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USFWS Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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In Reply Refer To:
FWS/R2/OKES/
02-14-04-F-0172

June 28, 2005

District Engineer
Attn: Planning, Environmental, and Regulatory Division
U.S. Army Corps of Engineers
1645 South 101st East Avenue
Tulsa, Oklahoma 74128-4609

Dear Colonel Kurka:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (opinion) pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq*.). This joint U.S. Army Corps of Engineers (Corps) and Southwestern Power Administration (SWPA) action involves operating multipurpose projects on the Red River from Lake Texoma to Index, Arkansas, the Canadian River from Eufaula Lake to the Arkansas River confluence, and all of the McClellan Kerr Arkansas River Navigation System (MKARNS) excluding Grand Lake. The Corps is the lead Federal agency for this consultation.

The Service has reviewed the recent information provided by the Corps for the Grand Lake portion of the MKARNS. We agree that, with modifications proposed by the Corps, Phase I and II of the Arkansas River Navigation Study (ARNS) are not likely to significantly affect Corps operations at that reservoir. Although the ARNS may not increase the frequency of flooding within gray bat *Myotis grisescens* maternity caves, the existing Corps flood control operations at Grand Lake occasionally flood these caves and may flood Neosho madtom *Noturus placidus* habitat upstream. It is unlikely that flood control operations could be sufficiently altered to completely avoid adverse effects to federally-listed species, and formal consultation regarding these operations likely will be required to comply with section 7 of the ESA. However, we agree with your request to delay this consultation until appropriate data can be obtained regarding potential impacts to listed species at that reservoir. We continue to recommend that this consultation include the Federal Energy Regulatory Commission, because some of their ongoing and future actions (such as hydropower generation and a potential new rule curve) are interrelated with the Corps flood control operations at Grand Lake. We agree that a separate consultation would allow time for necessary studies to be conducted at Grand Lake and allow the consultation on the remainder of the proposed action to continue on schedule. However, until that consultation is completed, the Corps currently has no exemption from section 9 of the ESA for take related to flood control operations at Grand Lake.

At least seventeen federally-listed species occur in or near the Action Area. The Corps determined in their Biological Assessment (BA) that only four are likely to be affected by the proposed action (when the Grand Lake portion is excluded). The Service concurs with the Corps' determination that the endangered American burying beetle *Nicrophorus americanus* (ABB) and interior population of the least tern *Sterna antillarum* (hereafter referred to as least tern) may be affected by the proposed action. The Corps has agreed to incorporate actions recommended by the Service to minimize adverse effects to these species, but adverse effects to the ABB and least tern are not completely avoided by the proposed action.

Information related to potential project-related impacts for the remaining two of these four species is limited. Potential impacts to the threatened bald eagle *Haliaeetus leucocephalus* related to contaminants in the dredged material cannot be fully assessed until testing of sediments to be dredged is completed and the status of the endangered pallid sturgeon *Scaphirhynchus alba* in the Action Area is unknown. There are no records of the species occurring in the Action Area, but the Service agrees that pallid sturgeon could occur there. The Service agrees that the proposed action may affect both the bald eagle and pallid sturgeon, but based on the existing information, we would support a "not likely to adversely affect" determination for both species. The preliminary contaminants information for sediments does not suggest impacts to bald eagles are likely and the proposed changes in flows are unlikely to affect potential pallid sturgeon habitat. Therefore, the bald eagle and pallid sturgeon will not be addressed in this consultation. While the Service does not anticipate that the proposed project would impact these species, if new information indicates the contrary, then the Corps should reinitiate consultation.

The Ivory-billed woodpecker *Campephilus principalis* was recently discovered in or near portions of the Action Area after the BA was prepared and was not addressed in the BA. The Corps has determined that the proposed action is not likely to adversely affect the Ivory-billed woodpecker and we concur with that determination, but we invite the Corps to assist in recovery actions for this species.

This opinion emphasizes anticipated effects of the proposed action on the least tern and is based on the best available scientific and commercial information, including the Corps BA, Service files, pertinent literature, discussions with recognized species authorities, and other reliable sources. A complete administrative record of this consultation is on file in the Oklahoma Ecological Service's Field Office (OKES) in Tulsa.

CHRONOLOGY OF SECTION 7 EVENTS/CONSULTATION HISTORY

The Corps has been attempting to operate Kaw and Keystone Reservoirs on the Arkansas River in Oklahoma under the provisions of a biological opinion completed on March 16, 1998. Since that time, incidental take has been exceeded in at least two years and some terms and conditions in the biological opinion have not been fully implemented. After several meetings and review of operating conditions for the Arkansas River with respect to terms and conditions established in the 1998 opinion, the Corps decided to reinitiate consultation.

In August 1998, the Service also requested the Corps initiate section 7 consultation for Corps actions on the Canadian River below Eufaula Reservoir and the Red River below Denison Dam. The Corps agreed in their November 6, 1998, letter and two BAs concluding a "may affect" determination were subsequently prepared and provided by the Corps. Additional information was requested by the Service for both BAs. After reviewing the proposed action, the Corps and Service agreed to combine the ongoing consultations on the Red, Arkansas, and Canadian Rivers.

The combined proposed action now includes two additional studies that would impact federally-listed species. The first study is the ARNS, which initially consisted of two phases. Phase I would have addressed system operations of the MCKARNS, and Phase II would address proposed channel modifications. The second study involves revising the Dredge Material Disposal Management Plan for the Oklahoma portion of the MCKARNS. The Corps also formed a multi-agency Least Tern Committee in 2002 to develop and provide comprehensive guidelines for management and protection of least terns nesting below Corps water resource projects on the Arkansas, Canadian, and Red Rivers. These management guidelines and strategies have been implemented by the Corps and are now part of the proposed action.

A chronology of previous section 7 consultation activities prior to 1998 on the Arkansas River system in Oklahoma can be found in the Service's opinion dated March 16, 1998. This opinion provides a history of all activities and correspondence from the start of informal consultation in 1986 to issuance of the opinion in 1998. The following is an update of all events and issues with respect to the consultation since issuance of the 1998 opinion for the Arkansas River:

- August 11, 1998. Service letter to Corps requesting Corps initiate formal consultation and begin efforts to minimize adverse effects on the Interior least tern at Corps projects on the Canadian and Red Rivers.

- November 6, 1998. Corps letter to Service agreeing that Corps would survey Red and Canadian rivers in 1999 and use the information to prepare a BA.

- March 13, 2001. Corps study plan for nesting habitat evaluation furnished to Service. This study plan would initiate implementation of Reasonable and Prudent Measure No. 5 of the 1998 opinion.

- March 15, 2001. Corps letter to Service stating that the Tulsa District has and will assume the lead responsibility for any future consultation on the operation of Kaw and Keystone per Memorandum of Understanding (MOU) dated July 23, 1980, signed by the Administrator, SWPA and the Corps Division Engineer, Southwestern Division. The MOU states, "The administrator recognizes the Corps responsibility to operate the projects to serve all authorized functions including power."

- April 20, 2001. Interagency meeting between Service, Corps, SWPA, and U.S. Department of Interior (DOI), Office of the Field Solicitor. The meeting was conducted

to resolve agency differences with respect to compliance with the ESA, section 7 consultation requirements, and ways to improve communication among the agencies.

- May 31, 2001. Service letter notifying Corps and SWPA that they should avoid and minimize "take" related to operation of projects on the Canadian and Red rivers and should reinitiate consultation for the Arkansas River projects.

- July 02, 2001. Corps submitted a "may affect" BA to Service on the effects of operating Denison Dam on the Red River and requested initiation of formal section 7 consultation.

- August 14, 2001. Service letter acknowledging receipt of the BA for the operation of Denison Dam on the Red River and concurring with the findings. The Service requested additional information on the Corps proposed actions to allow development of an accurate assessment of potential take and appropriate recommendations to avoid or minimize take.

- December 18, 2001. Letter from the Corps submitting their BA to Service concerning the effect of operating Eufaula Dam for its federally authorized purposes on the least tern and request for initiation of formal section 7 consultation.

- January 30, 2002. Service letter requesting additional information regarding the proposed action and cumulative effects related to the Eufaula Project.

- February – June 2002. A team was established to develop least tern management guidelines for the Tulsa District. The guidelines were implemented during the 2002-2003 least tern nesting season.

- November 20, 2002. A meeting was held between Corps and Service staff to discuss combining the section 7 consultations for projects on the Red, Canadian, and Arkansas Rivers.

- March 10, 2003. Corps letter notifying the Service of their intent to prepare a revised BA to include all projects on the three river systems.

- April 22, 2003. Service letter supporting the Corps proposal to prepare a BA regarding operation of multi-purpose projects in all three river systems and reminding the Corps and SWPA of obligations to avoid and minimize take until the consultation was completed.

- July 30, 2003. Corps letter to the Service requesting an official list of federally-listed species within the designated action areas.

- August 28, 2003. Service letter updating the list of species previously provided to the Corps in a planning assistance report for the ARNS dated April 2, 2001.

- November 20, 2003. Corps letter transmitting the BA to the Service.

- December 17, 2003. Service letter providing comments on the BA and requesting additional information.

- April 22, 2004. Corps letter to the Service requesting a modification of the proposed action to exclude operations at Grand Lake.

- May 5, 2004. Service letter to the Corps agreeing to modify the proposed action and requesting a description of the modified action and recommending that impacts at Grand Lake be addressed in a separate consultation.

- July 7, 2004. Corps letter to the Service describing the modified action at Grand Lake.

- August 12, 2004. Draft biological opinion provided to the Corps.

- September 30, 2004. Corps letter to the Service providing comments on the draft opinion and describing a change in the proposed action to incorporate standard practices to minimize take of ABBs.

- February 11, 2005. A revised draft biological opinion and transmittal letter provided to the Corps.

- May 17, 2005. Meeting with Colonel Kurka to discuss the Corps' comments on the draft biological opinion. A letter dated May 16, 2005 providing written comments on the revised draft was hand delivered by the Colonel.

Corps, Little Rock Chronology

After meeting with the DOI and the Service in 1985, the Little Rock District entered into consultation pursuant to section 7 of the ESA for operations of the Arkansas portion of the MKARNS. Mr. Fred Bagley of the Jackson, Mississippi Area Office of Region IV was the Service point of contact on this consultation. Mr. Clyde Gates represented the Corps, Little Rock District.

The consultation was initiated because the Arkansas River in Arkansas had been a historic nesting area for the least tern prior to construction of the navigation system. The navigation system at that time consisted of a series of locks and dams, two lakes, and various revetments to better maintain a navigational channel. As a result of the consultation, the Little Rock Corps developed a management plan that would protect and enhance nesting populations of the least tern on the navigation system in Arkansas. The management plan was coordinated with the Arkansas Department of Natural Heritage, the Arkansas Game and Fish Commission, and the Corps' Jackson Area office. The management plan has been in effect since 1986, but has not been fully implemented. The Corps failed to implement appropriate actions to avoid project-related adverse effects to least terns recommended by the Service in a June 3, 1986, letter.

DESCRIPTION OF PROPOSED ACTION

The proposed action is the operation and maintenance of Corps multi-purpose projects for portions of the Arkansas, Red, and Canadian Rivers in Oklahoma, Texas, and Arkansas. The proposed action includes flood control, navigation, water supply, recreation, and hydropower operations (including SWPA operations). The proposed action includes several proposed changes to existing operations, including the ARNS, and reallocation of water supplies in some reservoirs. The least tern management guidelines for the Tulsa District of the Corps (appendix A) are included in the proposed action and the BA references a Least Tern Management Plan (appendix A) has been in effect for the Little Rock District since 1986. A more complete description of the proposed action is provided in the BA (USACE 2003) and is incorporated by reference. The proposed action described in the BA has been subsequently modified by the Corps to:

1. Exclude and modify operations at Grand Lake in Oklahoma and initiate consultation for those operations at a later date.

2. Incorporate standard actions (such as conducting surveys and baiting away) recommended by the Service to minimize take of the ABB.

On September 30, 2004, the Corps submitted a letter of amendment to the BA. This amendment addressed conservation measures that the Corps and SWPA have incorporated into their project implementation methods to minimize adverse impacts to the ABB.

The following description of construction Best Management Practices (BMPs) for minimizing adverse effects to the ABB is included in the proposed action:

1. The Corps will evaluate the likelihood of ABBs in the project area by reviewing the Service's Oklahoma Ecological Services county list of Threatened & Endangered species at: <http://ifw2es.fws.gov/Oklahoma/ctylist.htm>.
2. If the project site is in a county where the ABB *is not* believed to occur, the Corps will proceed without further precautions with regard to the ABB.
3. If the project site is in a county where the ABB is known to occur, the Corps will evaluate the project area for ABB habitat. If the project site is confined to one or more of the following habitats, the Corps will conclude that the habitat is not suitable for the ABB and proceed without further precautions with regard to the ABB.
    - Land that has already been developed and no longer exhibits surficial topsoil or leaf litter.
    - Land that is tilled on at least an annual basis.
    - Soil that is greater than 70 percent sand.
    - Soil that is greater than 70 percent clay.
    - Land where greater than 80 percent of the soil surface is comprised of rock.

- Land where greater than 80 percent of the subsurface soil structure within the top 4 inches is comprised of rock.
- Land that meets the Corps definition of wetland. (However, projects developed in this type of habitat will need to be reviewed by the Corps to ensure compliance with section 404 of the Clean Water Act.)

4. Projects in areas that exhibit suitable habitat for the ABB, *i.e.*, do not exhibit the above characteristics, will be evaluated by the Corps for the presence/absence of the ABB in the immediate project area. This will be done by reviewing the Service's database of ABB surveys at: <http://ifw2es.fws.gov/oklahoma/beetle1.htm>.
5. If a nearby ABB survey (within a five-mile radius of the proposed construction site) is found, the Corps will apply the survey results to the project site. If both positive and negative surveys are found to be applicable, positive surveys will always be applied over negative surveys.
6. If applicable survey results are negative for ABB occurrences, the Corps will proceed with the project without further precautions with regard to the ABB.
7. If applicable survey results are positive for the ABB, the Corps will proceed with the project as follows:
    - Whenever possible, the Corps will postpone construction until the active season of the ABB, *i.e.*, between May 20 and September 20, when nighttime temperatures average above 60°F. The Corps will begin construction only after implementing the Service's current Baiting Away protocol or current Trapping and Relocating protocol whichever is determined more appropriate.
8. If there are no existing surveys applicable to the proposed construction site and the construction will occur during (or can be postponed until) the active season of the ABB, the Corps will either:
    - Assume ABBs are present and implement the Service's current Baiting Away protocol.
    - Conduct an ABB survey of the project area.
9. If an ABB survey of the project area is negative, the project will proceed without further precautions with regard to the ABB.
10. If an ABB survey of the project area is positive, the Service's current Baiting Away protocol or current Trapping and Relocating protocol will be utilized prior to proceeding with the project.

This opinion addresses effects to federally-listed species related to Corps studies, and operational and management activities on projects located within these areas:

- The main stem of the Arkansas River from Kaw Reservoir to Muskogee, Oklahoma, the MCKARNS, and the impacts of 11 operational Oklahoma reservoirs associated

with releases into the MCKARNS downstream to the mouth of the White River in Arkansas and then to the Mississippi River. These operational reservoirs include Keystone Lake, Oologah Lake, Grand Lake, Lake Hudson, Fort Gibson Lake, Tenkiller Ferry Lake, Eufaula Lake, Kaw Lake, Hulah Lake, Copan Lake, and Wister Lake.

