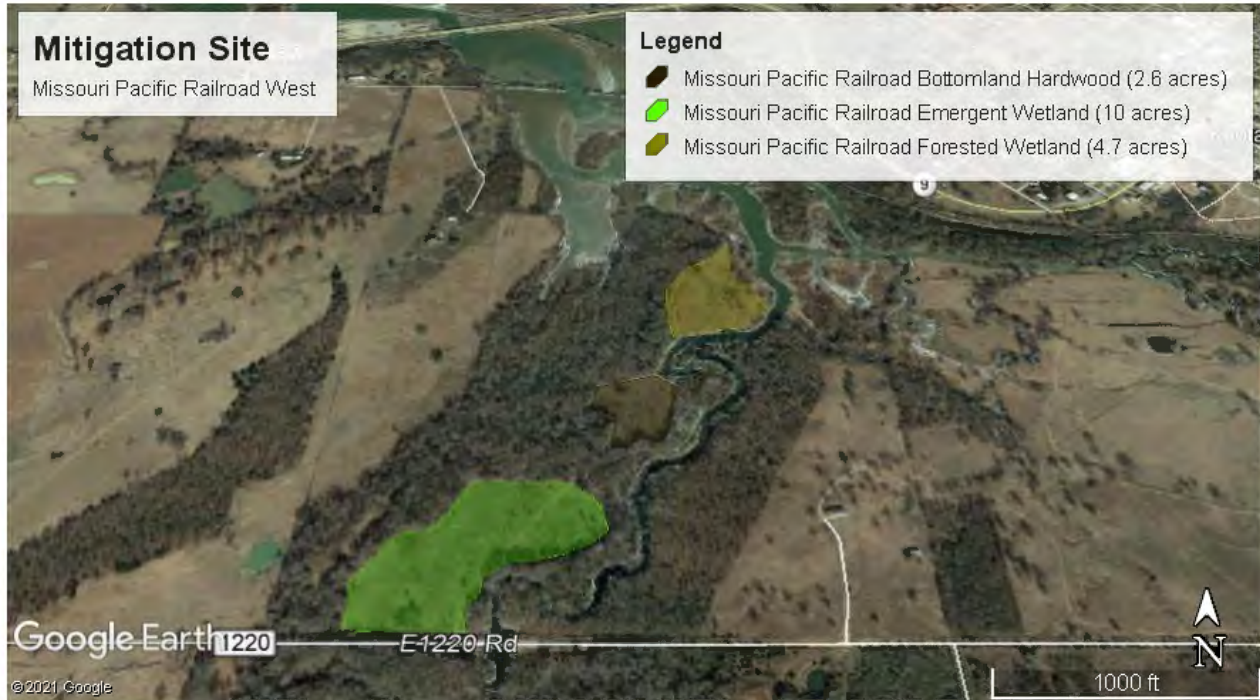
**Figure 5. Drake Road Mitigation Site**

- **Missouri Pacific Railroad East** (Figure 6) – This site is 0.10 miles south of U.S. Highway 9 in Keota, Oklahoma and can be accessed by N4550 Road. It is approximately 30.1 acres but has been adversely affected by illegal agriculture activities. The entire site is located on USACE fee-owned property. The site displays significant promise for emergent wetland vegetation. It is approximately 461' msl to 467' msl throughout the area. The soil types include Rexor silt loam, 0 to 1 percent slopes, occasionally flooded; Counts-Dela complex, 0 to 20 percent slopes; Rexor silt loam, 0 to 3 percent slopes, frequently flooded; and Water. This site is located off of San Bois Creek.



**Figure 6. Missouri Pacific Railroad East Mitigation Site**

- Missouri Pacific Railroad West** (Figure 7) – This site is 0.3 miles southwest of U.S. Highway 9 in Keota, Oklahoma and can be accessed by East 1220 Road. It is approximately 17.3 acres and has also been adversely impacted by illegal agriculture activities. The site is fee-owned by USACE. The site ranges in elevation from approximately 463' msl to 466' msl. The soil type is Cupco silt loam, 0 to 1 percent slopes, occasionally flooded. This site is located off of San Bois Creek.



**Figure 7. Missouri Pacific Railroad West Mitigation Site**

#### **4.2 Cultural Resources Effects and Standby Mitigation Sites**

All potential mitigation sites will be completely investigated for cultural resources during the planning phase, and prior to any ground disturbing activity. Cultural resources that are identified will be avoided, either by establishing a sufficiently protective “buffer zone” around the cultural resources site boundary and monitoring for complete avoidance, or if necessary, by abandoning the proposed mitigation site (location) altogether. If mitigation sites must be abandoned or if they are otherwise significantly reduced in size because of the discovery of cultural resources, it is an option to utilize “Standby Mitigation Sites,” which are alternative locations identified for this purpose. As a precaution, the areas described below were selected for standby mitigation to supplement emergent wetland mitigation if any preferred mitigation sites must be avoided to comply with Federal cultural resources laws and regulations. They meet the conditions described in Section 4 and were selected for consideration due to suitability in meeting the rationales and needs of the compensatory mitigation. All alternative locations will be included in the cultural resources investigations of all potential mitigation sites.

- **CR 4530** (Figure 8) – This site is 0.2 miles west of County Road 4530 and 0.7 miles north of County Road 1160 in Haskell County, Oklahoma. The site proposed is approximately 16.3 acres in size and is located on USACE fee-owned property. The site has Rexor silt loam, 0 to 1 percent slopes, occasionally flooded and Porum fine sandy loam, 3 to 5 percent slopes, eroded soils (CSRL, 2008). The site is low-lying in elevation as compared to the surrounding area 460' to 462' msl. It is located off of a small cove within the Robert S. Kerr Pool.



**Figure 8. CR 4530 Standby Mitigation Site**

- **Tract 1304** (Figure 9) – This site is one mile west of Highway 69 and 0.07 miles north of E0650 Road in Mayes County, Oklahoma. The site proposed is approximately 0.8 acres in size and is located on USACE fee-owned property. The site has Eram-Verdigris complex, 0 to 12 percent slopes (CSRL, 2008). The site is moderately low-lying in elevation as compared to the surrounding area at 584' to 587' msl.



**Figure 9. Tract 1304 Standby Mitigation Site**

### **4.3 Proposed Mitigation Site Protection**

All of the proposed locations are owned and operated by SWT and will be protected in perpetuity by use of the existing deed. Restrictions on these sites will be coordinated with the SWT Real Estate Branch to ensure the mitigation restrictions are recorded and documentation is complete. Leases on these sites will no longer be provided to the public to protect the property from incompatible uses such as grazing, haying, clear cutting, mineral extraction, etc. Any changes to the real estate instrument or management plan must contain a provision requiring 60-day advance notification to the district engineer before any action is taken. If there are changes in statute, regulation, agency needs, or if mitigation results in an incompatible use, USACE will be responsible for providing alternative compensatory mitigation that is acceptable to the district engineer for any loss in functions resulting from the use.

#### 4.4 Mitigation Work Plan

Mitigation efforts will primarily entail restoration of habitat. Mitigation bank availability is limited in the region. Purchasing mitigation bank credits will be considered should mitigation requirements remain for this project after all practicable USACE fee-owned property has been utilized for mitigation purposes. The ecological mitigation work will be done in-house by USACE's Engineering Research and Design Center. Grading and permanent fence installation will be necessary to create the most-appropriate site conditions for emergent and forested wetlands. The proximity to agricultural properties is a risk to mitigation success, so five-string barbed wire fence will be installed to protect the areas from cattle and adjacent land uses. A Grading Plan can be found in Attachment B while security fence specifications are shown in Attachment C.

The mitigation sites will be designed to improve habitat by introducing native vegetation, managing exotic invasive or nuisance species, creating microtopography appropriate for wetlands, and diversifying vertical stratification through herbaceous vegetation, shrubs, and trees upon the conclusion of grading and fencing.

As more information is made available, the following efforts will be completed, in coordination with the appropriate agencies and tribes during the planning phase:

- In accordance with Section 106 of the National Historic Preservation Act (as amended) (NHPA) and under an Archaeological Resources Protection Act (ARPA) permit issued by SWT, develop a Cultural Resources research design, conduct intensive surveys of all project components, and perform deep testing in areas where grading and contouring are proposed
- Develop haul route plan and haul schedule that avoids school zones and school bus stops during pickup and drop off periods. Identify areas for temporary traffic control, if needed; and
- Develop site security plans to secure construction, staging, and laydown areas so they do not create child or public safety concerns.

Upon completion of planning, additional mitigation efforts will be required to be complete prior to construction. Those efforts include:

- Ensure all construction staff are familiar with protected and natural resources to avoid unnecessary impacts;
- Develop avoidance and protection measures, as needed, based on results of cultural resources survey conducted during the planning phase, in coordination with the SHPO and Tribal Nations;
- Delineate areas to be avoided, including archaeological sites with surrounding buffer zones, such that construction equipment may not impact avoidance areas;
- Delineate construction areas with flagging, reflective tape, and fencing for child and public safety and to limit construction impacts, where appropriate;
- Ensure a Storm Water Pollution Prevention Plan (SWPPP) is prepared; and
- Submit a Notice of Intent to the Oklahoma Department of Environmental Quality and obtain authorization under OKR10.

During construction, ongoing efforts may be needed to avoid and limit adverse impacts. Those efforts include but are not limited to:



- Conduct cultural resources surveys of areas in which any changes to design or additional ground disturbance must occur to ensure no cultural resources will be adversely impacted.
- Ensure a cultural resources monitor will be onsite, if necessary, during ground disturbance activities, as determined necessary by USACE in consultation with the Oklahoma State Historic Preservation Office and Tribes;
- Revegetate all disturbed areas with native species, where appropriate;
- Ensure all environmental and cultural resource compliance efforts have been met;
- Ensure no insecticides or pesticides are used within or adjacent to natural areas;
- Limit herbicide use to only areas dominated by invasive species;
- Implement the SWPPP;
- Implement and follow all BMPs as directed under OKR10;
- Implement construction and staging site boundary marking and safety measures;
- Implement traffic flagging and haul route restrictions, where appropriate, to minimize safety concerns;
- Implement avoidance techniques where practicable for vegetation removal, if vegetation removal cannot be avoided it will occur outside of the migratory bird nesting and breeding season if surveys indicate presence; and
- Additional conservation measures can be found in Attachment D – Nationwide Standard Conservation Measures.