- Lake Eufaula and a total of 27 miles of the Canadian River from Eufaula Dam to the confluence of the MCKARNS.

- Lake Texoma and approximately 240 miles of the Red River from below Denison Dam to Index, Arkansas.

The Action Area is shown in Figure 1 below.

SECTION II. DESCRIPTION OF ACTION AREAS

A. Action Area I, Arkansas River (Kaw Lake to Muskogee, Oklahoma)

Kaw Lake is a main stem impoundment on the Arkansas River located at river mile 653.7. This reservoir was constructed by the Corps for flood control, water supply, water quality, recreation, and fish and wildlife and became operational in May 1976. Keystone Lake is also a main stem impoundment bisecting the Arkansas River at river mile 538.8, about 15 miles upstream of Tulsa, Oklahoma. This reservoir was constructed by the Corps for flood control, water supply, hydroelectric power, navigation, and fish and wildlife and became operational on May 21, 1968. Water released from Kaw and Keystone dams in the form of regulated flood flow, water quality, and hydropower releases contributes to main stem flows on the Arkansas River and largely influences flows under most conditions. Reaches within Action Area I to be considered and evaluated in this opinion are defined as follows:

- The 114.9-mile reach of the Arkansas River from Kaw Lake to Keystone Dam.

The 78.6-mile reach of the main stem of the Arkansas River from below Keystone Dam to its confluence with the Verdigris River and the MCKARNS at navigation mile 395 (See Figure 1).

B. Action Area II. Arkansas River Navigation Study (Verdigris and Arkansas Rivers, Oklahoma-Arkansas, Phases I and II)

The Corps, Tulsa District and Little Rock District, are conducting a combined study effort for the Arkansas River Navigation Feasibility Study that initially consisted of two phases. The Corps decided to combine the two phases into a single comprehensive study based on comments received during the National Environmental Policy Act scoping process for Phase I and Phase II (Notice of Intent published in the July 16, 2004, issue of the *Federal Register*). However, the two phases are kept separate in this opinion, because they are separate in the BA.

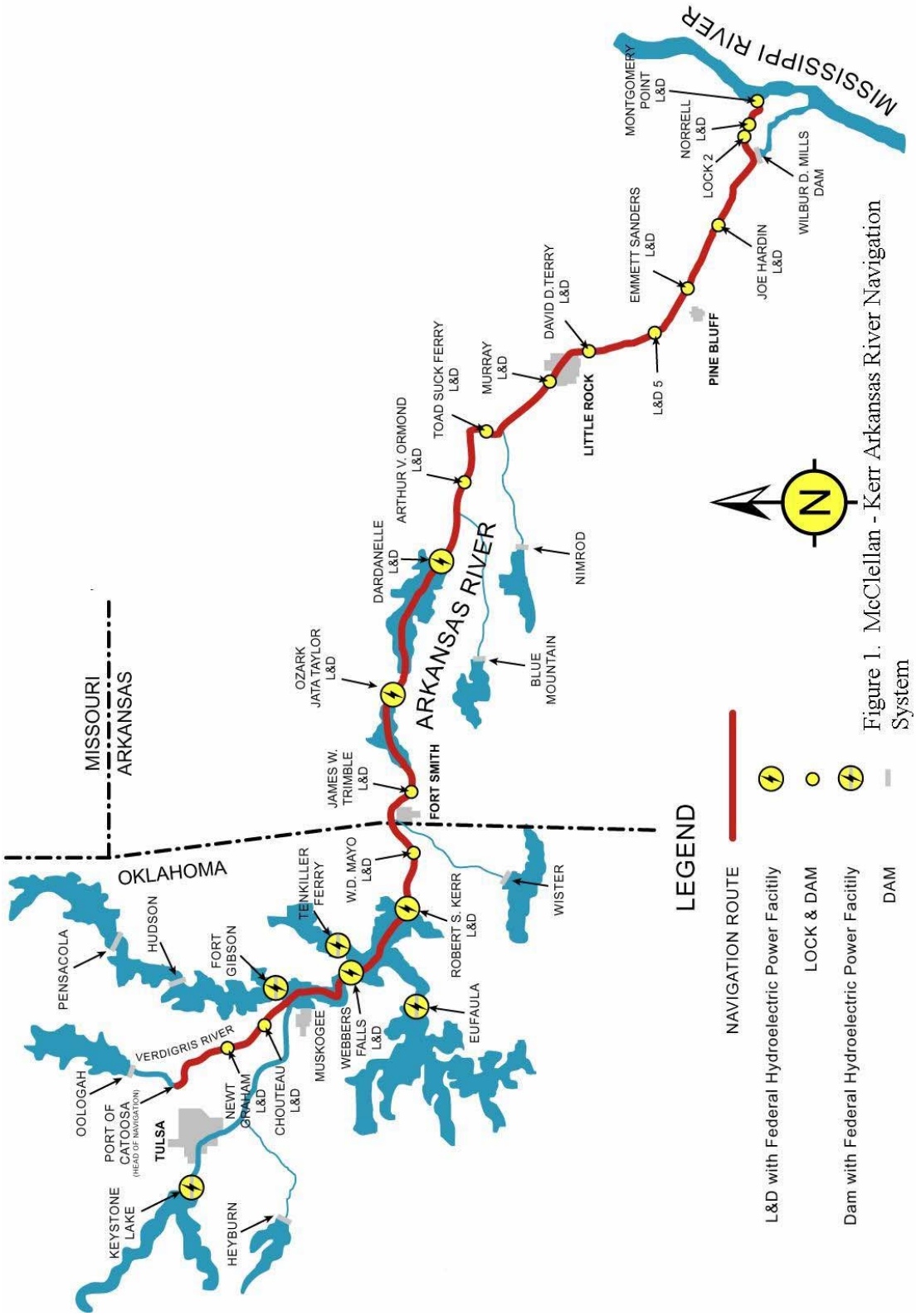

Figure 1. McClellan - Kerr Arkansas River Navigation System

Phase I was intended to develop and evaluate alternatives for implementing solutions to problems resulting from periods of sustained high flows on the MCKARNS. Phase I examined a variety of project alternatives, including operational changes to the existing reservoirs, as well as construction of additional reservoirs or levees along the Arkansas River for navigational flow management. Alternative 4, the Operations Only Plan, is the recommended plan and would increase the number of days in which longer tows of barges could navigate the system. The Operations Only Alternative is defined as the existing operating plan with a modified 60,000 cubic feet per second (cfs) bench (4 days of sustained flow) in place of the 75,000 cfs bench beginning at 3 percent lower system storage except during June 15 through October 1. Phase I, Alternative 4, would call for a 60,000 cfs bench at a system storage level of 8 percent (of the reservoir flood pool) during the spring months and 15 percent during the remainder of the year.

The existing plan calls for a 75,000 cfs bench at a system storage level of 10 percent (of the reservoir flood pool) during the spring months and 18 percent during the remainder of the year. Alternative 4 would accelerate evacuation of flood pools of reservoirs during flood pool rises, but then decrease water releases on the declining side of a flood event. The actual peak flood pool elevations during flood events would not be changed dramatically by the proposed action. Modeling analysis estimates there would be an approximately 14-day reduction in flows above 60,000 cfs as measured at Van Buren, Arkansas and a 2-day increase in flows above 100,000 cfs at Van Buren when compared to the existing operation plan. The analysis revealed essentially no change at flows of 137,000 cfs (channel capacity).

Phase II examines the feasibility of increasing the operational channel depth along the entire MCKARNS by as much as 3 feet (relative to the existing 9 foot minimum channel depth) and potentially widening the Verdigris River portion of the system to allow tows to pass at almost any location on the Verdigris River. Ongoing activities of Phase II include a detailed survey of the navigation channel from the juncture of the system with the Mississippi River to the Port of Catoosa at the head of the navigation channel.

Currently, the Corps is authorized to maintain the MCKARNS at a 9-foot channel depth. Due to ongoing maintenance dredging of the existing navigation channel and natural stream scour, approximately 80-90 percent of the system is already 12-feet deep over at least some portion of the channel width. Changing the authorized channel depth to 12-feet would allow tow drafts on the MCKARNS to match those of the lower Mississippi River system. A number of private and public ports on the system can currently only accommodate tows and barges capable of operating in a 9-foot channel. These ports will have to modify their facilities to accommodate barges with drafts deeper than those allowed by a 9-foot channel.

Current MCKARNS channel widths are 300 feet on the White River Entrance Channel, Arkansas Post Canal, and Lake Langhofer; 250 feet on the Arkansas River; 150 feet on the Verdigris River; and 225 feet on Sans Bois Creek. For most of the MCKARNS, channel width is sufficient to allow tows to pass each other at any location, but passing on the Verdigris River is restricted to only certain wider locations. Increasing the width of the Verdigris River to 300 feet would ease congestion by allowing tows to pass at almost any location on that portion of the system.

Currently, the Corps, Tulsa District and Little Rock District cooperatively control flows in the Arkansas River system in Kansas, Oklahoma, and Arkansas. However, the Little Rock District's operational flexibility in controlling flows is very limited. The action area for the ARNS includes the MCKARNS from the Port of Catoosa near Tulsa, Oklahoma, downstream to the confluence of the Mississippi River in southeastern Arkansas, as well as 11 reservoirs in Oklahoma that influence river flow within the MCKARNS. The MCKARNS action area (Figure 1) is approximately 445 miles in length and consists of a series of 18 locks and dams. Action Area II reaches to be considered and evaluated in this opinion are shown in Figure 1 and defined as follows:

- A 50-mile reach of the Verdigris River from the Port of Catoosa to Muskogee (navigation miles 445 to 394).
- Lower Arkansas River, which comprises 375 miles of the MCKARNS (navigation miles 394 to 19).
- The Arkansas Post Canal, a 9-mile canal connecting the Arkansas River to the lower portion of the White River (navigation miles 19 to 10).
- The lower 10 miles of the White River (navigation miles 10 to 0).
- The lower Arkansas River downstream of Dam 2 (not formally part of the MCKARNS). This portion of the Arkansas River is included in the Arkansas River Navigation Study project area because MCKARNS river flows may also influence this segment of the river.
- Eleven reservoirs in Oklahoma that may influence flows on the upper Arkansas River when operated for flood control, water supply, hydroelectric power, fish and wildlife, recreation, and other benefits. These include Keystone Lake, Oologah Lake, Pensacola (Grand) Lake, Lake Hudson, Fort Gibson Lake, Tenkiller Ferry Lake, Eufaula Lake, Kaw Lake, Hulah Lake, Copan Lake, and Wister Lake.

C. Action Area III, MCKARNS Dredge Material Disposal Management Plan (Verdigris and Arkansas rivers, Oklahoma)

The Oklahoma portion of the MCKARNS includes approximately 140 navigation miles of channel. Channel widths vary throughout, including 250 feet along the Arkansas River, 150 feet along the Verdigris and Poteau rivers, and 225 feet along the Sans Bois Creek. The depth of the navigation channel is approximately 9 feet minimum throughout the MCKARNS. There are five locks and dams within the Oklahoma portion of MCKARNS, including W. D. Mayo (Lock & Dam 14), Robert S. Kerr (Lock & Dam 15), Webbers Falls (Lock & Dam 16), Chouteau (Lock & Dam 17), and Newt Graham (Lock & Dam 18).

The operation and maintenance program for the Oklahoma portion of the MCKARNS is addressed in a Final Environmental Impact Statement (EIS) dated September 1974. This EIS

included the locations of dredge material disposal areas. Operation of the MCKARNS and disposal of dredged materials has occurred at the locations addressed in the final EIS. As part of the ongoing operations and management program, the Tulsa District Corps is evaluating a future 20-year plan for dredging operations for the Oklahoma portion of the MCKARNS. Preliminary findings indicate that additional disposal areas likely will be required to meet the projected 20-year dredging requirements for the Oklahoma portion of the MCKARNS. Consequently, the Dredge Material Disposal Management Plan and all new recommended sites will be evaluated for impacts associated with federally-listed species. The boundaries of the MCKARNS Dredge Material Disposal Management Plan are shown in Figure 1. The reaches of Action Area III to be considered and evaluated in this opinion are defined as follows:

- Along either side of the MCKARNS from the head of navigation on the Verdigris River at Catoosa, Oklahoma, navigation mile 445.2, to the lower limits of the Oklahoma portion of the MCKARNS at navigation mile 308.

D. Action Area IV, Canadian River, Oklahoma

The Canadian River originates in Colfax County, New Mexico, and flows southeasterly through New Mexico and easterly through the Texas Panhandle. It enters Oklahoma and forms the boundary between Ellis and Roger Mills counties. The river then travels eastward some 410 miles across the state of Oklahoma and joins the Deep Fork River and North Canadian River to form Eufaula Lake. Eufaula Lake was constructed by the Corps on the Canadian River at mile 27.0, and became operational in September 1964. Project purposes are flood control, water supply, hydroelectric power, and navigation (sediment control). The Canadian River exits Eufaula Dam and flows eastward to its confluence with the MCKARNS near navigation mile 357 and the Haskell County and Muskogee County line.

In December 2001, the Corps submitted a “may affect” BA to the Service with respect to operations of Eufaula Dam on the lower Canadian River for the least tern, but the Service requested additional information and consultation was not completed. One purpose of the current BA is to update the findings of the 2001 BA and expand it to include all federally-listed threatened and endangered (T&E) species. For assessment purposes, this component of the opinion is defined as follows:

- The 27-mile reach of the main stem of the Canadian River downstream of Eufaula Dam to its confluence with the MCKARNS at navigation mile 359.3.

E. Action Area V, Red River, Lake Texoma to Index, Arkansas; Texas; and Oklahoma

The Red River is one of the two major river systems draining Oklahoma. The River originates from small streams in eastern New Mexico and gradually runs eastward approximately 517 miles to the Oklahoma-Arkansas State line in southwestern Arkansas. In its extreme western reaches it is composed of the Prairie Dog Town Fork of the Red River, which flows southeasterly to form the southern border of Oklahoma east of the 100th meridian. At the confluence of the Prairie Dog Town Fork of the Red River with the Salt and North Forks of the Red River, it continues as

the State's southern border but is referred to simply as the Red River. In Oklahoma, there are 22,791 square miles of contributing drainage area to the Red River. At river mile 725.9, the main stem of the Red River is bisected by Denison Dam (Lake Texoma), which was constructed by the Corps for flood control, water supply, hydroelectric power, regulating flows, and improving navigation. Upon exiting Denison Dam, the river flows approximately 240 miles to Index, Arkansas, which is the eastern limit of the Corps, Tulsa District.

In July 2002, the Corps submitted a "may affect" BA to the Service on operations of Denison Dam on the lower Red River to Index, Arkansas, with respect to the least tern. The Service requested additional information and the consultation was never completed. The BA for the proposed action updates the findings of the 2002 BA and is expanded into a single comprehensive BA for all the noted action areas. For assessment purposes, this opinion will assess the impacts of operating Lake Texoma on all federally-listed species on the Red River to the eastern limits of the Tulsa District. The limits of Action Area V are defined as follows:

- Lake Texoma.
- The 240-mile reach of the Red River below Denison Dam to Index, Arkansas.

STATUS OF THE SPECIES/CRITICAL HABITAT

SPECIES IN THE ACTION AREA

In a Planning Assistance report dated April 2, 2001, the Service furnished a list of 12 federally-listed threatened and or endangered species that possibly could occur in association with the Arkansas River Navigation projects. By letter dated July 30, 2003, the Corps requested an official list of species from the Service for all the proposed action areas. The Service responded by letter dated August 28, 2003, providing four additional species and the Ivory-billed woodpecker was recently added for a total of 17 species to be addressed in this consultation. These species, along with their status and range in Oklahoma and Arkansas are shown in Table 1.