The mitigation sites shall be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved. The dependence on engineering features such as water control structures, pumps, stop-logs, and irrigation will be limited to ensure natural hydrology will support long-term sustainability. In addition, control of invasive species will be limited to the monitoring and adaptive management period. Upon establishment of native vegetation, invasive species propagation is expected to be limited, unless future unknown natural disturbances occur.

#### 4.4.1 Grading Plan

The objective of the grading plan is to adjust the topography of mitigation sites to accommodate emergent and forested wetland vegetation. Grading will establish the proper subgrade elevations associated with wetland communities. Some of the mitigation sites will require six inches to six feet of soil to be adjusted or moved to accommodate better hydrologic conditions for wetland plants (Attachment A – Grading Plan). The proposed sites requiring grading are listed below. Once the soil has been contoured, the remaining topsoil will be spread on the graded areas to create a substrate for native vegetation seeding and planting.

- West of Muskogee Turnpike
- E0960
- Missouri Pacific Railroad East
- Missouri Pacific Railroad West

#### 4.4.2 Desired Plant Community

A combination of species will be planted at each mitigation site. Because there are three habitat types that will have to be mitigated because of the Emergency Action, there will be varying wetland and bottomland hardwood forest species. The bottomland hardwood forest species will work as a buffer for the emergent wetland and forested wetland habitats, protecting them from potential adjacent land use pollution and adverse stormwater runoff, as well as serving as the need for mitigation. The vegetation list below represents the priority plants used for USACE's mitigation efforts. This list is preliminary, and species may be added or removed from it during design and implementation of the mitigation features.

**Table 2. Desired Plant Community for the Mitigation Plan**

Scientific name	Common name	Growth form	Habitat*
<b>Aquatic, wetland, and grassland herbaceous</b>			
<i>Acmella oppositifolia</i> var. <i>repens</i>	Oppositeleaf spotflower	Emergent	E
<i>Andropogon glomeratus</i>	Bushy bluestem	Graminoid	E
<i>Asclepias</i> sp.	Milkweeds	Herb/wildflower	E
<i>Bacopa monnieri</i>	Water hyssop	Emergent	E
<i>Carex</i> sp.	Sedges	Emergent	E, FW
<i>Chasmanthium latifolium</i>	Inland sea oats	Graminoid	E, BLH
<i>Echinodorus berteroi</i>	Tall burhead	Emergent	E, FW
<i>Echinodorus subcordatum</i>	Creeping burhead	Emergent	E, FW
<i>Eleocharis acicularis</i>	Slender spikerush	Emergent	E
<i>Eleocharis macrostachya</i>	Flatstem spikerush	Emergent	E
<i>Eleocharis quadrangulata</i>	Squarestem spikerush	Emergent	E
<i>Equisetum</i>	Horsetail	Emergent	E
<i>Heteranthera dubia</i>	Water stargrass	Submerged	E
<i>Juncus</i> spp.	Soft rush	Emergent	E
<i>Justicia americana</i>	Water willow	Emergent	E
<i>Nymphaea mexicana</i>	Mexican water lily	Floating-leaved	E
<i>Nymphaea odorata</i>	American water lily	Floating-leaved	E
<i>Panicum virgatum</i>	Switchgrass	Graminoid	E
<i>Peltandra virginica</i>	Arrow arum	Emergent	E, FW
<i>Phyla lanceolata</i>	Lanceleaf frogfruit	Herb/wildflower	E, FW
<i>Polygonum hydropiperoides</i>	Water smartweed	Emergent	E, FW
<i>Pontederia cordata</i>	Pickrelweed	Emergent	E
<i>Potamogeton illinoensis</i>	Illinois pondweed	Submerged	E
<i>Potamogeton nodosus</i>	American pondweed	Submerged	E
<i>Sagittaria platyphylla</i>	Delta arrowhead	Emergent	E
<i>Sagittaria latifolia</i>	Arrowhead	Emergent	E, FW
<i>Schoenoplectus californicus</i>	Giant bulrush	Emergent	E
<i>Schoenoplectus pungens</i>	American bulrush	Emergent	E
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush	Emergent	E
<i>Tripsacum dactyloides</i>	Eastern gamagrass	Graminoid	E

Scientific name	Common name	Growth form	Habitat*
<i>Vallisneria americana</i>	Wild celery	Submerged	E
<b>Woody</b>			
<i>Acer negundo</i>	Box elder	Tree	FW, BLH
<i>Acer saccharinum</i>	Silver maple	Tree	BLH
<i>Betula nigra</i>	River birch	Tree	FW, BLH
<i>Callicarpa americana</i>	American beautyberry	Shrub	BLH
<i>Carya cordiformis</i>	Bitternut hickory	Tree	BLH
<i>Carya illinoensis</i>	Pecan	Tree	BLH
<i>Carya ovata</i>	Shagback hickory	Tree	BLH
<i>Carya tomentosa</i>	Mockernut hickory	Tree	BLH
<i>Catalpa speciosa</i>	Northern catalpa	Tree	BLH
<i>Celtis laevigata</i>	Sugarberry	Tree	FW, BLH
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub	FW, BLH
<i>Cercis canadensis</i>	Eastern redbud	Tree	BLH
<i>Cornus drummondii</i>	Roughleaf dogwood	Shrub	FW, BLH
<i>Crataegus spp.</i>	Hawthorn	Tree	BLH
<i>Diospyros virginiana</i>	Common persimmon	Tree	FW, BLH
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	FW, BLH
<i>Ilex decidua</i>	Deciduous holly	Tree	BLH
<i>Juglans nigra</i>	Black walnut	Tree	BLH
<i>Maclura pomifera</i>	Osage-orange	Tree	BLH
<i>Morus rubra</i>	Red Mulberry	Tree	FW, BLH
<i>Nyssa sylvatica</i>	Blackgum	Tree	FW, BLH
<i>Platanus occidentalis</i>	American sycamore	Tree	FW, BLH
<i>Populus deltoides**</i>	Cottonwood	Tree	FW
<i>Prunus mexicana</i>	Mexican plum	Tree	BLH
<i>Prunus serotina</i>	Black cherry	Tree	BLH
<i>Quercus macrocarpa</i>	Bur oak	Tree	FW, BLH
<i>Quercus muehlenbergii</i>	Chinquapin oak	Tree	BLH
<i>Quercus nigra</i>	Water oak	Tree	FW, BLH
<i>Quercus phellos</i>	Willow oak	Tree	FW, BLH
<i>Quercus shumardii</i>	Shumard oak	Tree	BLH
<i>Salix nigra**</i>	Black willow	Tree	FW
<i>Sambucus nigra</i>	Elderberry	Shrub	FW, BLH
<i>Sideroxylon lanuginosum</i>	Gum bumelia	Tree	BLH
<i>Ulmus americana</i>	American elm	Tree	BLH

\*E = emergent wetland, FW = forested wetland, BLH = bottomland hardwood forest

\*\*Expecting recruitment and will monitor; may not transplant

Any desirable plants or wildlife structures, such as snags, will be left in place where practical. A final review of the planting areas will occur after completion of contouring to ensure soil, topographic, and hydrologic conditions are appropriate.

The draft design of the plant community will be structured as shown below:

- Emergent Wetlands
  - Seeding in disturbed/graded/appropriate areas
    - Estimated 30 acres needed for seeding
  - Transplants estimated 10 - 15-foot centers at appropriate depths
  - One submerged aquatic vegetation founder colony installation per tract/site
- Forested Wetlands & Bottomland Hardwoods
  - 100 (one to two years old, 0.6 gallon) transplants per acre
  - Stakes/germinated-acorns/bare-root seedlings as appropriate
    - Estimated >50 per acre average

#### 4.4.3 Control of Invasive Species

Prevalent invasive species at the mitigation sites include alligator weed (*Alternanthera philoxeroides*), callery pear (*Pyrus calleryana*), Chinese privet (*Ligustrum sinense.*), and multiflora rose (*Rosa multiflora*).

##### Alligator Weed

Alligator weed originated in South America. It is able to spread and reproduced rapidly through stems and leaf cuttings. It is difficult to eradicate because it can grow from the small portions left behind. It is normally found spread across bodies of water but can also be found in terrestrial areas around gardens or between row crops. Stems are pink and hollow and can reach lengths of one meter with opposite narrow elliptical leaves. The flowers are white in color, have thin petals, and are held on stems approximately four to five inches away from the main plant (Texas Invasive Species Institute [TISI], 2014a).

Alligator weed can be physically removed, but 100 percent success is not likely. There are currently no biological control methods to eradicate alligator weed. Chemical controls containing fluridone or imazapyr have been the most successful (TISI, 2014a).

##### Callery Pear

Callery pear is a resprouting invasive tree native to China and Vietnam. Seeds can remain viable for at least 11 years, indicating that a prominent seed bank might exist in invaded sites (Serota and Culley, 2019). Prescribed fire alone kills seeds and one-year-old seedlings, but only top-kills trees two years and older which each resprout with three to four new stems following burning. Fire and cut and spray methods may also be effective (Warrix and Marshall, 2018). Recommended herbicides and treatment methods include triclopyr or a combination of triclopyr and aminopyralid for basal bark application, or glyphosate or imazapyr for foliar application (Vogt et al., 2020) In summary, a combination of prescribed fire, followed by mechanical treatment and herbicide, might be most effective where possible. Where prescribed fire is not a possibility, cutting and grinding down followed by a foliar glyphosate or imazapyr treatment after resprouting might be most effective, as well as monitoring and following up with repeat treatments as needed.