Table 1. Federally Listed Species Occurring in Proposed Action Areas

Species Listings	Status	Range	
		OK	AR
Alligator, American (*Alligator mississippiensis*)	T (S/A)	X	X
Bat, Gray (*Myotis grisescens*)	E	X	X
Bat, Indiana (*Myotis sodalis*)	E	X	X
Bat, Ozark big-eared (*Corynorhinus townsendii ingéns*)	E	X	X
Beetle, American burying (*Nicrophorus americanus*)	E	X	X
Crane, whooping (*Grus americana*)	E	X	X
Eagle, bald (*Haliaeetus leucocephalus*)	T	X	X
Woodpecker, Ivory-billed (*Campephilus principalis*)	E		X
Mucket, pink (*Lampsilis abrupta*)	E	-	X
Mussel, scaleshell (*Leptodea leptodon*)	E	X	X
Plover, piping (*Charadrius melodius*)	T	X	-
Shiner, Arkansas River (*Notropis girardi*)	T	X	X
Sturgeon, pallid (*Scaphirhynchus albus*)	E	-	X
Tern, interior least (*Sterna antillarum*)	E	X	X
Geocarpon minimum *(no common name)*	T	-	X
Orchid, western prairie fringed (*Platanthera praeclara*)	T	X	-
Harperella (*Ptilimnium nodosum*)	E	-	X

STATUS OF AFFECTED SPECIES

At least seventeen federally-listed species historically occurred in or near the Action Area; however, existing information indicates that only the endangered ABB and least tern are likely to be affected by the proposed action. The ABB and least tern are the only species addressed in this consultation.

AMERICAN BURYING BEETLE

The ABB was proposed for federal-listing in October of 1988 (53 FR 39617) and was designated as an endangered species on July 13, 1989 (54 FR 29652) and retains that status. Critical habitat has not been designated for the ABB. The Final Recovery Plan was signed on September 27, 1991.

The ABB is an annual species and typically only reproduces once in their lifetime. They are dependent on carrion for food and reproduction. They often must compete with other invertebrate species, as well as vertebrate species, for carrion. Even though ABBs are considered feeding habitat generalists, they have still disappeared from over 90 percent of their historic range. Habitat loss, alteration, and degradation have been attributed to the decline of the ABB. The U.S. Fish and Wildlife Service (1991) concluded that the most plausible explanation for the decline of ABBs involved habitat fragmentation which creates edge habitat. This habitat change leads to a reduced carrion prey base and an increase in vertebrate scavengers, thus creating more competition and less favorable conditions for the ABB.

Status and Distribution

Historically, the geographic range of the ABB encompassed over 150 counties in 35 states, covering most of temperate eastern North America and part of Canada (USFWS 1991, Peck and Kaulbars 1987). The ABB has disappeared from over 90 percent of its historical range (Ratcliffe 1995). Historic records are known from Texas in the south, north to Montana (single record in 1913) and the southern fringes of Ontario, Quebec, and as far east as Nova Scotia and Florida (USFWS 1991). However, documentation is not uniform throughout this broad historical range. More historic records exist from the Midwest into Canada and in the northeastern United States than from the southern Atlantic and Gulf of Mexico region (USFWS 1991). The last ABB specimens along the mainland of the Atlantic seaboard, from New England to Florida, were collected in the 1940's (USFWS 1991). At the time of listing, in July 1989, known populations were limited to Block Island, Rhode Island; and eastern Oklahoma.

Currently, the ABB is known from only 8 states: on Block Island off the coast of Rhode Island; Nantucket and Peninskee Islands off the coast of Massachusetts; eastern Oklahoma; western Arkansas; Sand Hills in north-central Nebraska; Chautauqua Hills region of southeastern Kansas (Sikes and Raithel 2002); northeastern Texas (Godwin 2003), and in South Dakota (Ratcliff 1996, Bedick *et al.* 1993). Seeming differences in abundance throughout the ABB's range, may however largely be a function of survey intensity. Most extant populations are located on private land. Populations known to exist on public land include: Camp Gruber, Oklahoma; Fort

Chaffee, Arkansas; Sequoyah National Wildlife Refuge, Oklahoma; Block Island National Wildlife Refuge, Rhode Island; and Valentine National Wildlife Refuge, Nebraska (USFWS 1991).

There are currently three captive populations of ABBs. One is at the Roger Williams Park Zoo in Providence, Rhode Island. The second captive population is at the Entomology Department at Ohio State University in Columbus, Ohio. The third is at the St. Louis Zoo in St. Louis, Missouri.

Species Description

The ABB is a member of the beetle family Silphidae (208 species worldwide; Ratcliffe 1996) and is in the subfamily Nicrophorinae. Silphids are scavengers of carrion and play an important role in breaking down decaying matter and recycling it back into the ecosystem. The genus *Nicrophorus* presently contains 85 species distributed in Europe, Asia, and North and South America (Ratcliffe 1996), 15 of which occur in the U.S. (USFWS 1991). *Nicrophorus* species are known to bury vertebrate carcasses for reproductive purposes and exhibit parental care of young. Parental care, generally involving both parents, consists of food provisioning, protection, and direct feeding of larvae during the entire larval stage, demonstrating the highest level of sociality in the beetle order Coleoptera (Ratcliffe 1996).

The ABB is the largest species of its genus in North America, measuring 0.98-1.4 inches in length (USFWS 1991). The body of the ABB is shiny black and has hardened protective wings (elytra) that meet in a straight line down the back. The elytra are smooth, shiny black, and each elytron has two scalloped shaped orange-red markings. The pronotum, or shield over the mid-section between the head and wings, is circular in shape with flattened margins and a raised central portion. The most diagnostic feature of the ABB is the large orange-red marking on the raised portion of the pronotum, a feature shared with no other members of the genus in North America (USFWS 1991). The ABB also has orange-red frons (a mustache-like feature) and a single orange-red marking on the top of the head (triangular in females and rectangular in males). Antennae are large, with notable orange clubs at the tips. The aposematic coloration patterns of *Nicrophorus* appear to deter predation by insectivorous birds, although crows are known to eat the ABB and other *Nicrophorus* species (Ratcliff 1996).

General Life History

The ABB is presumed to be an annual species (USFWS 1991), fully nocturnal, and active when nighttime temperatures consistently (*i.e.*, 5 consecutive nights) exceed 60°F. In Oklahoma this typically occurs from May 20 to September 20 (Oklahoma Climatological Survey 1993-2002). For the remainder of its life cycle, late-September to mid-May, the ABB remains in an inactive condition buried in the soil at depths from 6 inches (Anderson 1982) to at least 36 inches (Kozol *et al*. 1988). American burying beetles feed and breed on a wide variety of carrion. They use keen antennal chemoreceptors to detect the presence of carrion.

INTERIOR LEAST TERN

The life history and status of the least tern are well described in the Service's 2000 (USFWS 2000) and 2003 Biological Opinions (BO) (USFWS 2003) for the Corps' Missouri River operations. The 2003 BO for the Missouri River probably provides the best and most recent available information on the status of the interior population of least terns. A portion of that information is summarized below.

Reproductive Biology

Most least terns begin breeding at age 2 or 3 and spend 4 to 5 months of each year at their breeding sites. They arrive at breeding areas from late April to early June (Youngworth 1930, Hardy 1957, Wycoff 1960, Faanes 1983, Wilson 1984, USFWS 1987, as cited in USFWS 2003). Courtship occurs at the nesting site or at some distance from the nest site (Tomkins 1959, as cited in USFWS 2003). It includes the fish flight, an aerial display involving pursuit and maneuvers culminating in a fish transfer on the ground between two displaying birds. Other courtship behaviors include nest scraping, copulation and a variety of postures and vocalizations (Hardy 1957, Wolk 1974, Ducey 1981, as cited in USFWS 2003).

> "The nest is a shallow and inconspicuous depression in an open, sandy area, gravelly patch, or exposed flat. Small stones, twigs, pieces of wood and debris usually lie near the nest. Least terns nest in colonies as small as a single pair to 100+ pairs and nests can be as close as just a few feet apart or widely scattered up to hundreds of feet (Ducey 1988, Anderson 1983, Hardy 1957, Kirsch 1990, Smith and Renken 1990, Stiles 1939, as cited in USFWS 2003). The birds usually lay two to three eggs (Anderson 1983, Faanes 1983, Hardy 1957, Kirsch 1987, 1988, 1989, Sweet 1985, Smith 1985, as cited in USFWS 2003). Both sexes share incubation which generally lasts 20 to 25 days but has ranged from 17 to 28 days (Moser 1940, Hardy 1957, Faanes 1983, Schwalbach 1988, as cited in USFWS 2003). Least tern chicks hatch within one day of one another and stay near the nest bowl for several days. Least tern chicks usually fledge in about three weeks. Departure from colonies by both adults and fledglings varies, but is usually complete by early September (Bent 1921, Stiles 1939, Hardy 1957, as cited in USFWS 2003)."

Survival and Longevity

Least terns are relatively long-lived birds with some adults surviving more than 20 years, but research on adult survival and comparisons between populations is limited. Little is know about survival rates for juveniles (fledgling to breeding adult).

Dugger *et al*. (2000) estimated chick survival from hatching to fledging for least terns nesting at two sites on the Lower Mississippi River in Missouri using mark-recapture methodology. The mean daily survival rate for least tern chicks at river kilometer (Rkm) 1431 was 0.951 and 0.972 at Rkm 1481. Estimated survival of least tern chicks throughout the entire 17-day fledging interval was 0.43 at Rkm 1431 and 0.62 at Rkm 1481. More detailed information on survival

and longevity of the interior least tern is provided in the Service's 2000 opinion for the Missouri River (USFWS 2000).

Movements/Dispersal Patterns

Least terns are thought to be highly philopatric, but limited data indicate that the degree and spatial scale of breeding site fidelity vary among breeding populations in different geographic areas (Thompson 1997, as cited in USFWS 2003). Massey (1992, as cited in USFWS 2003) found that 95 percent of banded least tern chicks returned to nest within 75 km of their Pacific Coastal natal colony at Huntington Beach, California. Renken and Smith (1995, as cited in USFWS 2003) reported that 97 percent of 78 banded terns returned to within 1.5 to 80 km of the colony where they were banded. On the central Platte River in Nebraska, 28 percent of 109 adults returned to their natal colony (Lingle 1993, as cited in USFWS 2003).

Band returns on least terns, although limited, also show movement within the least tern interior range. Chicks banded in Nebraska nested in Kansas (Boyd 1993, Lingle 1993, as cited in USFWS 2003), and a chick banded on the Missouri River in South Dakota nested on the Lower Platte River in Nebraska (Thompson 1997, as cited in USFWS 2003).

Relatively new genetic information suggests dispersal among Interior, Eastern, and California least tern populations. Whittier (2001) proposed that the three subspecies of least terns do not differ genetically, although the rate of genetic exchange appears to be lower between Interior and California least terns than between Eastern and Interior, and Eastern and California subspecies:

Results of mtDNA and nuclear DNA analysis were somewhat contradictory because nuclear DNA tests revealed less gene flow than did mtDNA; Whittier (2001) suggested this may be an artifact of small sample size rather than a reflection of actual gene flow. The limitations (such as small sample sizes) of Whittier's genetic results suggests the need for additional research and caution in interpreting existing genetic information. Additional genetic research is currently being conducted by the U.S. Geological Survey (USGS) and Oregon State University that may provide more information on gene flow and movement between least tern populations. The USGS genetic research involves much larger sample sizes and genetic markers that may be more appropriate for detecting genetic variability.

Distribution and Status

Least terns are found over a wide range of the central United States. Good descriptions of the historical and current range are provided in the 2000 and 2003 BOs for the Corps' Missouri River operations. They nest on a variety of habitats, but prefer sandbars and islands in major rivers. The number of adult least terns has increased in most areas since the species was listed in 1985. In 2003, over 8,000 least terns were counted on the Lower Mississippi River and these terns represent 67 percent of the total surveyed population of 12,035 adults.

The least tern is a difficult species to census accurately. The least tern frequently shifts nesting sites and timing of nesting varies locally because of weather, habitat availability (*e.g.*, seasonal

duration and timing of flooding of sandbar habitats), and latitude (Thompson, *et al.* 1997). Consistent timing and coverage of surveys is logistically difficult to achieve. The nesting colonies of least terns are ephemeral and occur over a large geographic area that contains remote riverine habitats.

No comprehensive, annual, or regularly scheduled rangewide census for the least tern exists, but the Interior Least Tern Working Group assisting in organizing surveys for 2005 that will cover nearly all of the interior range for nesting least terns. However, several river segments are being surveyed on an annual basis. Many of these surveys are being conducted by the Corps or its contractors. Rivers regularly surveyed by the Corps are the Missouri River, the Arkansas River in Oklahoma, the Red River from Denison Dam to Index, Arkansas, and the Lower Mississippi River. The annual census of the Missouri River is the most comprehensive survey conducted by the Corps. Least Tern surveys also are conducted regularly on the Kansas River, Platte River, North Platte River, Canadian River below Eufaula Dam, and on three National Wildlife Refuges (Salt Plains, Quivera, and Bitter Lake). Efforts are underway by the Service, the Corps, states, and others to develop standard, comprehensive census procedures for least terns. An Interior Least Tern Working Group has been formed to develop recommended monitoring protocols for least terns and their habitat. This is the basic objective of the population assessment measure addressed in the 2000 BO for the Missouri River and the BA.

Table 2 provides a summary of the approximate rangewide number of adult interior least terns. This information represents all available information provided to the Service as of December 2003 and updates the rangewide information provided in the 2000 BO. It is important to note that this table does not represent a complete census; some segments of some rivers are surveyed in one year but not another. Furthermore, no recent surveys have been conducted on the Canadian River above Norman, Oklahoma and the Cimarron River in Oklahoma and Kansas, whereas previous surveys on these two rivers documented important least tern nesting colonies. The Rio Grande River in Texas, another important river segment for least terns, has been sporadically surveyed in recent years. Because it is clear that not all areas have been surveyed recently, we believe that the total abundance estimate in Table 2 is likely a minimum estimate. Better estimates of the rangewide least tern numbers will be available after the 2005 surveys are completed. Most known least tern nesting areas will be surveyed in the summer of 2005.

The estimated number of adult least terns has increased since rangewide summaries were published by Kirsch and Sidle (1999) and in the 2000 BO. Rangewide numbers have increased in the last three years. The number of adult least terns recorded for the Lower Mississippi River in 2003 continues to represent the highest proportion of the interior population (8,082; 67 percent of the total number surveyed).

The number of adult terns surveyed on the Arkansas River, Red River, and Missouri River has increased during the past three years. Although a portion of the increase in tern abundance since

Table 2. Approximate Numbers of Adult Interior Least Terns Throughout the Range

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Yellowstone River, MT to L. Sakakawea	16	14	19	40	21	19	21						
Missouri River, MT Ft. Peck Reservoir	10	0	7	9	2	0	2	4	0	4[1]	0[1]	0[1]	2[1]
Missouri River, MT Ft. Peck Dam to L. Sakakawea	66	110	31	58	95	128	162	25	40	33[1]	39[1]	34[1]	38[1]
Missouri River, ND L. Sakakawea	8	29	14	35	7	27	2	23	9	10[1]	34[1]	21[1]	25[1]
Missouri River, ND/SD Garrison to Oahe Dams	338	322	258	377	368	179	142	231	162	190[1]	219[1]	232[1]	214[1]
Missouri River, SD Ft. Randall to Gavins Pt.*	87	42	114	87	26	30	60	154	200	116[1]	117[1]	126[1]	96[1]
Missouri River, SD/NE Gavins Pt. to Ponca	193	186	272	211	93	82	115	144	161	206[1]	232[1]	314[1]	366[1]
Missouri River, IA Sioux City	0	12			12	13	16						
Missouri River, IA Council Bluffs	20	9	0	0	4	8	5			6[3]			
Kansas River, KS					12[2]	14[2]	10[2]	36[2]	14[2]	22[2]	12[2]	34[2]	38[2]
Subtotal	738	724	715	817	640	500	535	617	586	587	653	761	779
Cheyenne River, SD					32	32	30						
Niobrara River, NE	291					321	103				150[3]		
Niobrara River, NE (Natl. Scenic R. Norden – HWY 137)												15[3]	12[3]
Loup River, NE	117	188	46		150	139					81[3]		
North Loup River, NE						17					16[3]		
South Platte River, NE	0	0	5	0	0	2				8[3]	4[3]		2[3]
North Platte River and Lake McConaughty, NE	16	24	10	12	8	10	10	14[3]	6[3]	4[3]	24[3]	24[3]	28[3]
Platte River, NE North Platte - Lexington (upper)	197[3]	32[3]	32[3]	62[3]	30[3]	24[3]	44[3]	34[3]	18[3]	18[3]	15[3]	12[3]	8[3]
Platte River, NE Lexington - Chapman (central)	19[3]	191[3]	178[3]	169[3]	119[3]	157[3]	120[3]	76[3]	34[3]	42[3]	101[3]	110[3]	94[3]
Platte River, NE Chapman - Missouri Riv. (lower)	487[3]	427[3]	451[3]	426[3]	180[3]	290[3]	377[3]	208[3]	134[3]	460[3]	310[3]		394[3]
Elkhorn River, NE	30	35	38	24	35	86	62				64[3]		
Lower Arkansas River Valley Lakes, CO	46	42	30	22		64							

Table 2 Continued	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Arkansas River (J.M. Res.) and adjacent col, CO													
Quivira NWR, KS	54		48	46	50	66	56					31[3]	28[3]
Jeffery Energy Center, Pottawatomie Co, KS	0	0	0	16	20	20	15				28[4]		10[4]
Cimarron River, KS/OK	67	452	16	22	16	14	14						
Optima Reservoir, OK	15	16											
Salt Plains NWR, OK	82	136	168	90	200	200	200						130[5]
Prairie Dog Town Fork of Red River, TX													597[8]
Red River, OK/TX Denison Dam - Index AR	187								700	631[6]	893[6]	782[6]	993[6]
Red River, AR													250[7]
Arkansas River, OK Kaw Dam to Muskogee	195	393	406	471	322	381	277	312[9]	181	384[9]	628[9]	614[9]	569[9]
Arkansas River, AR		68									198	264	
Canadian River, OK Newcastle to Purcell	38		80	78	122	86	110						
Canadian River, Norman to Eufaula Lake, OK												286	
Canadian River, OK Eufaula Dam – Sequoyah NWR					54	77	41		106[11]	107[11]	65[11]	71[11]	59[11]
Mississippi River, Cape Girardeau to Vicksburg	4297	3653	4589	6776	6971	3067	3428	5538	6159	5920[12]	6361[12]	5802[12]	8082[12]
Ohio River, KY/TN	0			44		138	91						
Gibson Lake, IN	12	9	34	30	24	68				70[3]	80[3]		
Bitter Lake NWR, NM	10	12	14	11	14	14	12			20[3]	22[3]		
Rio Grande River, Falcon Reservoir, TX			655							214[3]			
Rio Grande River, Lake Casa Blanca, TX													
Rio Grande, Armistad Reservoir, TX													
Dallas County, TX, Waste Water Treatment Plant		15	24	20	20	27	25			21[3]			
Annual Total	7153	6339	7580	9136	9024	5800	5550	6799	7743	8486	9693	8772	12035

Update Sources:

1. **Missouri River - U.S. Army Corps of Engineers, Omaha District. 2003. Mainstream Missouri River Least Tern Productivity Monitoring 1986-2003. Unpublished report submitted USFWS**
2. **Kansas River - Boyd 2003**
3. **Niobrara, Loup, South Platte, North Platte, Platte Rivers, Elkhorn River, Quivera NWR, Rio Grande River, Dallas County, TX, Gibson Lake, and Bitter Lake - Erika Wilson, pers. comm.**
4. **Jeffrey Energy Center, KS – Boyd 2003 and Boyd 2001**
5. **Salt Plains NWR – Joanna Whittier, Refuge staff, and Kevin Stubbs, pers. Comm..**
6. **Red River, OK/TX - Gulf South Research Corportation. 2000, 2001, 2002, and 2003; Kevin Stubbs, pers. comm.**
7. **Red River, AR - Meduna and Nupp, 2003**
8. **Prairie Dog Town Fork of Red River – Aqua-Terr, LLC., 2003**
9. **Arkansas River, OK - U.S. Army Corps of Engineers, Tulsa District 2003; Kevin Stubbs, pers. comm.**
10. **Arkansas River, AR - Urbanic, 2003**
11. **Canadian River, OK - U.S. Army Corps of Engineers, Tulsa District 2003; Kevin Stubbs, pers. comm.**
12. **Mississippi River - URS Corporation, 2003**

listing can be attributed to increased survey efforts, in 2003 sufficient habitat existed to support a rangewide population of at least 12,035 terns.

The Interior Least Tern Recovery Plan established a goal of 7,000 terns rangewide maintained for 10 consecutive years. While the current estimate of over 12,000 terns greatly exceeds this goal, the recovery plan also set goals for drainages. The goals for least terns in all drainage basins have not been reached and most areas have not been monitored for 10 years. The recovery plan has not been revised since it was written in 1990 and recovery goals may need to be updated.

In some areas habitat may not be a limiting factor, but on many rivers current suitable least tern nesting habitat is declining in quantity and suitability as woody vegetation encroaches on sandbar habitat. This is largely due to a lack of scouring flows that keep woody vegetation from becoming established and create new nesting habitat. Foraging habitat quality and quantity also may have declined from historical levels. Declining populations of native or suitable small fish species and increasing numbers of introduced and unsuitable forage species could reduce the terns' ability to acquire small fish. Fish that tend to benefit from creation of reservoirs, such as shad and sunfish, have deep, laterally compressed body shapes that are difficult for terns to swallow and these species rapidly grow to sizes that exceed the maximum prey size for least terns (especially chicks).

In the Missouri and Arkansas Rivers, fish community composition changes have occurred. The spatial and temporal availability of small fishes, a component of tern foraging habitat, may affect the species rangewide. Changes in the basin and floodplain physiography and channel morphology due to regulation of the river have greatly changed the native fish community composition and ecology (Welker 2000); commercial fish harvests decreased by over 80 percent and many other native fish have declined on the Missouri River (Hesse et al. 1989, as cited in USFWS 2003). Historically, the annual flow regime determined timing of forage fish availability because many newly spawned fish migrated from the floodplain to the river when the river stage dropped. This connectivity between the river and the floodplain, and resultant recruitment of small fishes provided forage for predators, including least terns (Tibbs and Galat 1998).

On the Lower Mississippi River, 80 percent of small fishes sampled in aquatic habitats adjacent to least tern nesting colonies consisted of taxa known to spawn in floodplain habitats (Tibbs and Galat 1998). Both the timing of the forage fish production and the initiation of least tern nesting are related to the spring rise in river stage; alteration of the historic flow regime may impact tern reproductive success by decoupling the timing of peak forage availability from timing of peak reproductive efforts. Where the connections between the river and the floodplain have been reduced or eliminated completely by construction of levees, forage fish production may have been significantly altered. Such a linkage between forage availability and reproductive success has been demonstrated for some gull and tern species (Safina and Burger 1985, Safina *et al.* 1988, Sydeman *et al*. 1991, as reported by Tibbs and Galat 1998). In addition, Dugger (1997) demonstrated a link between aspects of least tern reproduction and variation in food availability.

Reproduction

Several modeling efforts have suggested that the level of reproduction (measured by fledglings/breeding pair) necessary to ensure population stability or growth level is likely between 0.5 and 1.0 fledglings/breeding pair (USFWS 2003). In evaluating status and trend of least terns, several authors have evaluated what level of reproduction (as measured by number of fledglings produced per breeding pair) is necessary to result in a stable or increasing population given estimates of juvenile and adult survival. However, all estimates of the level of reproduction necessary to ensure population stability or growth should be considered preliminary due to limited information on survival rates and movement between populations (see Table 3). Relatively small changes in survival rates can have significant effects in population models.

Least Tern Table 3. Observed Ratios of Fledglings per Breeding Pair for Least Terns on Selected Rivers 1995-2003.

	Fledge Ratio								
River	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Missouri River[1]	0.67	0.21	0.52	1.74	1.42	1.24	1.06	1.28	0.87
Kansas River[2]	0	0.57	0	0.67	0	1.36	0.05	0.41	0.26
Arkansas River, OK[3]	0.70	1.16	0.68	0.41	0.61	0.49	0.46	0.65	0.64
Red River, OK/TX (Denison Dam – Index, AR)[4]						0.09	0.53	0.33	0.33
Red River, AR[5]								0.7	
Lower Mississippi[6]	1.27	0.28	0.5						
Lower Mississippi[7]	0.85								

1 Corps. 2003d. Mainstem Missouri River Least Tern Productivity Monitoring 1986-2003. Unpublished data

2 Boyd R.L. 2003. Least Tern and Piping Plover Surveys on the Kansas River 2003 Breeding Season. Rpt. To Kansas City District, US Army Corps of Engineers. 29p

3 Corps, Tulsa District. 2002. Table 2 in Annual Report to U.S. Fish and Wildlife Service. Unpublished Report. 2 p. with corrections provided by the U.S. Fish and Wildlife Service.

4 Gulf South Research Corp. 2000. Red River Interior Least Tern Surveys Denison Dam, Oklahoma to Index, Arkansas. Annual Report for Fish and Wildlife Permit submitted to U.S. Fish and Wildlife Service. 6p (excerpts)

Gulf South Research Corp. 2001. Final Report - Survey Report Lower Red River Population of the Interior Least Tern from Denison Dam to Index, Arkansas. US Army Corps of Engineers, Tulsa District. 5 p. (excerpts)

Gulf South Research Corp. 2002. Final Report - Survey Report Lower Red River Population of the Interior Least Tern from Denison Dam to Index, Arkansas. US Army Corps of Engineers, Tulsa District. 5 p. (excerpts)

Gulf South Research Corp. 2003. Draft Report - 2003 Survey Report Lower Red River Population of the Interior Least Tern from Denison Dam to Index, Arkansas. US Army Corps of Engineers, Tulsa District. 4 p. (excerpts)

5 Meduna, L. and T. Nupp. 2003. Annual Report - Status of Reproductive Ecology of the Interior Least Tern (Sterna antillarum) on the Red River in Southwest Arkansas. Unpublished Report.

6 Szell, C.C. and M.S. Woodrey. 2003. Reproductive Ecology of the Least Tern along the Lower Mississippi River. Waterbirds 26(1): 35-43.

7 Dugger, K.M., M.R. Ryan, and R.B. Renken. 2000. Least Tern Chick Survival on the Lower Mississippi River. J. Field Ornithol., 71(2): 330-338.

Thompson (1982) hypothesized that 0.5 fledglings per adult or 1.0 fledglings per pair would result in a stable population. Dugger (1997, page 12) used a deterministic population model, assumed a survival rate of 0.85 for adults and a survival rate of 0.30 for juveniles (fledglings to age 2; generated by Thompson 1982), and concluded that 1.0 fledglings per pair were necessary to support a stable population (see Table 3 for a review).

Kirsch (1996) also used a deterministic population model with a range of adult and juvenile survival rates, together with the average 0.5 fledglings per pair she had observed on the Platte River in Nebraska, and found that a stable or increasing population was achieved only when survival rates were fairly high. For example, at 0.5 fledglings per pair an adult survival rate of 0.85 only achieved a stable population when the juvenile survival rate was at 0.80, and an adult survival rate of 0.90 achieved a stable or increasing population when juvenile survival was at 0.65. She concluded that 0.5 fledglings per pair was a conservative estimate of the minimum level needed to achieve population stability or growth, because most estimates of adult tern survival do not exceed 0.85 and while few estimates of juvenile survival are available, it is unlikely that juvenile survival is as high as adult survival.

On the Platte River, postfledging survival must be very high for the observed level of productivity (0.5) to sustain the population (Kirsch 1996); alternately, the population may be supported by immigration from other areas.

Kirsch and Sidle (1999) in summarizing the status of the interior population of least terns, found that of six geographic areas with significant population trends, four of these areas had observed fledge ratios that would not support the observed population trend. In addition, observed fledge ratios in many local areas were below the 0.5 fledglings per pair conservatively thought necessary to achieve population stability. The observed fledge ratios on the Lower Mississippi River were not sufficient to support the observed population trend in that drainage basin. The overall population trend for the entire interior population was positive, but this was primarily due to the increases observed on the Lower Mississippi River. Kirsch and Sidle (1999) stated that the most plausible explanation for the increase in the population of least terns was surges of immigration from the least tern population along the Gulf Coast. However, relatively little of the Gulf Coast habitat is surveyed for least terns and the tern's status there is uncertain. Only one published record of a least tern moving between the Gulf Coast and interior breeding areas has been reported (Boyd and Thompson 1985, as cited in USFWS 2003), so this hypothesis is difficult to test. Recent data on rate of genetic exchange between Eastern least terns and Interior least terns indicates that greater than 3 migrants per generation are being exchanged (Whittier 2001), but additional genetic research is ongoing and information with larger sample sizes should be available within a year.

An alternate hypothesis stating that adult longevity, coupled with occasionally high recruitment, may offset generally low levels of production was assessed using data from least terns at Salt Plains National Wildlife Refuge in Oklahoma, Quivira National Wildlife Refuge in Kansas, and along the Missouri River in South Dakota (Whittier 2001). Longevity and periodic high recruitment counteracted lower productivity estimates in the model for terns at Salt Plains and Quivira National Wildlife Refuges, and indicated that the breeding population would persist

despite low productivity, but the same was not true for the Missouri River. Whittier (2001) hypothesized that longevity could not counteract low productivity in the Missouri River due to lower overall productivity and no peaks in productivity compared to the other sites. Kruse's (1993) Missouri River data analyzed by Whittier (2001) covers 1986-1992. His estimates of fledglings/pair ranged from 0.20 to 0.64. Since that time observed data indicate a greater range of productivity estimates for this and other reaches of the Missouri River, particularly in the years since the 1997 flood. Since 1998, the average ratio for terns nesting on the Missouri River has exceeded 1.0 fledglings/breeding pair. Whittier's analysis of the Missouri River terns with a longer time series of data might yield a different result for this population. All known least tern nesting areas that have been monitored for 10 or more years have averaged less than 1.0 fledglings/breeding pair, but Whittier's model predicts that periodic peaks of high reproductive success would maintain a stable or increasing population.