### Chinese Privet

Chinese privet is an evergreen shrub with spreading branches. It can be found near streams and in old fencerows. Leaves on the shrub are opposite with short petioles; blades up to two inches long, ovate to elliptic, normally rounded at the tip, tapering to the base, and with smooth margins. Flowers are white, fragrant and about 3/8<sup>th</sup> inches wide and up to four inches long. The flowers appear from March to May (TISI, 2014b).

Herbicide application is best from August to December. Leaves should be thoroughly wet in water with a surfactant which can be glyphosate 3% solution (12 ounces per three-gallon mix) or Arsenal Applicators Concentrate 1% solution (four ounces per three-gallon mix). Stems that are too tall for foliar sprays can be applied with Garlon 4 as a 20% solution in commercially available basal oil, diesel fuel, or kerosene (2.5 quarts per three-gallon mix) with a penetrant (check with herbicide distributor) to young bark as a basal spray. Large cut stems can be treated with Arsenal Applicators Concentrate or Velpar Liquid Herbicide as a 10% solution in water (one quart per three-gallon mix) with a surfactant. Safety to surrounding vegetation will be extremely important with implementation of the mitigation plan, so Chinese privet can immediately have stumps and cut stems with Garlon 3A or a glyphosate herbicide as a 20% solution in water (2.5 quarts per three-gallon mix) with a surfactant (TISI, 2014b).

### Multiflora Rose

Multiflora rose is an invasive shrub native to China, Japan, and Korea. Multiflora rose exhibits high seed production and good seed viability. Individual plants may produce as many as 500,000 seeds per year, and seeds stay viable in the soil bank for 10 to 20 years depending upon soil conditions (Munger, 2002). It also reproduces vegetatively, sprouting from broken stems and even rooting from stems if they have soil contact. Leaves emerge very early in the spring, and the plant holds onto its leaves longer than most native plants. It flowers May to June, and fruits in August. Fruits persist into the winter months. Timing of control measures seems quite important, given the long fruiting/seed production period.

Smaller multiflora rose plants should be hand-pulled or dug up prior to August (fruit production). Hard to pull or dig plants can be cut to a one-inch stump, and glyphosate immediately applied to the stump, in July, August, or September. Alternatively, plant can be cut to six to 12 inches above the ground in the spring or early summer, allowed to resprout, and then cut again to one inch above the ground in July, August, or September and glyphosate applied. A first cutting earlier in the year allows the resprout to draw reserves away from the roots, making the cut-stump glyphosate application more effective. For very large, established plants or colonies of plants, foliar application of glyphosate works best, from July to mid-September. A final recommended method is cold-weather stump application of glyphosate; when temperatures are 15.8 to 46.4 degrees Fahrenheit, the risk of contaminating non-target plants is apparently reduced.

## **5 Maintenance Plan**

The proposed mitigation sites have demonstrated that they are capable of naturally supporting wetlands as described in Section 4. Grading and contouring within some of the mitigation areas will provide a lower base elevation and create a minor impoundment. The slight modification of the areas will create hydrologic conditions on a larger scale and add to the duration of water inundation, as well as the establishment of native vegetation.

Upon completion of initial construction, the mitigation sites will be monitored as described in Section 7 of this plan. Corrective actions in addition to those described in the previously mentioned sections may be required and can include:

- Maintaining security fencing;
- Maintaining mitigation site information signs;
- Protecting mitigation sites from human disturbances, such as encroachments, illegal agriculture use, and vandalism; and
- Any other actions that may be triggered by the adaptive management plan described in Section 9.

## 6 Performance Standards

The following discussion outlines the performance standards associated with the monitoring plan that will support the MKARNS Emergency Action mitigation. The plan identifies performance measures along with desired outcomes and monitoring design in relation to specific objectives. A performance measure includes specific feature(s) to be monitored to determine project performance. Additional monitoring is identified as supporting information needs that will help further understand interrelationships of restoration features and external environmental variability and to corroborate project effects.

Such criteria, or decision-making triggers, are related to each performance measure and desired outcome and identify the need to discuss potential implementation of adaptive management actions.

Overall, monitoring results will be used to evaluate the progress of habitat mitigation toward meeting project objectives and to inform the need for adaptive management actions to ensure successful restoration is achieved.

**Performance Measure 1:** Establish 15 acres of bottomland hardwood habitat, 78.5 acres of emergent wetland habitat, and 10.8 acres of forested wetland habitat.

**Success Criteria:** One year following completion of final construction activities achieve 85% survival of planted woody species on 15 acres of bottomland hardwood habitat. The 85% survival criteria would continue to five years after construction.

One year following completion of final construction activities achieve 85% survival of planted emergent wetland species on 78.5 acres of emergent wetland habitat. The 85% survival criteria would continue to five years after construction.

One year following completion of final construction activities achieve 50% survival of bottomland hardwood forest species and 85% survival of emergent wetland species on 10.8 acres of emergent wetland habitat continuing 5 years after completion of project construction

**Monitoring Design and Rationale:** Planted woody and emergent wetland species will be assessed each year during site surveys to determine what percentage of each species the plants have survived. Sites will be evaluated annually from post-construction until success is determined. To determine the increase in acreage, satellite and aerial imagery will be used to identify change pre- and post-construction in years 1-5. Vegetated habitats should be classified using digital aerial imagery and field observation.

**Performance Measure 2:** Average cover of 75% of desired vegetation on mitigation sites at year 5 compared to pre-construction.

**Success Criteria:** One year following completion of final construction activities achieve a minimum average cover of 25%, comprised of native herbaceous species. Three years following construction, achieve a minimum average cover of 75% native emergent wetland, forested wetland, and bottomland hardwood species (according to appropriate site). Five years following construction, achieve a minimum average cover of 50% herbaceous species.

**Monitoring Design and Rationale:** Vegetation will be sampled annually, at the six mitigation sites. Permanent vegetation monitoring stations will be established for assessing the vegetation community at each site. Sites will be sampled annually post-construction until success is determined.

**Performance Measure 3:** Establish overall site biodiversity through increasing plant species taxa richness.

**Success Criteria:** One year following completion of final construction activities achieve a minimum of a 25% increase in plant species taxa richness depending on initial site conditions, comprised of native species. Five years following construction, maintain or increase level of taxa richness achieved during vegetation establishment efforts during construction phase, comprised of native species.

**Monitoring Design and Rationale:** The species composition of each site will be sampled annually at the permanent vegetation monitoring sites. Sites will be sampled annually post construction until success is determined. Diversity metrics may consist of species richness, species evenness, and/or other species diversity metrics such as the Shannon Weiner or Simpson Index.

**Performance Measure 4:** Manage non-native invasive vegetation within mitigation sites.

**Success Criteria:** One year following completion of final construction activities achieve less than 25% average cover of non-native invasive species. Years 2 to 5 following completion of final construction activities achieve average cover of less than 5% non-native invasive species with no area greater than 0.25 acres in size with greater than 10% non-native invasive species.

**Monitoring Design and Rationale:** Vegetation will be sampled annually, at the mitigation site. Permanent vegetation monitoring stations will be established for assessing the vegetation community at each site. Sites will be sampled annually post-construction until success is determined. Initial control/removal of unwanted plants will be evaluated, and determinations made on an annual or semi-annual basis on whether additional action will be needed.

**Vegetation:** Vegetation sampling will occur annually within the mitigation unit for the duration of the monitoring period. Sampling will occur during spring months, at the peak of the growing season. Permanent 1/10th-acre, field monitoring plots will be located randomly within the mitigation plot. Monitoring will measure percent cover of native and non-native plant species and structural diversity. Photograph stations are also important for documenting vegetation conditions. All plots and photograph stations staked and will be documented via Global Positioning System (GPS) coordinates to reoccupy in each year of sampling.

General observations, such as fitness and health of plantings, survival, growth, soil moisture, precipitation, phenology, native plant species recruitment, and signs of drought stress should be noted during the surveys. Additionally, potential soil erosion, flood damage, vandalism and

intrusion, trampling, and pest problems would be qualitatively identified. Efficacy of invasive plant management will also be monitored.

A general inventory of all wildlife species observed and detected using the project area would be documented. Nesting sites, roosting sites, animal burrows, and other signs of wildlife use of the newly created habitat and habitat structures would be recorded. The notes would be important for early identification of species colonization patterns.

## **7 Monitoring**

An effective monitoring program will be required to determine if the project outcomes are consistent with original project goals and objectives. The power of a monitoring program developed to support adaptive management lies in the establishment of feedback between continued project monitoring and corresponding project management. A carefully designed monitoring program is the central component of the project adaptive management program as it supplies the information to assess whether the project is functioning as planned.

Monitoring must be closely integrated with the adaptive management components because it is the key to the evaluation of adaptive management needs. Objectives must be considered to determine appropriate indicators to monitor. In order to be effective, monitoring must be able to distinguish between ecosystem responses that result from project implementation (i.e. management actions) and natural ecosystem variability.

In general, monitoring will be established for no less than five years after mitigation construction completion for emergent wetland habitats. A longer monitoring period must be required for aquatic resources with slow development rates, such as forested wetlands so the monitoring will be no less than 10 years for forested wetland and bottomland hardwood forest habitat. However, following project implementation, the district engineer may reduce or waive the remaining monitoring requirements upon a determination that compensatory mitigation has achieved its performance standards. Annual monitoring reports will be submitted to the district engineer by USACE SWT Operations Division.

The USACE SWT Operations Division is the responsible party for ensuring monitoring is conducted. The USACE SWT Operations Division will delegate monitoring and adaptive management to the USACE Lewisville Aquatic Ecosystem Restoration Facility (LAERF) upon repositioning of funding but USACE SWT Operations Division will remain the responsible party for achieving compensatory mitigation requirements.

Monitoring reports must include the progress of the compensatory mitigation and can include plans, maps, and photographs to illustrate site conditions at the time of the report. They may also include the results of functional, condition, or other assessments used to provide quantitative or qualitative measures of the functions provided by the compensatory mitigation site. Permanent locations for photographic documentation will be established to provide a visual record of habitat development over time. The locations of photo points will be identified in the pre-construction monitoring report. Photographs taken at each photo point will be included in monitoring reports. Any reports submitted to the district engineer must be provided to Federal, Tribal, state, and local resource agencies, and the public, upon request.

Any Cultural Resources that are avoided within a selected mitigation site must be monitored for compliance with Federal cultural resources laws and regulations. The USACE SWT Operations Division is the responsible party for ensuring monitoring is conducted and reported annually for no less than 10 years, after which the sites will be monitored as part of regular SWT cultural resources management activities. Site condition assessments, including detailed documentation of any impacts to cultural resources, including but not limited to inadvertent project impacts,



natural impacts, or vandalism/looting must be included in cultural resources monitoring reports. Photographs must be taken, and photo points and direction documented. Cultural Resources monitoring reports should not be included in any report provided to the public, per the Archaeological Resources Protection Act (ARPA). Distribution of Cultural Resources monitoring reports will be determined by USACE SWT Operations Division cultural resources personnel, and may include distribution to Federal, Tribal, and state agencies.

## **8 Long-term Management Plan**

The party responsible for ownership and all long-term management of the compensatory mitigation project is USACE SWT Operations Division. The funding for long-term maintenance will be identified by USACE SWT Operations Division as needs are identified and appropriated by Congress each fiscal year. The funding for maintenance is established by the fiscal year and will be dependent on the extent of any future needs. Intensive long-term management is not anticipated beyond the required monitoring and maintenance period because all mitigation associated with the MKARNS Emergency Action is designed for self-sustainment. The MKARNS Emergency Action mitigation plan does not include long-term diversion of water, wetland cell pumps, stop-logs, or any other common water control structures. Impacts to the mitigation site as a result of public disturbance can be addressed under USACE's Title 36 – Parks, Forests, and Public Property. The rules and regulations govern the public use of water resources development projects administered by the Chief of Engineers and all visitors are bound by these Title 36 regulations.

Impacts to Cultural Resources within mitigation sites will be addressed under the appropriate legislation, regulations, and executive orders, including, but not limited to the National Historic Preservation Act (NHPA) of 1966, as amended, the ARPA of 1979 (as amended), and the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (as amended) and their implementing regulations. The ARPA compels federal land-holding agencies to protect archaeological sites and artifacts on government land from looting, vandalism, and trafficking, impose and enforce penalties, both Civil and Criminal, against violators of the Act, and better manage archeological sites on public land. The NAGPRA directs federal land-holding agencies to protect Native American burials and burial sites on federal fee lands.

Any wetlands created as an act of compensatory mitigation will fall under regulatory jurisdiction of Section 404 of the Clean Water Act.

## **9 Adaptive Management Plan**

Results of monitoring will be assessed in comparison to project objectives and decision-making triggers to evaluate whether the project is functioning as planned and whether adaptive management actions are needed to achieve project objectives. The results of the monitoring will be provided to the USACE SWT Operations Division and SWT RO, who will evaluate and compare data to project objectives and decision-making triggers. The USACE will use the monitoring results to assess habitat responses to management, evaluate overall project performance, and make recommendations for adaptive management actions as appropriate. If monitoring results, as compared to desired outcomes and decision-making triggers show that project objectives are not being met, USACE will evaluate causes of failure and recommend adaptive management actions to remedy the underlying problems.

Decision criteria, also referred to as adaptive management triggers, are used to determine if and when adaptive management should be implemented. They can be qualitative or quantitative based on the nature of the performance measure and the level of information necessary to

make a decision. Desired outcomes can be based on reference sites, predicted values, or comparison to historic conditions. Several potential decision criteria are identified below, based on the project objectives and performance measures. More specific decision criteria, possibly based on other parameters such as hydrology, geomorphology, and vegetation dynamics.

If assessments show that any of these triggers are met, USACE would decide whether an adaptive management action is warranted, and if so, what that action will entail. Investigations may be required to determine the cause of need for action to inform the type of adaptive management response that should be implemented, if needed. Additionally, prior to enacting any adaptive management measures, USACE would assess whether supplemental environmental analyses (including Cultural Resources review) are required.

**Performance Measure 1:** Establish 15 acres of bottomland hardwood habitat, 78.5 acres of emergent wetland habitat, and 10.8 acres of forested wetland habitat.

**Success Criteria:** One year following completion of final construction activities achieve 85% survival of planted woody species on 15 acres of bottomland hardwood habitat. The 85% survival criteria would continue to five years after construction.

One year following completion of final construction activities achieve 85% survival of planted emergent wetland species on 78.5 acres of emergent wetland habitat. The 85% survival criteria would continue to five years after construction.

One year following completion of final construction activities achieve 50% survival of bottomland hardwood species and 85% survival of emergent wetland species on 10.8 acres of emergent wetland habitat continuing 5 years after completion of project construction

**Monitoring Design and Rationale:** Planted woody and emergent wetland species will be assessed each year during site surveys to determine what percentage of each species the plants have survived. Sites will be evaluated annually from post-construction until success is determined. To determine the increase in acreage, satellite and aerial imagery will be used to identify change pre- and post-construction in years 1-5. The same requirements for wood species will be required in years 6-10. Vegetated habitats should be classified using digital aerial imagery and field observation.

**Trigger:** By year 1, the number of surviving woody and emergent plant species is below 85% for bottomland hardwood and emergent wetland habitats. By year 1, the number of surviving woody species is below 50% and surviving emergent wetland species are below 85% for forested wetland habitats. Volunteer plant species may replace unsuccessful planting, but only if the species is consistent with the species diversity goals and is not a dominant component of the restoration target composition.

**Possible Causes for Not Meeting Success Criteria Potential:** Failure mechanisms for the successful establishment for the habitats mentioned above may include drought or extreme storm events, predators (invertebrates and vertebrates), incompatible plant species selection, wetland design errors/flaws resulting in inadequate hydrology, and/or reinfestation of non-native invasive and native noxious species.

**Potential Adaptive Management Measures:** Adaptive management measure would include irrigation or soil amendments during drought conditions; predator control (i.e., enclosures) to ensure the vitality and survival of the plantings; changing the target plant species to those be more tolerant of site specific abiotic conditions; and modifying the active ingredient/surfactant or application rates of herbicides, changing the treatment methodology (chemical, mechanical, or biocontrol), reinitiating grading, and/or the

refinement of the integrated pest management strategy to manage invasive and noxious plant species in the restoration areas. Prior to initiation of adaptive management measures, review by SWT Operations Division Cultural Resources personnel must be conducted to ensure that avoided cultural resources are not impacted, and that required measures are consistent with the level of cultural resources investigations previously conducted.

**Performance Measure 2:** Average cover of 75% of desired vegetation on mitigation sites at year 5 compared to pre-construction.

**Success Criteria:** One year following completion of final construction activities achieve a minimum average cover of 25%, comprised of native herbaceous species. Three years following construction, achieve a minimum average cover of 75% native emergent wetland, forested wetland, and bottomland hardwood species (according to appropriate site). Five years following construction, achieve a minimum average cover of 50% herbaceous species.

**Monitoring Design and Rationale:** Vegetation will be sampled annually, at the six mitigation sites. Permanent vegetation monitoring stations will be established for assessing the vegetation community at each site. Sites will be sampled annually post-construction until success is determined.

**Trigger:** The percent canopy cover of native herbaceous species is less than 50% after one year, 75% after two years, or 85% after three years.

**Possible Causes for Not Meeting Success Criteria Potential:** Failure mechanisms for the successful establishment of mitigation sites may include drought, predators (invertebrates and vertebrates), incompatible plant species selection, wetland design errors/flaws resulting in inadequate hydrology, and/or reinfestation of non-native invasive and native noxious species.

**Potential Adaptive Management Measures:** Adaptive management measures would include irrigation or soil amendments during drought conditions; predator control (i.e., enclosures) to ensure the vitality and survival of the plantings; changing the target plant species to those be more tolerant of site specific abiotic conditions; and modifying the active ingredient/surfactant or application rates of herbicides, changing the treatment methodology (chemical, mechanical, or biocontrol), reinitiating grading, and/or the refinement of the integrated pest management strategy to manage invasive and noxious plant species in the restoration areas. Prior to initiation of adaptive management measures, review by SWT Operations Division Cultural Resources personnel must be conducted to ensure that avoided cultural resources are not impacted, and that required measures are consistent with the level of cultural resources investigations previously conducted.

**Performance Measure 3:** Establish overall site biodiversity through increasing plant species taxa richness.

**Success Criteria:** One year following completion of final construction activities achieve a minimum of a 25% increase in plant species taxa richness depending on initial site conditions, comprised of native species. Five years following construction, maintain or increase level of taxa richness achieved during vegetation establishment efforts during construction phase, comprised of native species.

**Monitoring Design and Rationale:** The species composition of each site will be sampled annually at the permanent vegetation monitoring sites. Sites will be sampled annually

post construction until success is determined. Diversity metrics may consist of species richness, species evenness, and/or other species diversity metrics such as the Shannon Weiner or Simpson Index.

Trigger: The target increase in species diversity is not achieved within one year of construction.

Possible Causes for Not Meeting Success Criteria Potential: Failure mechanisms associated with meeting the species diversity performance measure includes those listed above for performance measures 1 and 2.