ENVIRONMENTAL BASELINE

The environmental baseline is predicated upon an analysis of the accumulated effects of past and recent or ongoing human-induced and natural factors that have lead to the current status of the affected listed species and their habitat. The environmental baseline incorporates: 1) past and present impacts of all federal, state, or private actions or other human activities affecting the species; 2) anticipated impacts to the affected species from all proposed federal projects that have already undergone formal or early section 7 consultations; and 3) impacts of non-federal actions contemporaneous with the consultation in process.

SPECIES STATUS WITHIN ACTION AREA

Status of the ABB within the Action Area

Presently, eastern Oklahoma contains two large concentrations of ABB, one at Camp Gruber in Muskogee County and one in McCurtain County, Oklahoma on a large, privately owned holding (Weyerhaeuser). The numbers of ABBs captured at these areas provides insight into the numbers of ABBs in surrounding areas.

Table 4 provides the number of all surveys (represented by the number of trap nights) conducted throughout Oklahoma by county. The number of trapnights varies among counties and years, ranging from 24 trap nights in Tulsa County to 17,388 in Muskogee County. Camp Gruber is located in Muskogee and Cherokee counties. Surveys for the ABB have been conducted at Camp Gruber annually since 1992, accounting for the high number of trap nights. Likewise, Weyerhaeuser lands are located in McCurtain County and surveys have been conducted since 1997. Although survey intensity differs among counties, this information does provide at least a rough estimate of abundance based on ABBs captured per trap night. This information provides a means to monitor ABB trends and distribution.

Long-term survey data from throughout eastern Oklahoma is lacking. Long-term, mark and recapture data is available for Camp Gruber in northeastern Oklahoma and from a pine plantation

on Weyerhaeuser lands in southeastern Oklahoma. Long-term mark and recapture information also is available for Fort Chaffee in Arkansas. However, these mark and recapture surveys are considered unreliable at best.

Most standard techniques used to estimate population size assume that marked and unmarked individuals are equally likely to be captured and that a substantial number of the animals remain in the available population from one trapping period to the next. Creighton and Schnell (1998) discuss mark and recapture efforts for the ABB in eastern Oklahoma and western Arkansas. Absence of recaptures beyond 6 nights post capture was believed to be indicative of the rapid turnover in the trappable ABB population (Creighton and Schnell 1998). They suspected that factors such as mortality, dispersal, and burrowing activity influenced their ability to recapture beetles. As stated by Creighton and Schnell (1998), most standard methods of estimating

Table 4. Abundance of American Burying Beetles in Oklahoma as of 2003.

County	# ABB Captured Per County	Total Trap Nights Per County	ABBs / Trap Night	County	# ABB Captured Per County	Total Trap Nights Per County	ABBs / Trap Night
Atoka	5	681	0.0073	McCurtain	399	12130	0.0329
Bryan	1	248	0.0040	Muskogee	1132	17388	0.0651
Cherokee	450	6240	0.0721	Okfuskee	1	400	0.0025
Choctaw	4	210	0.0190	Osage	2	24	0.0833
Coal	1	68	0.0147	Pittsburg	25	1042	0.0240
Haskell	76	1386	0.0548	Pushmataha	27	334	0.0808
Hughes	1	40	0.0250	Rogers	2	24	0.0833
Johnston	1	68	0.0147	Sequoyah	4	196	0.0204
Latimer	56	6686	0.0084	Tulsa	2	24	0.0833
LeFlore	72	6535	0.0110	Wagoner	2	432	0.0046

population size from mark and recapture data assume that marked and unmarked individuals are equally likely to be captured and that most, if not all, of the organisms remain in the trappable population. They felt this assumption was not valid for ABB populations considering the high turnover rate they observed for the ABB (Creighton and Schnell 1998). Accordingly, conventional methods of estimating population size may not be applicable for the ABB and accurate measures of absolute densities are problematic (Creighton and Schnell 1998).

Kozol (1990) conducted a population estimate for Block Island, Rhode Island, and indicated that the population was relatively stable at a level of approximately 375 animals with a confidence

interval ranging from 316 to 450 from 1986-1990. Kozol's mark and recapture population estimate was based on trapping efforts spanning several weeks. Even with an intensive survey effort on a relatively confined population, Kozol cautioned using such figures as more than a guide because, as stated above, ABBs violate the two basic assumptions of population estimate methods.

Factors Potentially Affecting ABBs within the Action Area

The action area defined in this consultation covers the most of the known range of the ABB in Oklahoma and Arkansas. Adequate evaluation of the proposed action covered in this opinion must not only consider the impacts from the proposed activities, but also must consider other, separate effects currently ongoing and likely to occur in the foreseeable future that also could have adverse impacts to the ABB. In accomplishing this evaluation, the Service considers other incidental take statements issued, incidental take permits issued, recovery permits issued, other section 7 consultations conducted, and cumulative impacts within the action area.

From October 1, 2002 to September 30, 2003, the OKES consulted on approximately 1,562 proposed actions of which 858 (55 percent) were proposed to be implemented in the 33 counties in which the ABB likely occurs. Project types evaluated included pipelines, roads, communication towers, residential housing developments, bridges, mining, petroleum production, commercial developments, recreational developments, transmission lines, and water and waste water treatment facilities. Of the 858 projects the Service reviewed, approximately 35 percent involved fuel and petroleum production and distribution, and other industry distribution pipelines.

From October 1, 2003, to June 9, 2004, this same office reviewed about 1,020 projects. Of this total, 438 projects (about 43 percent) were proposed within the 33 counties in Oklahoma where the ABB is believed to occur. Of these 438, about 30 percent involved petroleum production and distribution, and other industry distribution pipelines, including a 280 mile pipeline extending from the Gulf of Mexico in Texas to Cushing, Oklahoma. A programmatic biological opinion recently was completed with the Environmental Protection Agency (EPA) for oil and gas related construction activities requiring a Phase I stormwater discharge permit. The Service is also currently working with the Federal Highway Administration and other federal agencies to develop a programmatic consultation for their activities.

Currently 11 entities or individuals possess valid section 10 permits for the ABB in Oklahoma. Ten are section 10(a)(1)(A) scientific research permits to enhance the survival of the species and one is an incidental take permit issued in conjunction with a Habitat Conservation Plan (HCP). Although nine permits are enhancement of survival permits, some authorized take of ABBs is allowed. The research conducted must further conservation efforts for the species. The loss of some individual ABBs over the short-term from research is allowed as long as the survival of the ABB is not jeopardized. The Service requires that every available precaution be implemented to reduce and/or eliminate authorized take associated with research activities.

The HCP and related 10(a)(1)(B) incidental take permit was issued in 1996 to Weyerhaeuser Timber Company for ABBs on their lands in southeast Oklahoma. Habitat Conservation Plans with incidental take permits are available to private landowners, corporations, state or local governments, or other non-Federal entities who wish to conduct activities that might incidentally harm (or "take") a species listed as endangered or threatened. Before obtaining a permit, the applicant must develop an HCP, designed to minimize or mitigate any harmful effects the proposed activity might have on the species. The HCP process allows development to proceed while promoting listed species conservation.

The Weyerhaeuser HCP is valid for 35 years and does not estimate a number of ABBs that could potentially be taken. The HCP stipulates the following as foreseeable activities implemented by Weyerhaeuser over 35 years: 28,000 acres (average of 800 acres per year) of forest will potentially be harvested; 16 ponds constructed; 10 or less food plots planted; EPA approved application of pesticides for control of pales weevil damage to planted pine seedlings; right-of-way vegetation control; 2 miles of road constructed; 20 acres of mineral, oil, or gas exploration; and 600 acres or less of cattle grazing. From 1997 to 2000 approximately 10,710 acres were surveyed for the ABB annually and from 2001 to 2003 approximately 14,382 acres were surveyed. From 1997 to 2003 the following number of ABBs were captured: 106, 64, 26, 41, 16, 25, and 85, respectively.

There are two BOs with incidental take statements issued for the ABB in Oklahoma. One pertains to the Department of Defense, for Camp Gruber near Braggs, Oklahoma; and the other to the U.S. Forest Service regarding the Ouachita National Forest in southeast Oklahoma. The opinion for Camp Gruber allows for the take of 35 ABBs per year. The opinion for the Ouachita National Forest covers forest lands in both Oklahoma and Arkansas, and allows for the take of 30 ABBs per year.

In addition, the Service may recommend that ABBs be trapped and relocated in certain instances. While these activities can have an adverse impact, the existing recovery permit provides for take which may occur. The extent of take is unknown prior to implementation of this type of activity. However, all accidental deaths are required to be reported to the Service. From 1997 to 2003 ABB incidental deaths ranged from approximately 5 to 28 per year.

Status of the Least Tern within the Action Area

There are several errors in the BA and the 2003 BO (USFWS 2003) related to the status of least terns in the Action Area. The correct adult least tern numbers for the Arkansas and Red River surveys are provided in Table 5. The BA also incorrectly states that 1998 was the only year that the fledgling per breeding pair ratio for the Arkansas River was below 0.50. The fledgling per breeding pair ratio also went slightly below 0.50 in 2000 and 2001. The fledgling per breeding pair ratio for the Oklahoma portion of the Arkansas River in 2004 was 0.02 and was far below 0.50 for all monitored portions of the Action Area. A combination of unusually wet and cool weather, frequent flooding, and poor habitat conditions are the most likely causes for the poor reproductive success in 2004. The current fledgling per breeding pair ratio information was previously provided in Table 3.

Table 5. Least Tern Peak Adult Numbers for Areas Monitored Within the Action Area

	Arkansas R. Kaw to Muskogee	Arkansas R. Arkansas	Canadian R. Below L. Eufaula	Canadian R. Norman to L. Eufaula	Red R. Texoma To Index AR	Red R. Above L.Texoma	Salt Plains NWR
1990	210						
1991	195*				187	139-152	
1992	393						
1993	406*						
1994	471						
1995	322						116
1996	381						122
1997	277*						
1998	312						
1999	181**		106		694		
2000	384		107		631		
2001	628	198***	65		893		
2002	614	264***	71	286	782		
2003	569		59		993	597	130
2004	529	376	75		1009		

* No survey from Kaw Dam to Keystone L. (usually 20-100 adults in this reach)
** No survey from Tulsa to Muskogee, high flows entire nesting season
*** Only partial survey of this river reach

The existing recovery plan set delisting goals for least tern numbers by river drainages and required that these goals be met or exceeded for at least 10 years (USFWS 1990). The goals for all drainage basins have not been reached and most areas have not been monitored for 10 years (USFWS 2003). The total numbers of adult least terns within drainages in the Action Area have met or exceeded existing recovery plan goals in recent years, but only the Arkansas River in

Oklahoma has been monitored for 10 years. The Arkansas River in Oklahoma has met recovery plan goals for the last ten years with the possible exception of 1999 when flooding of nearly all nesting habitat occurred during the entire nesting season. Only a partial survey was conducted that year, and the tern numbers did not meet the recovery goal.

Least tern population information and recovery goals provided in the existing recovery plan do not reflect the current knowledge of least tern populations. The recovery plan was written in 1990 and was not the sole source used to assess the status of populations for this biological opinion. For example, least terns were not known to occur or nest in the portion of the Red River addressed in this opinion when the recovery plan was written; now it is known as an important nesting area with over 1,000 adults attempting to nest there in some recent years. The entire Red River in 2004 supported an estimated 2,000 or more adult least terns, but the existing recovery goal for this river is only 300 and was based on the habitat on the Prairie Dog Town Fork alone.

The total number of adult least terns has remained relatively stable or increased since 1998 (Table 5) for most of the monitored reaches of the Action Area. The adult least tern numbers for the short reach of the Canadian River below Lake Eufaula is an exception to this stable to increasing trend within the Action Area. This area of the Canadian River has experienced relatively poor reproductive success and the total number of adult birds has declined slightly in recent years. The greatest increase in adult least tern numbers has been on the Red River from Lake Texoma to Index Arkansas. Adult numbers have increased from 187 (1991) to 1009 (2004), and more than 600 adults have been counted each year since 1999 (Table 5).

Fledglings per breeding pair estimates (through 2003) averaged above 0.5 for monitored reaches of the Arkansas River, but less than 0.5 for the Red River (Table 3). The reproductive success monitored in 2000-2003 for this reach of the Red River (average of 0.32 fledglings per breeding pair) does not appear to support the observed population increase. The Service has not received the 2004 monitoring report for the Red River, but the preliminary information indicates very few fledglings were produced in the 2004 breeding season. The most plausible explanation for the increase in tern numbers for the Red River is immigration from other least tern populations. However, this reach of river did produce 0.53 fledglings per breeding pair in 2001, with an adult population of 893. This demonstrates this reach has the potential to support a relatively large population. Also, monitoring methods used to estimate fledglings per breeding pair may have underestimated the total number of fledglings in some years.

Fledgling per breeding pair ratios have been measured in most of the Action Area, but monitoring has been very limited on Arkansas portions of the Arkansas River. However, using available information, the average fledgling per breeding pair ratio is approximately 0.5 for all monitored areas of the Action Area (Table 3).

Adult least tern numbers in the Action Area in 2004 were at or above the average for the last ten years. However, reproductive success in nearly all of the Action Area was extremely poor in 2004 and habitat conditions also were relatively poor. The unusually wet and cool weather was a factor in the poor reproductive success in 2004, but habitat conditions in the Oklahoma portion

of the Arkansas River were so poor that reproductive success would be low in most years. Effects of habitat changes on the Arkansas River in Oklahoma have previously been documented in the 1998 opinion (USFWS 1998). Least terns appear to be affected by nesting habitat availability and changes in habitat due to regulated flows released from Kaw and Keystone Dams. The frequency of high flow events downstream of Keystone Dam has declined significantly due to flood control operations. Analysis of pre and post impoundment flows at the Tulsa gage show 25 flow events exceeding 90,000 cfs between 1926 and 1964 (prior to completion of Keystone Dam). Only three flow events exceeding 90,000 cfs have occurred since 1964 and 1993 was the last large flood event. After scouring flows in 1993 that elevated existing sandbars and created new sandbars, the number of breeding colonies, adults observed, number of nests, chicks, and eggs observed, and number of terns fledged all increased the following year. In addition, loss of nests due to flooding declined the following year (Leslie *et al*. 2000). Leslie *et al*. (2000) reiterated the need for periodic ($\geq$ 7 years) scouring flows to maintain the quality of nesting habitat available to terns. However, habitat quality has declined since 1993 due to a lack of scouring flows. No major high flow events have occurred in recent years and habitat has declined in quantity and quality. In 2004, frequent flooding events and poor habitat conditions reduced or eliminated reproductive success on most of the least tern nesting areas within the Action Area.

Least tern nesting habitat quality and quantity has declined the most on the Arkansas River and is probably in the worst condition known since least tern monitoring began in the 1980s. The degree of habitat degradation cannot be accurately quantified due to the Corps' failure to fully implement some of the reasonable and prudent measures in the 1998 opinion that required monitoring of habitat in the Oklahoma reach. Nonetheless, differences in Arkansas River habitat quality relative to 1994 are apparent. Flows of 30,000 cfs in 1994 did not flood many of the least tern nesting sites, but flows of only 15,000 cfs would flood most of the suitable habitat and nests in 2004 and 2005. Most of the higher islands and sandbars are now vegetated to a degree that precludes least tern nesting. Zink Island is a relatively high island that previously supported 50 or more nests in high water years similar to 2004. In the last few years Zink Island has supported 15 or fewer nests. The reason for the decline is uncertain, but the most likely cause is the reduced availability of suitable habitat due to vegetative encroachment. The 1998 opinion included a reasonable and prudent measure to maintain habitat quality on Zink Island, but the Corps had only partially complied and vegetative encroachment had made most of the island unsuitable for nesting until March of 2005. The least tern nesting habitat on Zink Island was restored with heavy equipment in March through cooperative efforts of Tulsa County, the Corps and Tulsa River Parks Authority. The island supported at least 36 nests on June 9, 2005 and it appears that the habitat restoration was successful in attracting more nesting pairs. Storms destroyed most of those nests on June 12, 2005, and ensuing storms continued to increase flows in the Arkansas River. Releases from Keystone Dam completely inundated the island by June 18, 2005. Releases were increased in an attempt to hasten the evacuation of stored flood waters and return reservoir water elevations and river flows to levels that would allow least terns to renest. The success of renesting attempts will be monitored.

Relatively little monitoring of least tern nesting habitat conditions has occurred on the Arkansas River in Arkansas and the first complete boat survey for nesting terns was completed in 2004.

Seventeen tern nesting islands were identified in the 2004 survey. The quality of the nesting habitat varied, but all nesting islands were flooded and no successful reproduction was known to occur in 2004.

Habitat conditions also have declined on the Red River. Monitoring on the Red River below Lake Texoma has documented a decline in average freeboard for nests since 2001, an increase in the percentage of nesting colonies that land bridge, and an increase in the percentage of nesting colonies with disturbance. Disturbance includes evidence of predation, cattle trampling, and human disturbance. Disturbance increased from only 25 percent of the nests in 2000, to 89 percent of the nests in 2003 (Gulf South 2003).

Importance of the Action Area to the Least Tern

Least terns in the Action Area may currently (2004 adult count) account for approximately 16 percent of the interior population (1,989 in the action area /12,035 rangewide) based on the most recent population estimate. However, the rangewide estimate probably underestimates the size of the total population due to a lack of recent surveys in several areas of the least tern's range and recent increases in some areas. The Arkansas and Red River systems appear to be an important component of the overall distribution of the interior population. The numbers of adults in these river systems are second only to those on the Mississippi River.

Factors Potentially Affecting Least Terns within the Action Area

The Action Area defined in this consultation covers much of the known range of the least tern in Oklahoma and Arkansas. Adequate evaluation of the proposed action covered in this opinion must not only consider the impacts from the proposed activities, but also must consider other, separate effects currently ongoing and likely to occur in the foreseeable future that also could have adverse impacts to the least tern. In accomplishing this evaluation, the Service considers other incidental take statements issued, incidental take permits issued, recovery permits issued, other section 7 consultations conducted, and cumulative impacts within the action area.

The incidental take that is currently authorized for least terns in the Action Area is limited to collection (salvage) of eggs for genetics research proposed by the USGS and take associated with disturbance related to least tern surveys on the Arkansas, Canadian, and Red Rivers. The Corps has had authorization for incidental take related to operations of Kaw and Keystone projects, but this is no longer valid due to exceedance of incidental take limits and failure to implement reasonable and prudent measures. Unauthorized take has occurred each nesting season, including more than 300 nests, and unknown numbers of eggs and chicks in 2004.

EFFECTS OF THE ACTION

American Burying Beetle

Adverse impacts to ABBs occur primarily from ground disturbance associated with construction during the ABB's inactive and active periods. Construction activities associated with dredged material disposal pits and other proposed actions may disturb soils in areas within the ABB's range and have the potential to harm, harass, or kill individuals. Typical individual construction projects are relatively short-term, usually completed in fewer than 60 days. However, maintenance and additional disposal of dredged material are recurring impacts over the life of the project.

DIRECT EFFECTS

Direct adverse impacts to ABBs during their inactive and active periods may occur as a result of impacts from clearing vegetation; soil compaction due to heavy equipment operation; fuel and chemical contamination of the soil; grading; soil excavation and filling; and revegetation and reseeding of disturbed areas. Approximately 1,100 acres of terrestrial habitat are proposed to be converted to dredged material disposal pits with implementation of the proposed action.

During construction of dredge disposal pits and access roads, soil is excavated and vegetation is cleared. Excavating soils, clearing vegetation and constructing access roads involve displacement of soils that could uncover ABBs. Uncovered ABBs could be exposed to predation, adverse environmental conditions, or crushed by equipment. If construction occurs during the active season, ABB broods could be displaced during soil excavation, adults could be separated from larvae/eggs, and/or both could be crushed by equipment. Revegetation and associated planting activities could result in further disturbance as described above.

In addition, use of heavy construction equipment, such as bulldozers, excavators, track hoes, and back hoes during road and dredge spoil disposal pit construction could compact the soils. Soil compaction could result in destroying ABB brood chambers, including adults and larvae; and preventing use by ABBs for carcass burial if construction takes place during the reproductive season. If construction takes place during the winter season, adult individuals could be crushed and ABB re-emergence in late spring or early summer could be prohibited.

The periodic disposal of dredged material has the potential to bury adults and larvae if previously deposited materials provide suitable soils. The frequency of dredging and subsequent disposal in dredge disposal pits is highly variable and the potential for take related to periodic disposal will vary from pit to pit.

Prior to construction activities implemented in the ABB's active season, the Corps will determine the presence or absence of the ABB in the project county and immediate vicinity of the project site. A presence/absence survey for the ABB may be conducted. If ABBs are known to be in the area, then measures will be implemented to remove ABBs from the project site prior to soil disturbance. This minimizes or avoids adverse impacts to the ABB. Projects

implemented during the ABB's inactive season will incorporate measures listed above to minimize soil disturbance, contamination, or compaction, and ABBs will be removed from the project site prior to the onset of the ABB's inactive season. These measures minimize adverse effects to the ABB, but do completely avoid potential for take.

All of these activities could result in the direct mortality of individual ABBs or broods, or create conditions that lessen the chance of survival of individuals or broods. In summary, ground disturbance associated with disposal of dredged material could result in take of individual ABBs, eggs, or larvae in eastern Oklahoma.

INDIRECT EFFECTS

Construction activities and related habitat disturbance may temporarily reduce local rodent populations that would provide carrion for ABBs.

Interior Least Tern

DIRECT EFFECTS

Least tern nesting habitat can be impacted by any action that changes river hydrology and morphology. The construction and operation of large Federal reservoirs is a major action impacting least tern nesting habitat within the Action Area. A major hydrologic effect of these reservoirs on nesting habitat is the reduction in the magnitude, frequency, and duration of peak flows that are necessary to move sediments to form new sandbars, maintain channel widths, and scour existing sandbars. The frequency of high flow events downstream of Keystone Dam has declined significantly due to flood control operations (Wood 1994). Seven day bankfull flows (110,000 cfs) on the Arkansas River at Tulsa were predicted to occur with a frequency of 6.7 years without project and 28.6 years with project-related flood control operations (USFWS 1998). Analysis of pre and post impoundment flows at the Tulsa gage show 25 flow events exceeding 90,000 cfs between 1926 and 1964 (prior to completion of Keystone Dam). Only three flow events exceeding 90,000 cfs have occurred since 1964 and the last large flood event occurred in1993.

These reservoirs also retain large volumes of sediment (sand) that normally would be distributed throughout an unregulated river system. For example, Lake Texoma traps an average of 17,700 acre-feet of sediment annually (USACE 2001). A 100-300 mile downstream recovery zone for sediment loads has been estimated for Lake Texoma (Williams and Wolman 1984). Recharge of drainage-basin sediments 60 miles below Kaw Dam and 15 miles below Keystone Dam has been insignificant because mean daily sediment loads of the Arkansas River at Ralston and Tulsa have been reduced approximately 91-96 percent (Wood 1994, USFWS 1998). This sediment is the basic building block of least tern nesting habitat. The substantial reduction of sediment movement by these reservoirs impacts the distribution, abundance, and quality of least tern nesting habitat.

The 1998 opinion documented the impacts of flood control operations on hydrology of the Arkansas River and similar impacts are documented in the original BAs prepared for the Canadian and Red Rivers. The direct effect of the reservoirs and flood control operations is reduced quantity and quality of least tern nesting habitat. For example, no suitable least tern nesting habitat exists for several miles below all major impoundments in the Action Area due to a lack of sand. The proposed action is primarily a continuation of the existing conditions for most of the Action Area and the proposed action includes few measures to avoid, or reduce most habitat impacts. The Corps has not monitored habitat conditions on the Arkansas River as required by the reasonable and measures in the 1998 opinion, so we cannot quantify the existing effects on the Kaw Lake to Muskogee reach. However, habitat has declined and we expect habitat degradation due to project-related alterations in flow and sediment transport to continue.

Nesting Habitat

Least tern nesting habitat is in poor condition over most of the Action Area, and the Corps' past and current operations appear to be the primary factors. The Corps has had limited opportunities to provide scouring flows in recent years without impacting other project purposes, and few efforts have been made to restore nesting habitat via other means. The Corps and SWPA did attempt to restore tern nesting habitat on two islands in lower portions of the Canadian River by scraping vegetation off existing vegetated islands with bulldozers. The attempt was unsuccessful, at least partially, because vegetation quickly reestablished itself on most of the cleared areas before the nesting season was completed. Limited hand pruning and some herbicide spraying also was implemented in two years at Zink Island and in 2005 the island habitat was greatly improved by moving new sand onto the island with heavy equipment. The Zink Island habitat improvement project was a cooperative effort involving Tulsa County, the Corps, and Tulsa River Parks Authority and the Service. Also, the Corps helped fund an Oklahoma State University student project to design a conceptual tern nesting island with promising results. However, the design has not been implemented and no new nesting islands have been constructed.

In June, 2005, the Corps cooperated by releasing relatively high flows (68,000-77,000 cfs) from Keystone Reservoir for several days to hasten the evacuation of the flood pools in Kaw and Keystone Reservoirs. These relatively large releases are less than the flows recommended in the 1998 opinion for enhancing nesting habitat, but they may provide some scouring and move enough sediment to enhance or create some downstream nesting sites. The effects of these releases will be evaluated when river flows decrease to levels that allow terns to renest.

Most least terns are currently nesting on relatively low elevation islands and sandbars. A lack of scouring flows has allowed vegetation to encroach on all but the lowest elevation nesting habitat. This increases the flooding risk for nesting least terns. The current habitat conditions on the Arkansas River make it extremely difficult for the Corps and SWPA to maintain other project functions and still protect terns from flooding. The peak flow generated by hydropower at the Keystone project is approximately 12,000 cfs and some nests were flooded in 2004 by this level of flow. Virtually all nests on the Arkansas River from Keystone dam to Muskogee are flooded at approximately 15,000 cfs (with the exception of Zink Island). The small 3,000 cfs buffer

between peaking hydropower flows and flows that flood most of the nests means that nearly all nests are at a high risk of flooding on nearly a daily basis. Any significant rainfall event that adds 2,000-3,000 cfs or more to the hydropower peaking level will flood a majority of the nests. To prevent flooding nests under such conditions the Corps would have to predict all significant rainfall events and curtail hydropower generation at least 24 to 48 hrs ahead of the rainfall event. This solution is unlikely to be feasible or successful in avoiding relatively frequent flooding of least tern nests and chicks. Even one flooding event late in the nesting season can effectively eliminate most or all reproductive success for that year. While the Corps has improved communication with the Service and modified operations to reduce flooding of tern nests and chicks, avoiding flooding has become increasingly difficult. The Tulsa District developed Least Tern Management Guidelines for project operations and they have been implemented since 2002. However, the Corps' ability to reduce flooding of tern nesting sites is very limited with the existing habitat conditions described above.

Habitat conditions on the Arkansas River reach from Keystone Reservoir to Muskogee in 2004, allowed a water release of only about 9,000 cfs from Keystone Dam to protect nesting terns from downstream flooding. The inability to release more than 9,000 cfs for flood control without flooding tern nests means that reservoir water levels would quickly rise with any significant inflows. Reservoir water levels at Keystone Reservoir would reach the upper limits (730 ft, specified in the Least Tern Management Guidelines) for protecting least terns or even the upper limits of the flood storage capacity, in a relatively short period of time with even moderate inflows. The Corps must then release large quantities of water for safety reasons (usually greater than 20,000 cfs) to evacuate the flood pool. With existing habitat conditions, such a release would flood nearly all the least tern nests and chicks that may exist in this reach downstream to Muskogee. Frequent flooding and cool wet weather resulted in the loss of nearly all nests and chicks on the Arkansas River in 2004 (only 6 fledglings counted) and flooding has occurred again in 2005. Unless habitat improves, we expect relatively frequent flooding to continue on the Oklahoma reach of the Arkansas River in most years.

Another potential impact to habitat is that the height of some nesting islands are degraded by extended periods of relatively moderate to high flood pool releases that continue long after any significant amount of sediment is being delivered through tributaries. These moderate water releases from the reservoirs transport very little sediment from the reservoir, but do pick up some sediment below the dam and move some of this sediment downstream. These moderate flows are usually insufficient to scour vegetation from higher elevation sand bars or islands.

The poor habitat conditions on the Arkansas River can be enhanced to some degree through management of flows to minimize flooding and landbridging of nesting islands. However, with existing habitat conditions, this would require a very narrow range of flows and may not allow maximum hydropower releases at Keystone Dam.

Habitat conditions also have declined on the Red River and least tern reproductive success has been relatively low (see previous discussion in the Status of the Species in the Action Area section). The effects of the action on least terns nesting along the Red River are similar to those described for the Arkansas River. However, habitat is not as degraded within the Red River

portion of the Action Area. Also, flooding of nests and chicks on the Red River is not as directly attributable to reservoir water releases. The Red River has more major tributaries without mainstem reservoirs and higher average annual rainfall over much of this reach. However, there are several Corps reservoirs in the watershed and the effects of reduced peak flows and sediment loads are evident. The proposed action does not include any measures to improve habitat on the Red River or change operations. Unless habitat improves, we expect relatively frequent flooding of nests and chicks and high rates of disturbance to continue.

Arkansas River Navigation System - The effects of the action on nesting terns on the Arkansas River in portions operated for navigation in Oklahoma and Arkansas are comparable in that limited habitat and flooding of nesting habitat is the greatest impact to nesting terns. Nesting habitat is very limited within the navigation system. Most of what is available was unintentionally created by sediment deposited behind manmade structures. Virtually all natural nesting habitat was destroyed when the navigation system was constructed. Only one least tern nesting island is proposed to be constructed within the navigation channel in the Corps' proposed action. Therefore, we expect nesting habitat would continue to be limited within the MCKARNS with implementation of the proposed action.

The Little Rock District of the Corps has not been monitoring the elevations and locations of tern nests in Arkansas and no coordination with the Tulsa District or the Service has occurred to attempt to minimize flooding of nests and chicks in Arkansas. The proposed action does not include any measures to reduce these flooding impacts. We expect the proposed action would result in continued flooding of nests and chicks on the Arkansas reach of the Arkansas River.

The Service does not concur with the Corps determination that Phase I of the ARNS will not adversely affect least terns. We agree that the effects are variable and the duration of the effects are usually limited to several days or less, but there are some adverse effects. According to information provided by the Corps, the changes in flood water storage at reservoirs related to Phase I operations would decrease the rate of water releases following the peak of a flood event. Reducing the rate of water releases can prolong the number of days that some reservoir elevations stay above or near the upper limits for protecting least terns stated in the Least Tern Management Guidelines implemented in 2002. This would increase the likelihood of flooding downstream nests and further delay the evacuation of stored flood water under some conditions. Phase I would slightly extend periods of relatively high flood pool releases that continue long after any significant sediment is being delivered through tributaries. Such releases could degrade the height and quality of nesting islands. Portions of the Corps modeling data that demonstrate this effect are included in Appendix B.