Potential Adaptive Management Measures: Potential adaptive management measures include those listed above for performance measures 1-2; however, modifying the plant species used to replace unsuccessful plantings would be the most likely adaptive management measures. This is especially the case when survival of a species is significantly lower than other species planted in the restoration area. Prior to initiation of adaptive management measures, review by SWT Operations Division Cultural Resources personnel must be conducted to ensure that avoided cultural resources are not impacted, and that required measures are consistent with the level of cultural resources investigations previously conducted.

**Performance Measure 4:** Manage non-native invasive vegetation within mitigation sites.

Success Criteria One year following completion of final construction activities achieve less than 25% average cover of non-native invasive species. Years 2 to 5 following completion of final construction activities achieve average cover of less than 5% non-native invasive species with no area greater than 0.25 acres in size with greater than 10% non-native invasive species.

Monitoring Design and Rationale: Vegetation will be sampled annually, at the mitigation site. Permanent vegetation monitoring stations will be established for assessing the vegetation community at each site. Sites will be sampled annually post-construction until success is determined. Initial control/removal of unwanted plants will be evaluated, and determinations made on an annual or semi-annual basis on whether additional action will be needed.

Trigger: Non-native invasive species percent cover exceeds 25% after one year, 15% after two years, and/or 10% after 3 years.

Possible Causes for Not Meeting Success Criteria Possible: Failure modes for invasive species management include ineffective treatment of the invasive species, root sprouting of the invasive plant, reestablishment of invasive species from the seed bank in the restoration areas, or immigration of invasive species seeds from animals or floodwaters.

Potential Adaptive Management Measures: Adaptive management measures to address failures in invasive species control include modifying the active ingredient/surfactant or application rates of herbicides, changing the treatment methodology (chemical, mechanical, or biocontrol), or modifying the integrated pest management strategy. Should ground disturbing methods be selected, review by SWT Operations Division Cultural Resources personnel must be conducted prior to implementation to ensure that avoided cultural resources are not impacted, and that required measures are consistent with the level of cultural resources investigations previously conducted.

This mitigation plan involves active manipulation (as needed) to sustain project goals and objectives, primarily by applying an iterative process of assessing and learning from the results of management actions. The application of adaptive management principals in this project will provide decision support tools to address site changes that may occur as the project progresses, as well as integrate additional project resources or technologies as needed. In some cases additional resources may be needed to address issues that occur (such as management of new infestations of invasive species), but in most cases reallocation of resources (e.g., modifying planting lists/species selection based upon successes and failure of earlier plantings) can be used to meet or exceed project goals as defined by tree, shrub, vine, and herbaceous plant establishment combined with nuisance plant control.

In contrast, periodic monitoring of performance criteria which contain trigger values informs the iterative process of implementing specified adaptive management measures to help achieve ecological success. However, the project area is susceptible to several uncertainties that could significantly impact the ecological success of constructed restoration features as described.

Decisions on the implementation of adaptive management actions are informed by the assessment of monitoring results. The information generated by the monitoring plan will be used by USACE to guide decisions on adaptive management that may be needed to ensure that the mitigation achieves success.

## 10 Financial Assurances

The funds necessary to carry out this mitigation plan will come from Maintenance and Operations (M&O) funds allocated for the USACE SWT Operations Division. In total, an estimated \$3,348,000 would be needed to complete the mitigation plan, see Table 3 below for line item estimates.

**Table 3. Mitigation Plan Costs**

<b>Task</b>	<b>Cost (\$)</b>
Planning, Design, and Initial Site Preparation	15,000
Propagule, Materials Acquisition, and Plant Production	648,000
Plantings	806,000
Monitoring	225,000
Adaptive Management	282,000
Reporting and Operations & Maintenance	96,000
<b>Task</b>	<b>Cost (\$)</b>
Grading and Contouring	441,000
Security Fencing	1,425,000
<b>Total</b>	<b>3,938,000</b>

## 11 References

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## 12 List of Preparers

Justyss Watson – Biologist, Regional Planning and Environmental Center; 6 years USACE experience.

## **Attachment A**

**PROJECT AREA PHOTOS**



North – Below Lock 16



East – Below Lock 16



South – Below Lock 16



West – Below Lock 16





North – Salt Creek



East – Salt Creek



South – Salt Creek



West – Salt Creek



North – Sandtown Bottom



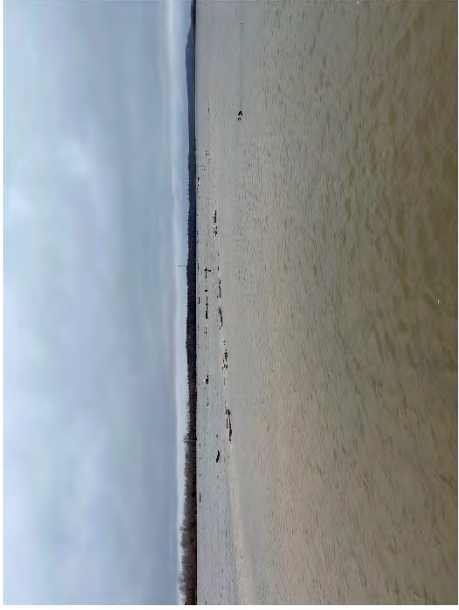
East – Sandtown Bottom



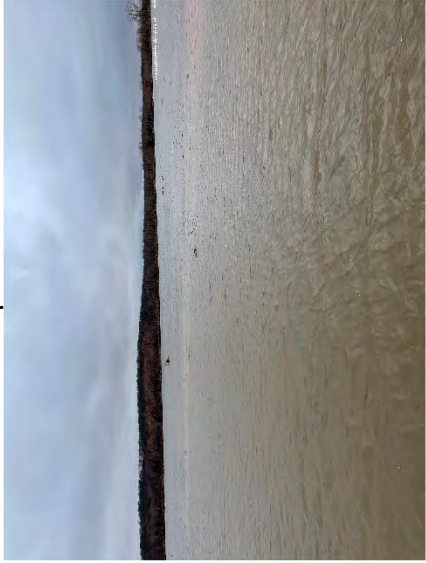
South – Sandtown Bottom



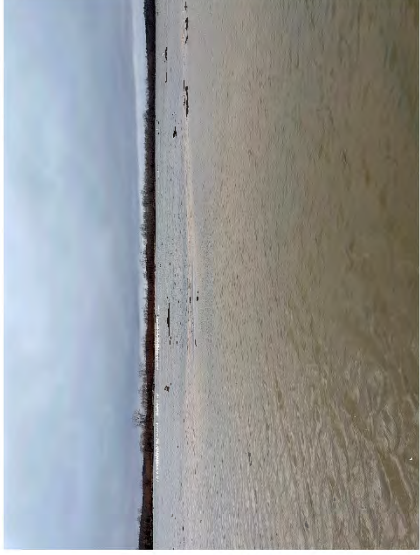
West – Sandtown Bottom



North – Spaniard Creek



South – Spaniard Creek



West – Spaniard Creek



North – Kerr Lake (RM 343)



East – Kerr Lake (RM 343)



South – Kerr Lake (RM 343)



North – Stoney Point



East – Stoney Point



South – Stoney Point



West – Stoney Point



San Bois Creek



San Bois Creek



San Bois Creek



San Bois Creek

**PROPOSED MITIGATION AREA PHOTOS**



West of Muskogee Turnpike



West of Muskogee Turnpike



West of Muskogee Turnpike



West of Muskogee Turnpike



E0960



E0960



E0960



E0960





North of I40



North of I40



North of I40



North of I40



Drake Road



Drake Road



Drake Road



Drake Road



Missouri Pacific Railroad East



Missouri Pacific Railroad East



Missouri Pacific Railroad East



Missouri Pacific Railroad East



Missouri Pacific Railroad West



Missouri Pacific Railroad West



Missouri Pacific Railroad West



Missouri Pacific Railroad West



CR4530



CR4530



CR4530



CR4530



Tract 1304



Tract 1304



Tract 1304



Tract 1304

## **Attachment B**



West Muskogee Turnpike: This site will need minor grading around the edges of the neon green polygon. There is a slight increase in elevation ~3 feet.