Phase I has potential to extend the effect of a flood and the time required to reduce flows to a level that will provide suitable habitat for terns attempting to renest. The risk of nests being flooded by water releases made due to subsequent rainfall or inflow events is increased when reservoir elevations stay near the upper limits for longer periods of time. Reservoirs such as Kaw and Keystone have relatively little flood storage and nesting least terns have very little buffer for future inflow events when reservoir water levels are near the upper limits. To provide nesting habitat and protect renesting least terns, reservoir water levels need to be dropped as

quickly as possible following inflow events that cause upper limits to be exceeded and downstream flooding of least tern nests.

The deepening portion (Phase II) of the proposed action is not likely to adversely affect most of the current least tern nesting areas. The Arkansas River within Arkansas is the only portion of the existing navigation channel that supports nesting least terns in areas likely to be dredged. The maintenance dredging and proposed dredging to implement Phase II has the potential to benefit least terns, if the dredge spoils are used to create nesting habitat. No suitable tern nesting habitat is present on a large percentage of the existing navigation channel and creation of habitat could facilitate nesting by terns on portions of the river that have not supported tern reproduction since the MCKARNS project was constructed.

Dredging does have the potential to adversely affect least terns if contaminants in the sediments are released in concentrations that would impact nesting terns or their forage base. Contaminants released into the water through dredging activity could become available to the birds through direct contact or through the food chain. However, potential impacts related to contaminants in the dredged material cannot be thoroughly assessed until testing of sediments to be dredged is completed. The Corps should reinitiate consultation if testing of sediments indicates dredging could have potential adverse effects to terns and other federally-listed species, such as bald eagles.

Hydropower effects - Normal hydropower operations (when reservoirs are not in the flood pool) consist of peaking hydropower generation during portions of the day with the most demand and highest price for electricity. Little or no generation occurs during off peak hours. This results in higher downstream water releases (frequently 10,000-12,000 cfs) for a portion of the day and low flows (frequently less than 1,000 cfs) for the remainder of the day. During weekends and other periods of low demand, little or no generation occurs and the flows are correspondingly low (sometimes less than 100 cfs). These periods of low flows contribute to landbridging of nesting islands and increase access for mammalian predators and humans. Very few nesting islands that are not inundated at the higher peaking flows remain suitable nesting islands and are landbridged at the low flows. Least terns are frequently forced to nest on islands or sandbars that are not flooded at the higher flows, but become landbridged at the lower flows. The dramatic daily fluctuation in flows results in a change in stage or water height on the river of several feet for miles downstream of the reservoirs. These changes in flow and stage are moderated in intensity moving downstream, but severely limit the suitable nesting habitat available to least terns for at least 40 miles below Keystone Dam and all of the Canadian River below Lake Eufaula.

INDIRECT EFFECTS

Predation and Human disturbance

Ongoing reservoir operations in the Action Area likely contribute to loss of nests and eggs from predators because of the effects of water management on the shoreline and sandbar habitats. Moderation of extreme flows has reduced the amount of scouring taking place along shorelines;

consequently vegetation regrowth provides habitat for predators of least tern eggs and chicks. Reduced channel width and increased vegetation encroachment within the channel creates more suitable habitat for predators and reduces the amount of suitable habitat for least terns. Flood control operations influence predation by reducing the quantity of suitable nesting habitat, making it easier for predators to search the remaining habitat. Consequently, even unoccupied habitat has value for nesting least terns and can reduce predation by providing more potential habitat for predators to search.

The effects of hydropower operations and other flow manipulations also influence predation (see discussion under direct effects). The periods of low flows contribute to landbridging of nesting islands and increase access opportunity for mammalian predators such as coyotes, dogs, and raccoons.

The low flows also improve access for humans and domestic animals. Disturbance by humans walking in search of artifacts or using sandbars and islands for other recreational uses occurs relatively frequently in the Action Area. These people often have dogs with them which increases the risk for take of chicks or eggs. Low flows and landbridging also improve access for livestock; and trampling of least tern nesting sites has been documented each year on the Red River (Gulf South 2003). ATVs and other off-road vehicle use is increasingly popular and low flow conditions on the rivers allow such vehicles access to most of the river bed, including many least tern nesting areas. While monitoring least terns nesting on the Arkansas River in Oklahoma, Service and Corps biologists have witnessed the apparent abandonment of least tern nesting colonies with relatively high levels of human disturbance. Other studies have noted that human disturbance of nesting colonies may reduce reproductive success (Burger 1984) and may result in eventual abandonment of the site (Kotliar and Burger 1986). Monitoring on the Red River below Lake Texoma has documented an increase in the percentage of nesting colonies that land bridge, and an increase in the percentage of nesting colonies with disturbance. Disturbance includes evidence of predation, cattle trampling, and human disturbance. Disturbance increased from only 25 percent of the nests in 2000, to 89 percent of the nests in 2003 (Gulf South 2003).

Recreational use and human disturbance in the navigation system is more related to access by boaters and some ATV use. A least tern nesting colony on an island that was created with dredge spoils in Arkansas in 2001 was completely abandoned after high levels of human use and camping occurred. Human disturbance accounted for 29 percent of the losses of nests monitored in Arkansas in 2001 (Urbanic 2003).

Impacts to Fish and Fish Habitat

The spatial and temporal availability of small fishes, a component of tern foraging habitat, may affect the species in the Action Area. Changes in the basin and floodplain physiography and channel morphology due to river flow regulation can greatly alter the native fish community composition and ecology. Aspects of the annual flow regime determine timing of forage fish availability. Alteration of the historic flow regime may impact tern reproductive success by decoupling the timing of peak forage availability from timing of peak reproductive efforts (USFWS 2003). Particularly where the connections between the river and the floodplain have

been reduced or eliminated completely by construction of levees, forage fish production may have been significantly altered (USFWS 2003). Such a linkage between forage availability and reproductive success has been demonstrated for some gull and tern species (Safina and Burger 1985, Safina et al. 1988, Sydeman et al. 1991, as reported by Tibbs and Galat 1998). In addition, Dugger (1997) demonstrated a link between aspects of least tern reproduction and variation in food availability. The abundance of small fish in the Action Area also may be reduced due to flood control operations that reduce the peaks and frequencies of flood events that inundate the floodplain. The effects of hydropower releases also have potential to negatively affect fish populations through rapid and frequent changes in flow volume and water temperature.

SPECIES RESPONSE

The least tern has maintained a relatively stable fledgling to breeding pair ratio in most of the Action Area until 2004. Little if any reproductive success has occurred in most of the Action Area in 2004 due to reduced nesting habitat quality, cool and wet weather, and frequent flooding events. Although the average fledgling to breeding pair ratio for the Arkansas River has been near 0.7, the average fledgling to breeding pair ratio for the Red River and Canadian River has been less than 0.5 (Table 3).

Essentially all the tern nesting habitat in the Action Area is affected by the proposed action to varying degrees. All nesting terns in the Kaw Dam to Muskogee reach of the Arkansas River are expected to experience very limited reproductive success until nesting habitat conditions improve. Terns nesting on Red River also will be affected by project-related reduced habitat quality, but to a lesser degree, and reproductive success is expected to be similar to recent years. Terns nesting in portions of the Arkansas River maintained for navigation may benefit from the proposed action, provided new nesting habitat is created and maintained with dredged material. Terns nesting on this created habitat could be very successful, assuming fish populations are adequate to support nesting terns, nesting habitat is maintained over time, and human disturbance is controlled. Artificially created nesting habitat in the navigation channel should experience relatively infrequent flooding and has the potential to support relatively large numbers of nesting least terns if they colonize the newly created habitat. However, construction and maintenance of the navigation channel has eliminated all suitable tern nesting habitat over a large portion of the Arkansas River for more than 30 years. The success of artificially created nesting habitat in areas lacking recent nesting history is unknown and can only be determined through monitoring.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, and private actions that are reasonably certain to occur within the **action area** considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The impacts of future state, local, and private actions are difficult to predict because they are dependent upon the political climate within the action area and conditions and changing patterns

of economic and human population growth. The Service anticipates that the Arkansas and Red River navigation systems will continue to be operated for commercial barge traffic for at least the next 50 years, but increasing and competing demands for water for municipal, industrial and recreational use may lead to changes in the management of reservoirs and river flows. Siltation at aging reservoirs will reduce water storage capacity for competing uses. Some of the changes in demands for water will be under Federal control and will require section 7 consultation, but others will be private or state controlled and would be considered cumulative effects.

Development in watersheds, including river floodplains and riparian areas, is likely to increase and contribute to potential flooding and flood control problems. Any structures constructed in or near the rivers have potential to impact flows and sediment transport. Farming within the floodplain already influences water management decisions. Most of these cumulative effects are likely to negatively affect the river ecosystems and the federally-listed species that depend on these river systems. Species such as bald eagles and least terns are relatively adaptable to human disturbance, but nesting and foraging habitat are likely to be adversely affected by altered flows and increased development. An example of the potential development-related impacts to bald eagles and least terns is the proposed development plan for the Arkansas River corridor in Tulsa County, Oklahoma. The Corps is involved in the feasibility study, but many of the proposed actions would be privately funded. Several low-head dams, pedestrian trails, and commercial development are included in the preliminary plan and many of these proposed developments have potential to impact habitat for bald eagles and least terns.

Some private actions, such as commercial sand and gravel operations that remove sand and gravel from rivers, may exacerbate the effects of sediment reduction caused by the Corps projects. Some of these sand and gravel operations do require a permit from the Corps under Section 404 of the Clean Water Act, but most do not (utilizing the current definition of Section 404 authorities). It is difficult to quantify the amount of material removed by sand and gravel operations and even more difficult to determine the effects of these actions. Most effects are assumed to be adverse, but there is potential to maintain or enhance tern nesting habitat with the cooperation of sand and gravel operators.

Another example of a beneficial cumulative effect is the artificial creation of least tern and bald eagle nesting habitat at Sooner Lake, a small reservoir near the Arkansas River in Pawnee County, Oklahoma. The reservoir is privately owned by OG+E Electric Services and is used as a source of water for cooling a coal-powered electric power plant. Sand was placed on an area of concrete dikes in the lake to create least tern nesting habitat. At least 19 least tern nests were recently documented on that dike. An artificial nesting platform for bald eagles also was erected at Sooner Lake in 2004.

EFFECTS OF THE ACTION – CONCLUSIONS

American Burying Beetle

Adverse effects to ABBs should be relatively minor, if protective measures included in the

proposed action are implemented. Despite these protective measures, some ABBs may be disturbed or killed during dredged material disposal pit construction, dredged material disposal, and related ground disturbance activities, but most of the effects are expected to be infrequent and of short duration.

Interior Least Tern

The greatest impact of the proposed action is to nesting habitat quantity and quality. The proposed action does not include restoring or maintaining nesting habitat with water releases. Although the proposed action included creating artificial nesting habitat using spoil material at two sites, it does not propose to create or maintain any significant quantity of nesting habitat with mechanical methods. Periodic high flow events are likely to occur that will restore some nesting habitat despite continuing flood control efforts. However, the quality and quantity of tern nesting habitat will decline following those events (provided those events do not reoccur within 3-5 years) and project-related flood control operations and impacts on sediment transport would hasten the decline. Tern nesting habitat in the Action Area currently is in poor condition and could remain in poor condition for relatively long periods of time with the proposed action. The adverse indirect effects, such as predation, human disturbance, and trampling by livestock, associated with the poor habitat conditions, could increase or remain at relatively high levels until habitat is improved or protective measures are implemented. Manipulation of water releases to reduce flooding of nests would reduce the adverse effects somewhat, but overall, the proposed action is likely to continue to adversely affect terns in a manner similar to the existing operations.

BIOLOGICAL OPINION

Section 7(a)(2) of the Act requires federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to: 1) jeopardize the continued existence of any endangered or threatened species, or 2) result in the destruction or adverse modification of critical habitat. The term "jeopardize the continued existence of" means to reduce appreciably the likelihood of both the survival **and** recovery of listed species in the wild by reducing the species' reproduction, numbers, or distribution. Jeopardy biological opinions must present reasonable evidence that the project will jeopardize the continued existence of the listed species or result in destruction or adverse modification of critical habitat.

After reviewing the current status of the ABB and least tern, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the Service’s biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of either species, and is not likely to destroy or adversely modify designated critical habitat. No critical habitat has been designated for these species; therefore, none will be affected. However, the proposed action likely will result in incidental take of ABBs and least terns.

INCIDENTAL TAKE

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior or behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to, and not intended as a part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require a contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(I)(3)]

AMOUNT OR EXTENT OF TAKE ANTICIPATED

American Burying Beetle

The amount or extent of incidental take will be difficult to enumerate in the form of individual ABBs. This difficulty is due to multiple factors, including a lack of a comprehensive survey effort due to the ABBs large distribution across eastern Oklahoma. Recent survey efforts that are available are limited in scope and geographical range. Some counties have not been surveyed at all recently. Further, as stated above, conducting an accurate population estimate is not feasible due to the biology of the ABB, as well as the lack of surveys or the incompatibilities of survey methods implemented. In addition, the ABB has a small body size making it hard to locate, which makes encountering dead or injured individuals unlikely. Further, ABB losses may be masked by annual fluctuations in population numbers and geographic densities. These complications result in difficulty enumerating or estimating the quantity of ABBs in Oklahoma in order to accurately estimate the amount or extent of take. Consequently, the Service believes using habitat as a surrogate for take is the best method to determine the amount of take that is likely to occur.

Despite the proposed protective measures, some ABBs may be disturbed or killed during dredged material disposal pit construction, dredged material disposal, or other ground disturbance activities. Approximately 1,100 acres would be disturbed to create dredged material disposal pits with the proposed action. The Corps must reinitiate consultation with the Service if more than 1,100 acres of ABB habitat are disturbed.

Least Tern

Incidental take of least terns is expected to occur in the following manner:

1. *Take of eggs and chicks by flooding on the river and reservoir reaches that result from the operations of the water control system by the Corps.*

Certain reservoir levels and water releases (including hydropower releases) from dams along the Arkansas, Canadian, and Red rivers during the summer results in flooding of nests and mortality of eggs and chicks. Most least terns have been nesting on relatively low elevation islands and sandbars in recent years because flood control operations have reduced scouring flows and allowed vegetation to encroach on most of the higher elevation (former) nesting habitat. We estimate that existing operations can and have contributed to the flooding of nests with eggs and chicks through the impacts to nesting habitat. Potentially more than 1,000 eggs and chicks can be flooded in an individual year. For example in 2004, a minimum of 160 nests were flooded on the Arkansas River in Oklahoma, and an estimated 100 or more nests in Arkansas. An additional 150-200 nests were flooded on the Red River in 2004. The exact numbers of eggs or chicks flooded are unknown, although an estimate can be derived by multiplying the number of flooded nests (only nests with eggs are counted) by two since most nests average 2 or more eggs. Chicks are more difficult to count and any direct counts are certainly an underestimate of the actual chick numbers, but we do have direct counts of chicks prior to most flood events. We realize, however, that some nests would flood naturally without any Corps action, and that it is difficult to determine the level of take related to the Corps actions alone.