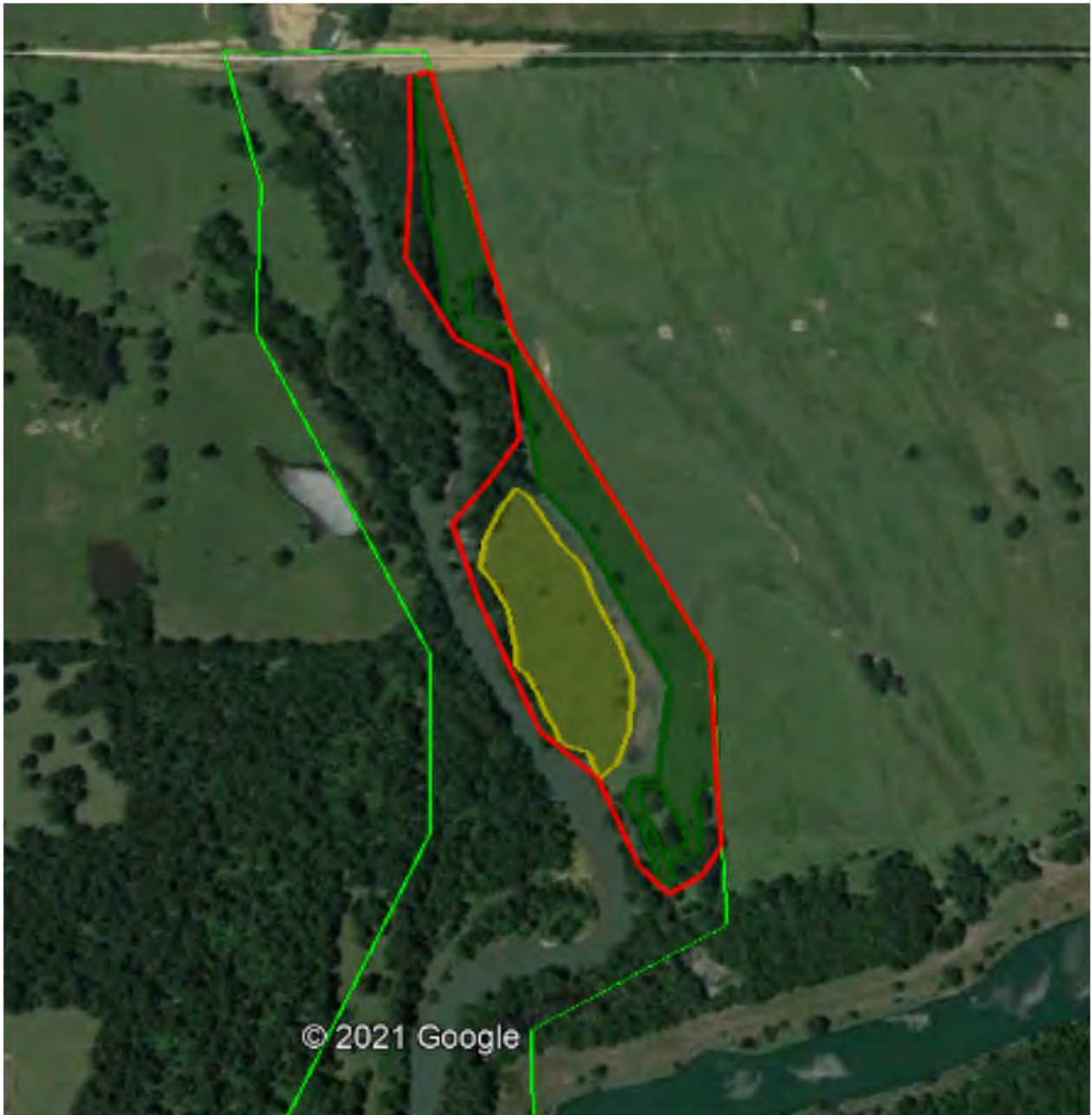




E0960: Grading in the area within the blue circle to match the rest of the green polygon. Approximate change in elevation between 4 to 9 feet. Approximately 1.0 miles of fencing.



North I40: No grading required.



Drake Road: No grading required.

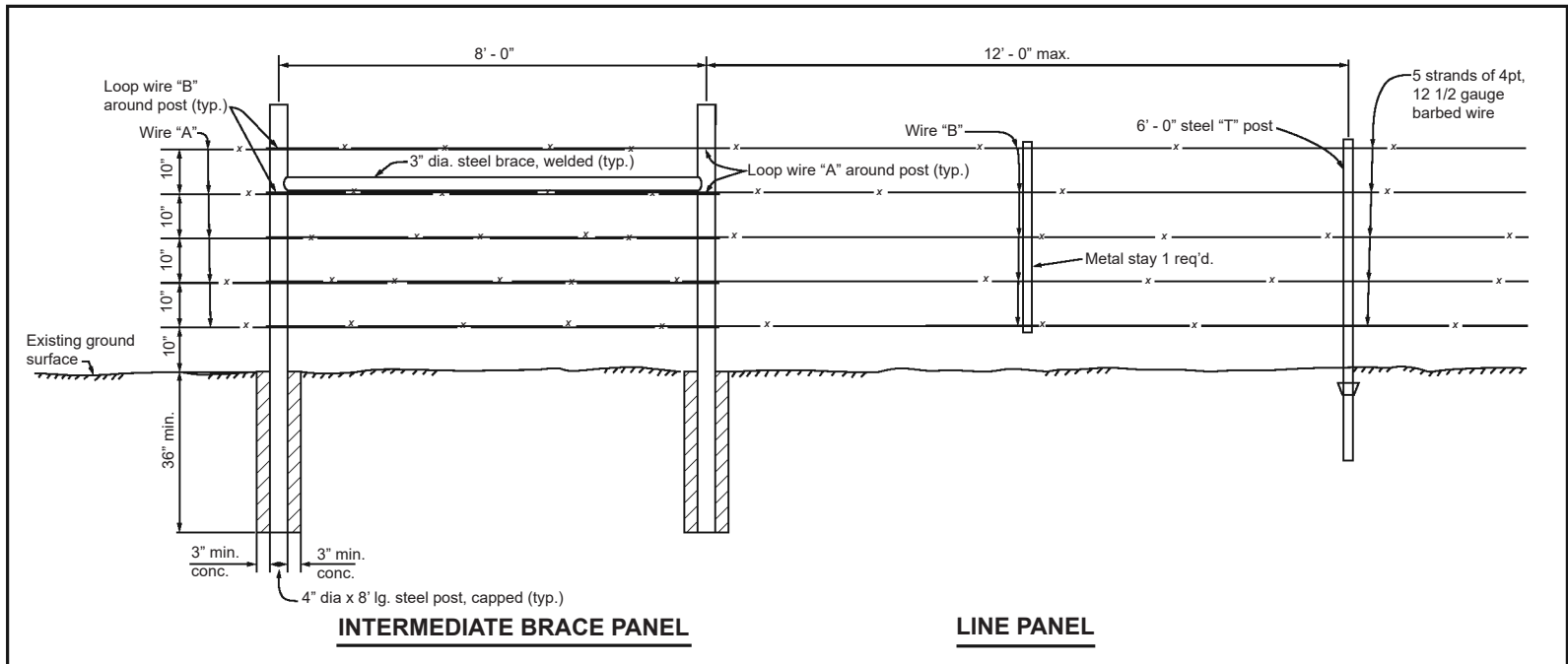
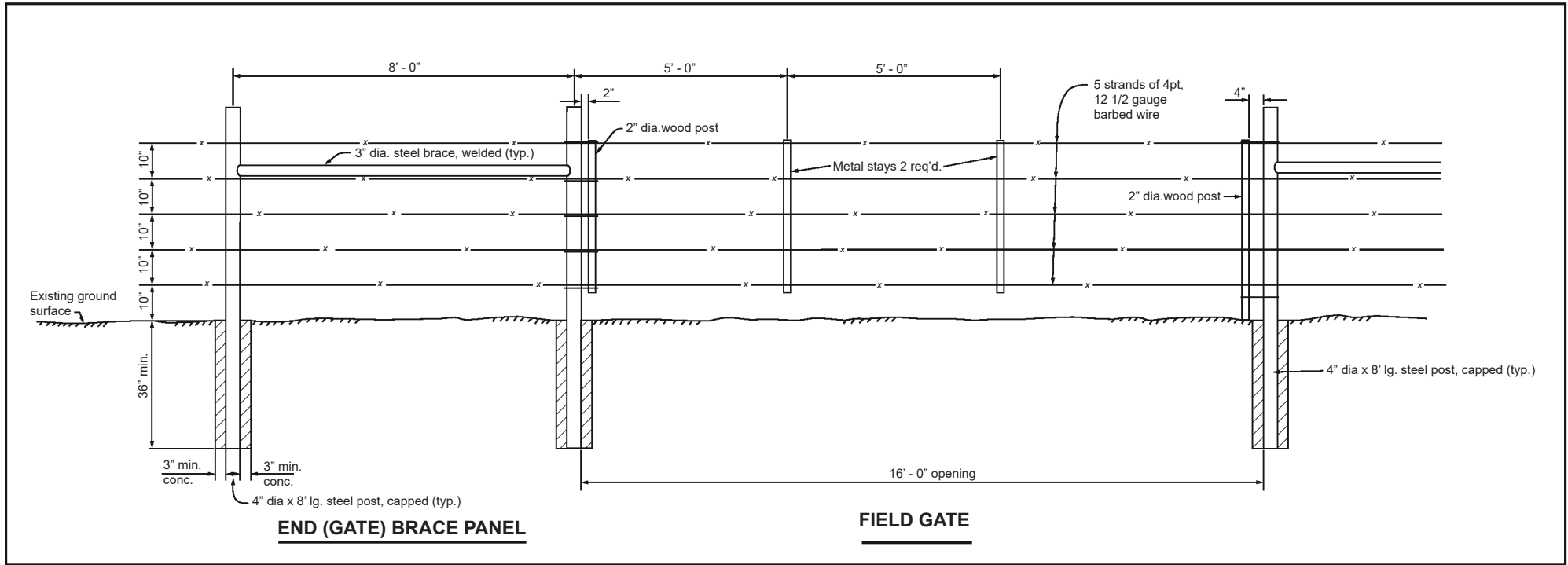


Missouri Pacific Railroad East: Light pockets of grading within neon green and yellowish polygon. No steep slopes, only enough to create minor sumps or depressions.



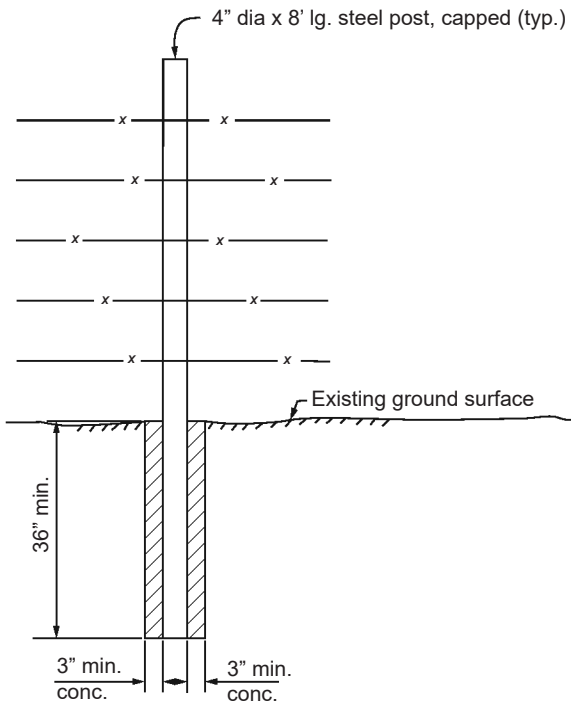
Missouri Pacific Railroad West: Minor grading, perhaps 10'x10' or 20'x20 to allow for better drainage to the rest of the site.

## Attachment C





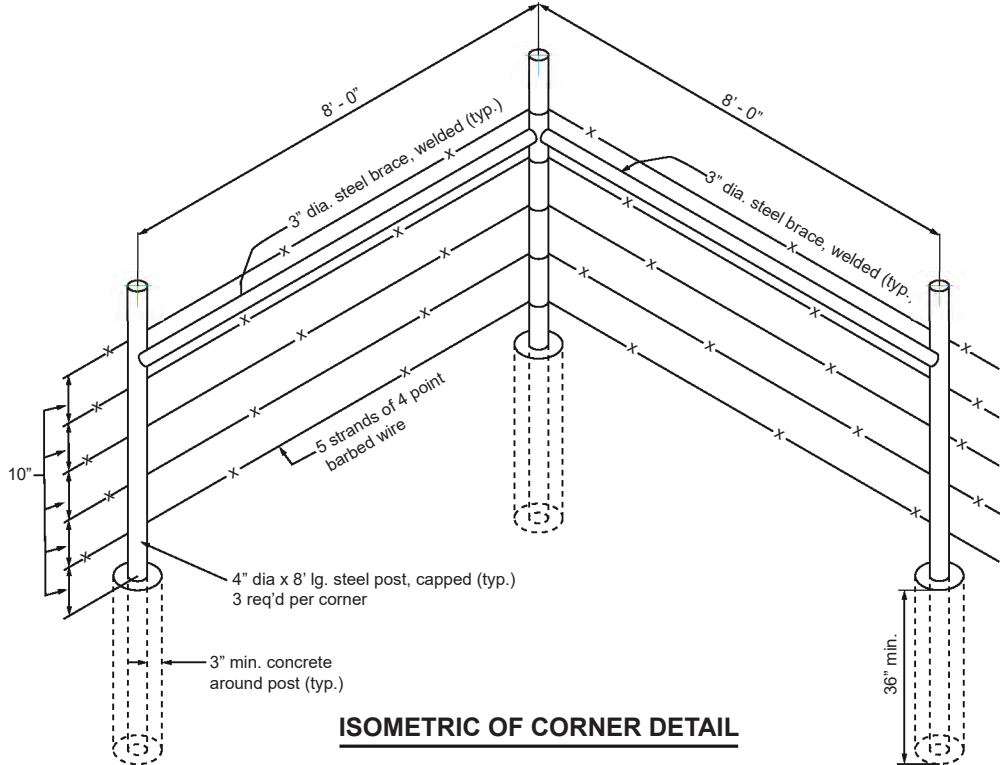




### **ANCHOR POST**

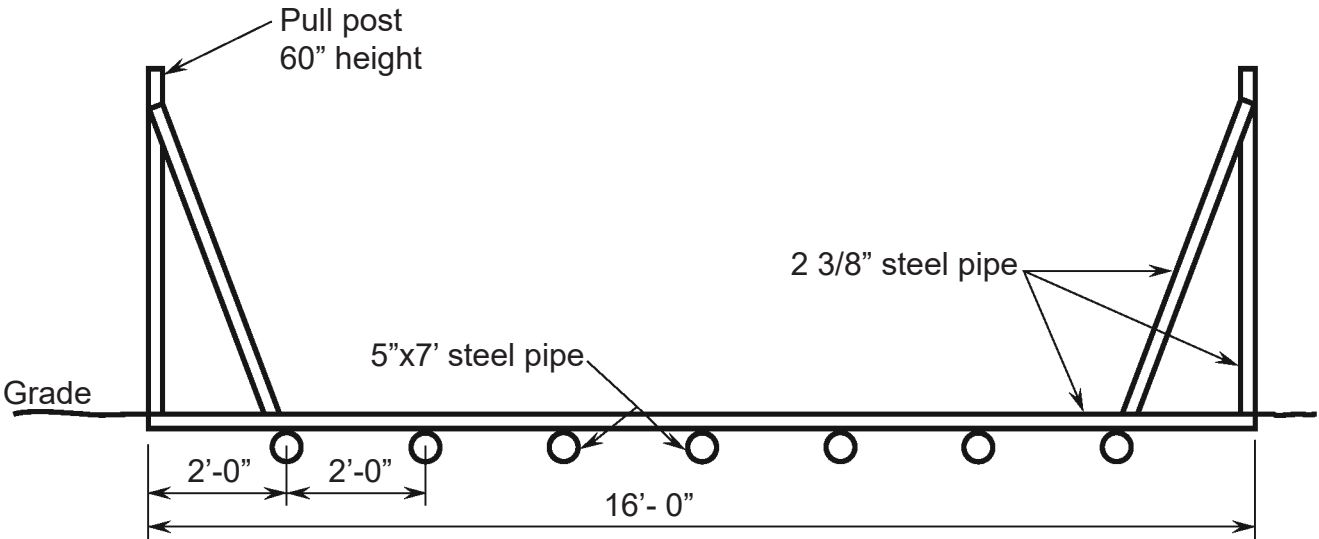
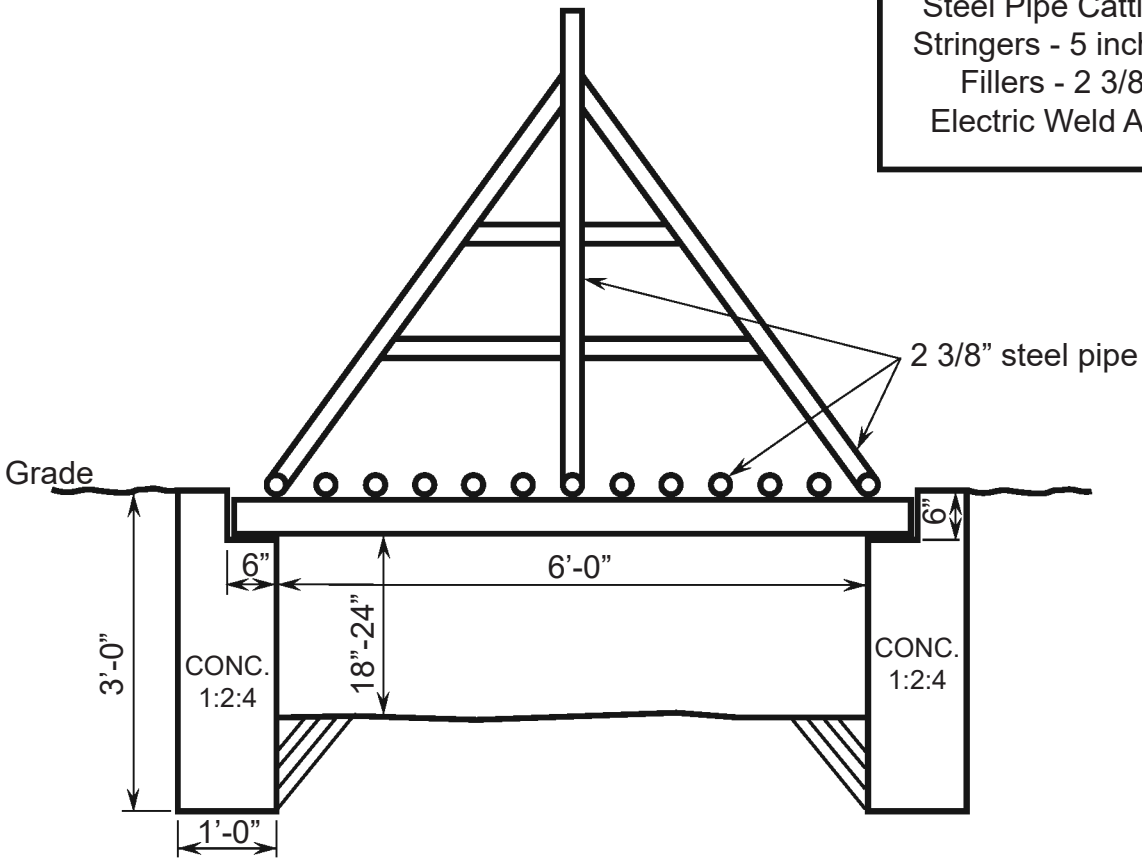
**NOTES:**

1. Used where fence alignment changes are 5 degrees or greater, but less than 10 degrees.
2. Used at bottom of sharp vertical breaks to prevent uplift from removing normally set post.



### **ISOMETRIC OF CORNER DETAIL**

**SPECIFICATIONS**  
 Steel Pipe Cattle Guard  
 Stringers - 5 inch x 7 foot  
 Fillers - 2 3/8 inch  
 Electric Weld All Joints



## Attachment D

## NATIONWIDE STANDARD CONSERVATION MEASURES

Listed below are effective measures that should be employed at all project development sites nationwide with the goal of reducing impacts to birds and their habitats. These measures are grouped into three categories: General, Habitat Protection, and Stressor Management. These measures may be updated through time. We recommend checking the Conservation Measures website regularly for the most up-to-date list.

### 1. General Measures

- a. Educate all employees, contractors, and/or site visitors of relevant rules and regulations that protect wildlife. See the Service webpage on Regulations and Policies for more information on regulations that protect migratory birds.
- b. Prior to removal of an inactive nest, ensure that the nest is not protected under the Endangered Species Act (ESA) or the Bald and Golden Eagle Protection Act (BGEPA). Nests protected under ESA or BGEPA cannot be removed without a valid permit. i. See the Service Nest Destruction Policy
- c. Do not collect birds (live or dead) or their parts (e.g., feathers) or nests without a valid permit. Please visit the Service permits page for more information on permits and permit applications.
- d. Provide enclosed solid waste receptacles at all project areas. Non-hazardous solid waste (trash) would be collected and deposited in the on-site receptacles. Solid waste would be collected and disposed of by a local waste disposal contractor. For more information about solid waste and how to properly dispose of it, see the EPA Non-Hazardous Waste website.
- e. Report any incidental take of a migratory bird, to the local Service Office of Law Enforcement.
- f. Consult and follow applicable Service industry guidance.

### 2. Habitat Protection

- a. Minimize project creep by clearly delineating and maintaining project boundaries (including staging areas).
- b. Consult all local, State, and Federal regulations for the development of an appropriate buffer distance between development site and any wetland or waterway. For more information on wetland protection regulations see the Clean Water Act sections 401 and 404.
- c. Maximize use of disturbed land for all project activities (i.e., siting, lay-down areas, and construction).
- d. Implement standard soil erosion and dust control measures. For example: i. Establish vegetation cover to stabilize soil ii. Use erosion blankets to prevent soil loss iii. Water bare soil to prevent wind erosion and dust issues

### 3. Stressor Management

#### **Stressor: Vegetation Removal**

**Conservation Goal:** Avoid direct take of adults, chicks, or eggs.

**Conservation Measure 1:** Schedule all vegetation removal, trimming, and grading of vegetated areas outside of the peak bird breeding season to the maximum extent practicable. Use available resources, such as internet-based tools (e.g., the FWS's Information, Planning and Conservation system and Avian Knowledge Network) to identify peak breeding months for local

bird species; or, contact local Service Migratory Bird Program Office for breeding bird information.

**Conservation Measure 2:** When project activities cannot occur outside the bird nesting season, conduct surveys prior to scheduled activity to determine if active nests are present within the area of impact and buffer any nesting locations found during surveys.

- 1) Generally, the surveys should be conducted no more than five days prior to scheduled activity.
- 2) Timing and dimensions of the area to be surveyed vary and will depend on the nature of the project, location, and expected level of vegetation disturbance.
- 3) If active nests or breeding behavior (e.g., courtship, nest building, territorial defense, etc.) are detected during these surveys, no vegetation removal activities should be conducted until nestlings have fledged or the nest fails or breeding behaviors are no longer observed. If the activity must occur, establish a buffer zone around the nest and no activities will occur within that zone until nestlings have fledged and left the nest area. The dimension of the buffer zone will depend on the proposed activity, habitat type, and species present and should be coordinated with the local or regional Service office.
- 4) When establishing a buffer zone, construct a barrier (e.g., plastic fencing) to protect the area. If the fence is knocked down or destroyed, work will suspend wholly, or in part, until the fence is satisfactorily repaired.
- 5) When establishing a buffer zone, a qualified biologist will be present onsite to serve as a biological monitor during vegetation clearing and grading activities to ensure no take of migratory birds occurs. Prior to vegetation clearing, the monitor will ensure that the limits of construction have been properly staked and are readily identifiable. Any associated project activities that are inconsistent with the applicable conservation measures, and activities that may result in the take of migratory birds will be immediately halted and reported to the appropriate Service office within 24 hours.
- 6) If establishing a buffer zone is not feasible, contact the Service for guidance to minimize impacts to migratory birds associated with the proposed project or removal of an active nest. Active nests may only be removed if you receive a permit from your local Migratory Bird Permit Office. A permit may authorize active nest removal by a qualified biologist with bird handling experience or by a permitted bird rehabilitator.

**Conservation Measure 3:** Prepare a vegetation maintenance plan that outlines vegetation maintenance activities and schedules so that direct bird impacts do not occur.

#### **Stressor: Invasive Species Introduction**

**Conservation Goal:** Prevent the introduction of invasive plants.

**Conservation Measure 1:** Prepare a weed abatement plan that outlines the areas where weed abatement is required and the schedule and method of activities to ensure bird impacts are avoided.

**Conservation Measure 2:** For temporary and permanent habitat restoration/enhancement, use only native and local (when possible) seed and plant stock.

**Conservation Measure 3:** Consider creating vehicle wash stations prior to entering sensitive habitat areas to prevent accidental introduction of non-native plants.

**Conservation Measure 4:** Remove invasive/exotic species that pose an attractive nuisance to migratory birds.

### Stressor: Artificial Lighting

**Conservation Goal:** Prevent increase in lighting of native habitats during the bird breeding season.

**Conservation Measure 1:** To the maximum extent practicable, limit construction activities to the time between dawn and dusk to avoid the illumination of adjacent habitat areas.

**Conservation Measure 2:** If construction activity time restrictions are not possible, use down shielding or directional lighting to avoid light trespass into bird habitat (i.e., use a 'Cobra' style light rather than an omnidirectional light system to direct light down to the roadbed). To the maximum extent practicable, while allowing for public safety, low intensity energy saving lighting (e.g. low pressure sodium lamps) will be used.

**Conservation Measure 3:** Minimize illumination of lighting on associated construction or operation structures by using motion sensors or heat sensors.

**Conservation Measure 4:** Bright white light, such as metal halide, halogen, fluorescent, mercury vapor and incandescent lamps should not be used.

### Stressor: Human Disturbance

**Conservation Goal:** Minimize prolonged human presence near nesting birds during construction and maintenance actions.

**Conservation Measure 1:** Restrict unauthorized access to natural areas adjacent to the project site by erecting a barrier and/or avoidance buffers (e.g., gate, fence, wall) to minimize foot traffic and off-road vehicle uses.

### Stressor: Collision

**Conservation Goal:** Minimize collision risk with project infrastructure and vehicles.

**Conservation Measure 1:** Minimize collision risk with project infrastructure (e.g., temporary and permanent) by increasing visibility through appropriate marking and design features (e.g., lighting, wire marking, etc.).

**Conservation Measure 2:** On bridge crossing areas with adjacent riparian, beach, estuary, or other bird habitat, use fencing or metal bridge poles (Sebastian Poles) that extend to the height of the tallest vehicles that will use the structure.

**Conservation Measure 3:** Install wildlife friendly culverts so rodents and small mammals can travel under any new roadways instead of over them. This may help reduce raptor deaths associated with being struck while tracking prey or scavenging road kill on the roadway.

**Conservation Measure 4:** Remove road-kill carcasses regularly to prevent scavenging and bird congregations along roadways.

**Conservation Measure 5:** Avoid planting "desirable" fruited or preferred nesting vegetation in medians or Rights of Way.

**Conservation Measure 6:** Eliminate use of steady burning lights on tall structures (e.g., >200 ft).

### Stressor: Entrapment

**Conservation Goal:** Prevent birds from becoming trapped in project structures or perching and nesting in project areas that may endanger them.

**Conservation Measure 1:** Minimize entrapment and entanglement hazards through project design measures that may include:

1. Installing anti-perching devices on facilities/equipment where birds may commonly nest or perch
2. Covering or enclosing all potential nesting surfaces on the structure with mesh netting, chicken wire fencing, or other suitable exclusion material prior to the nesting season to prevent birds from establishing new nests. The netting, fencing, or other material must have no opening or mesh size greater than 19 mm and must be maintained until the structure is removed.
3. Cap pipes and cover/seal all small dark spaces where birds may enter and become trapped.

**Conservation Measure 2:** Use the appropriate deterrents to prevent birds from nesting on structures where they cause conflicts, may endanger themselves, or create a human health and safety hazard.

1. During the time that the birds are trying to build or occupy their nests (generally , between April and August, depending on the geographic location), potential nesting 5 surfaces should be monitored at least once every three days for any nesting activity, especially where bird use of structures is likely to cause take. It is permissible to remove non-active nests (without birds or eggs), partially completed nests, or new nests as they are built (prior to occupation). If birds have started to build any nests, the nests shall be removed before they are completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.
2. If an active nest becomes established (i.e., there are eggs or young in the nest), all work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied. Construction activities that may displace birds after they have laid their eggs and before the young have fledged should not be permitted. If the project continues into the following spring, this cycle shall be repeated. When work on the structure is complete, all netting shall be removed and properly disposed of.

**Stressor: Noise**

**Conservation Goal:** Prevent the increase in noise above ambient levels during the nesting bird breeding season.

**Conservation Measure 1:** Minimize an increase in noise above ambient levels during project construction by installing temporary structural barriers such as sand bags

**Conservation Measure 2:** Avoid permanent additions to ambient noise levels from the proposed project by using baffle boxes or sound walls.

**Stressor: Chemical Contamination**

**Conservation Goal:** Prevent the introduction of chemicals contaminants into the environment.

**Conservation Measure 1:** Avoid chemical contamination of the project area by implementing a Hazardous Materials Plan. For more information on hazardous waste and how to properly manage hazardous waste, see the EPA Hazardous Waste website.

**Conservation Measure 2:** Avoid soil contamination by using drip pans underneath equipment and containment zones at construction sites and when refueling vehicles or equipment.

**Conservation Measure 3:** Avoid contaminating natural aquatic and wetland systems with runoff by limiting all equipment maintenance, staging laydown, and dispensing of fuel, oil, etc., to designated upland areas.

**Conservation Measure 4:** Any use of pesticides or rodenticides shall comply with the applicable Federal and State laws.

1. Choose non-chemical alternatives when appropriate

2. Pesticides shall be used only in accordance with their registered uses and in accordance with the manufacturer's instructions to limit access to non-target species.

3. For general measures to reducing wildlife exposure to pesticides, see EPA's Pesticides: Environmental Effects website.

**Stressor: Fire**

**Conservation Goal:** Minimize fire potential from project-related activities.

**Conservation Measure 1:** Reduce fire hazards from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off road).

**Conservation Measure 2:** Consider fire potential when developing vegetation management plans by planting temporary impact areas with a palette of low-growing, sparse, fire resistant native species that meet with the approval of the County Fire Department and local FWS Office.