However, the operation of Corps projects over time has altered sediment delivery patterns and a lack of scouring flows has allowed vegetation to encroach on higher islands (Corps 2003). This has substantially reduced the elevation of islands and sandbars used for nesting habitat, and increased the likelihood or frequency of flooding of occupied habitat during the nesting season. In the Oklahoma portion of the Arkansas River, nesting habitat conditions are extremely poor and flooding is expected to potentially take nearly all eggs and chicks in most years until nesting habitat improves. River systems are highly variable and it is difficult to predict incidental take levels in any given year, but flood releases are expected to take eggs and/or chicks in the Red and Arkansas rivers (including the Canadian River) in most years. The timing of flood events determines the effect of this take. Least terns may renest if flooding of nests occurs early in the nesting season, but flood events late in the nesting season eliminate all potential for reproductive success during that year.

2. *Take of eggs, chicks, and adults by factors influenced by, but not directly attributable to the Corps.*

An unknown number of eggs and chicks have been lost due to predation, weather, trampling by livestock, erosion, and other factors that are influenced by, but not directly attributable to Corps activities. For example, modification of the historical hydrograph as a result of reservoir operations reduces the number of large scouring events that otherwise would maintain wide channel widths and limit vegetative encroachment on sandbars and islands used for nesting by least terns. Encroachment of vegetation on sandbars used by least terns increases the potential for predation of eggs, chicks, and adults by predatory mammals and birds. Vegetative encroachment also reduces the quantity and quality of suitable nesting habitat. Least terns usually will not initiate nesting at sites with greater than 30 percent vegetative cover.

Releases associated with hydropower operations that result in relatively high flows during a portion of the day and extremely low flows at other times effectively limit suitable nesting habitat for least terns and negatively impact forage fish populations. Low flow periods increase the potential for predation and human disturbance associated with landbridging. The Service expects increased human disturbance associated with Corps and SWPA operations will result in the mortality of eggs and chicks in the Action Area and harm or harassment of adult least terns. Extended periods of hydropower releases that leave relatively little freeboard for nesting terns also put nests at a greater risk of flooding due to the additive effect of increased flows from local rainfall events.

Quantification of Take

The amount or extent of incidental take is difficult to enumerate in the form of individual least terns. The incidental take occurs in many direct and indirect forms that cannot be easily measured with existing or proposed levels of monitoring. Numbers of least terns, and especially eggs and chicks, are difficult to accurately count over several hundred miles of riverine habitat.

The proposed action is very similar to the existing operations. All forms and amount of take for the proposed action are assumed to be similar to those known to occur under existing conditions**.** The estimates of incidental take in this opinion are, therefore, based on averages of existing tern population levels and reproductive success. These measures of tern population levels and reproductive success for the existing population's status are used as a surrogate measure of incidental take and a way to measure the effects of the proposed action. The direct and indirect take (in all forms) cannot be precisely determined, but can be estimated through least tern population numbers and breeding success via fledgling per breeding pair ratios.

Least tern numbers must be monitored and maintained at adequate levels to ensure that anticipated levels of incidental take do not jeopardize populations in the future. Tern population numbers, in addition to reproductive success and habitat conditions, are factored into evaluations of the impacts of take related to proposed actions. Population numbers for each reach of river are averages (rounded to the nearest multiple of ten) of adult least tern numbers from surveys

conducted since 1990 (Table 5). However, two exceptions to using average adult counts were required to accommodate insufficient or inconsistent available survey data.

1. Arkansas River, Arkansas - There is only one year (2004) with complete survey data for the Arkansas River in Arkansas. Therefore, calculating the average number of adult terns was not possible for this river reach. It is likely that the 2004 adult least tern count of 376 is greater than the ten year average, if we assume this portion of the Action Area is similar to the Oklahoma portion of the Arkansas River. Therefore, the 2004 adult least tern count of 376 was adjusted down by the same percentage as the Oklahoma reach (420 average verses a 529 adult count in 2004 or about a 20 percent reduction) to account for the potential that 2004 may have been an above average year for adult least terns. The adjusted number of adult terns for the Arkansas River in Arkansas is 298; then this was rounded to 300. However, several partial surveys in the past counted 200 or more least terns and the Service considers 300 to be a reasonably conservative population estimate for this reach.

2. Red River - Because the number of adult terns is used to calculate breeding pairs (adults/2), the Red River population average was adjusted to more accurately represent the number of breeding adults used to calculate fledgling to breeding pair ratios. Adult least tern numbers along the Red River declined dramatically between the first and second surveys in 2002 and 2003 due to floods in June of those years. Past monitoring has demonstrated that most nesting pairs will renest if failures occur in June or early July. Most of the terns apparently renested in the surveyed area, but the decline in adult numbers after flooding events in 2002 (from 782 to 649) and 2003 (from 993 to 670) implies that some terns renested outside of the Red River reach surveyed by the Corps. For those years, the second or July survey adult count, rather than the first (peak) adult count, represented the number of breeding terns (in the monitored reach) used to calculate fledgling to breeding pair ratios for that reach of the Red River.

Fledgling per breeding pair ratios have been measured in all of the Action Area, but monitoring has been very limited on portions of the Arkansas River. However, using available information, the average fledgling per breeding pair ratio for monitored portions of the Action Area is approximately 0.5. The average number of adult terns in the entire Action Area is estimated to be approximately 1,420 or 710 breeding pairs. Consequently 710 breeding pairs with an average of 0.5 fledglings per breeding pair would annually produce 355 fledglings. The estimates of existing numbers of adult and fledgling terns by river reach are:

A. Arkansas River, Oklahoma, Kaw Reservoir to Oklahoma/Arkansas state line, including the lower Canadian River below Eufaula Reservoir – 500 adults and 125 fledglings annually.

B. Arkansas River, Arkansas - 300 adults and 75 fledglings annually.

C. Red River, Lake Texoma to Index, Arkansas - 620 adults and 155 fledglings annually.

While we cannot precisely quantify take due to a number of variables, an estimate of the actual amount or extent of take related to reproduction is the difference between the measured reproductive success and the potential reproductive success without project-related impacts. The highest fledgling per breeding pair ratio reported for the Action Area is 1.16. Since no without project reproductive data are available, this information was judged to be the best at hand for quantifying an estimate of take attributable to project operations.

Using this ratio, the average number of breeding pairs for the Action Area (710 breeding pairs) would produce 823 fledglings, compared to the 355 fledglings produced at the 0.5 fledgling per breeding pair ratio (existing average). The difference is 468 fledglings and we assume incidental take will vary but is unlikely to exceed this amount in any individual year. Until habitat is improved, take of at least 300-600 eggs and chicks is expected in most years. We assume all adults in the Action Area (1,989 is the highest count to date) could be harmed or harassed by flooding and other impacts associated with the proposed action.

The Corps must reinitiate consultation with the Service if direct and indirect take occurs to the degree that the number of adults and fledglings, in any river reach, average (over a five year period) fewer than the numbers identified above.

EFFECT OF THE TAKE

American Burying Beetle

Approximately 1,100 acres of soil disturbance is anticipated with the proposed action and is a very small percentage of the total project area. In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the ABB or adverse modification of critical habitat.

Least Tern

Our review of information that has become available since the 1998 biological opinion indicates that the adult tern numbers have increased in many areas. However, this may be partially due to increased survey effort; in addition, not all tern populations have increased. Approximately 12,000 adult terns is the most recent rangewide estimate (2003). We evaluated new information on the species and its habitat within the Action Area. Least terns in the Action Area currently may account for approximately 16 percent of the listed entity (1,989 action area /12,305 rangewide; Table 1) based on the most recent population estimate. However, the rangewide estimate probably underestimates the total population due to a lack of recent surveys in several areas of the least tern range and recent increases in some areas.

We suspect that fledge ratios and numbers of nesting birds may decline in the Action Area until nesting habitat quantity and quality improve. Existing habitat conditions are relatively poor in much of the Action Area. However, despite Corps flood control efforts, relatively high flow

events do periodically occur and are likely to restore some habitat and tern nesting success for an unknown duration. We expect tern nesting habitat conditions to fluctuate over time, but be negatively impacted by the proposed action. However, if the existing average numbers of adults and fledglings are maintained, the least tern populations in the Action Area should remain stable. The proposed action should be able to average and maintain existing levels of reproductive success (average of 355 fledglings) and that should be adequate to support existing tern populations (average of 1,420 adults) and meet or exceed existing recovery plan goals. In the accompanying biological opinion, the Service determined that the anticipated take is not likely to result in jeopardy to the least tern or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the take of ABBs and least terns.

American Burying Beetle (ABB)

To minimize potential take of the ABB, the Service recommends the following RPM:

1. The Corps must implement all conservation measures outlined in the proposed action to minimize incidental take of ABBs. These measures are standard protective measures generally recommended by the Service and have been incorporated into the Corps' proposed action.

Interior Least Tern

To minimize potential take of least terns, the Service recommends the following RPMs:

1. Maintain suitable habitat for nesting least terns in the Action Area by:

   a) providing adequate flows to create and maintain nesting habitat, and/or

   b) artificially or mechanically enhancing**,** constructing, and maintaining nesting habitat.

2. Monitor, evaluate, and adjust operations as needed to minimize take of least terns.

3. Monitor and evaluate least tern habitat conditions.

4. Reduce predation and human disturbance of least terns in the Action Area.

TERMS AND CONDITIONS FOR IMPLEMENTATION

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions which implement the RPMs described above and outline required reporting/monitoring provisions. These terms and conditions are non-discretionary.

American Burying Beetle

RPM 1. The Corps must implement all measures in the proposed action to minimize incidental take of ABBs.

1. The Corps must provide an annual report detailing the area (acres) impacted by construction of dredge spoil pits and deposition of dredged materials on terrestrial habitat. This report must include a copy of all ABB survey results and a description of trap and relocation and baiting away activities.

2. If a dead or impaired ABB is found, care should be taken in its handling to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. The dead or impaired ABB should be photographed prior to disturbing it or the site. The Service is to be notified within three (3) calendar days upon locating a dead or injured ABB. Initial notification must be made to the nearest U. S. Fish and Wildlife Service Law Enforcement Office, at (918) 581-7469, then the Oklahoma Ecological Services Field Office, at (918)581-7458. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Formal written notification also must be submitted (Appendix 3).

3. All dead or moribund adults should be salvaged by placing them on cotton in a small cardboard box as soon as possible after collection. The date and location of collection should be included with the container. Specimens should then be furnished to the Sam Noble Museum of Natural History at the University of Oklahoma in Norman for deposition in their collection of invertebrates, or to another suitable site approved by the Service.

Least Tern

RPM 1. Maintain suitable habitat for nesting least terns in the Action Area.

Suitable nesting habitat can be established and maintained by provision of appropriate river flows and/or mechanically or artificially enhanced, constructed, and maintained. As our knowledge of river habitat conditions and tern populations changes over time, the exact locations, design, and number of constructed nesting sites may be modified if approved by the

Service. Initially, all constructed nesting habitat must be at locations approved by the Service and meet the following criteria:

a) Substrate – Nesting substrates consist of well drained particles ranging in size from fine sand to small stones < 1 in. (2.5 cm) in diameter.

b) Size/Shape – Nesting areas should be a minimum of 1 ac (.4 ha), and preferably 10 ac (4 ha) in size; circular to oblong in shape, maximizing surface area; recommended slopes of 1:25 with maximum slopes not exceeding 1:10; surface height above water to exceed 18 in. (45.7 cm) at nest initiation (usually May or June).

c) Visibility – Smooth topography with < 10 percent early successional vegetation.

d) At least 50 percent of the enhanced or constructed nesting habitat must be in place by April 2008 and 100 percent by April 2010.

1. Arkansas River, Oklahoma, Kaw Reservoir to Muskogee - Nesting habitat will be provided and maintained to support the minimum population (currently at least 420 adults). Habitat for at least 200 adults (100 nesting pairs) should be at an elevation that will not flood at 20,000 cfs flows or less. Least terns will not use created nesting habitat exclusively and existing data indicate it is not realistic to expect nesting colonies to average more than 20 nests per site. Currently 8 existing nesting sites in this reach average 20 or more nests and these sites could be enhanced. At least 6 nesting sites with suitable habitat above water levels at a 20,000 cfs flow would be required to maintain 100 nesting pairs. Nesting habitat enhancement at one site (Zink Island) was accomplished in March of 2005. Most of the remaining five sites could be enhanced through cooperative efforts with sand and gravel operations or in association with proposed bridge or dam projects. The nesting habitat improvements can include relatively temporary projects, such as vegetation removal conducted on an annual basis, or more permanent enhancement/creation projects, but must meet criteria a-d above and not be flooded at 20,000 cfs. Nesting habitat improvement is important because take of nearly all (at least 300- 600) eggs and chicks is expected in most years until habitat is improved (see discussion in the Effects of the Action section).

2. Arkansas River, Muskogee to Oklahoma/Arkansas state line, including the lower Canadian River below Eufaula Reservoir - Nesting habitat will be provided and maintained to support the minimum population (currently at least 80 adults). Habitat should be at elevations that will not flood on at least a ten year frequency (as measured over the period of record and including the water elevation fluctuations due to barge traffic). This will require at least 3 nesting sites with suitable habitat. The nesting habitat improvements can include relatively temporary projects, such as vegetation removal conducted on an annual basis, or more permanent enhancement/creation projects, but must meet criteria a-d above.

3. Arkansas River, Arkansas - Nesting habitat will be established and maintained to support the minimum population (currently at least 300 adults). Dredge spoil will be utilized to create and/or enhance potential least tern nesting habitat at sites recommended and approved by the Service and the Corps. The dredge spoil islands will be monitored and evaluated by the Service and the Corps, as discussed in Part 5, during the breeding season. Suitable nesting habitat will be maintained as defined by criteria a through c listed above at sites recommended by the Service, pending post construction monitoring and evaluation. An average of at least one nesting island per pool, or 12 islands (with the Dardanelle pool counting as 2 for pools 10 &11), will be constructed and/or enhanced with dredge material disposition and maintained to provide sustainable and viable nesting habitat above an elevation that will not flood during the breeding season on at least a ten year frequency (as measured over the period of record and including the water elevation fluctuations due to barge traffic). The location and number of nesting islands per navigation pool will be based on monitoring and evaluation of tern use, sustainability, habitat quality, and viability as determined by the Service and the Corps. Of the 12 islands, at least 1 (each) must be maintained in pools 2, 5, 7, 8, 9, 10, and 12. The remaining 5 islands will be maintained where determined appropriate and feasible by the Service and the Corps based on previously described methods and considerations.

4. Red River, Lake Texoma to Index, Arkansas – Nesting habitat will be maintained to support the minimum population (currently at least 600 adults). Least tern nesting habitat in most of the Red River is not as degraded as in the Arkansas River, but the average freeboard of nests is declining. Construction of artificial islands should be considered an option to improve existing conditions or creating habitat in areas where little if any nesting habitat currently remains.

5. The Corps will monitor and evaluate the created or enhanced island/sandbar habitat annually to determine if physical and biological requirements of the least tern are being achieved. The Corps shall report the data for created or vegetation-managed nesting habitat separately from natural nesting habitat. If the created island/sandbars are not providing habitat as anticipated, then the Corps will evaluate and implement methods to improve the habitat suitability. The Corps will coordinate these actions with the Service.

6. Following three years of creating, enhancing, evaluating, and monitoring sandbar habitat, the Corps will report the results and conduct a peer review of habitat creation methods and outcomes. The Corps will provide a copy of its report and the results of the peer review to the Service and the Interior Least Tern Working Group.

RPM 2. Monitor, evaluate, and adjust operations to minimize take of least terns.

1. The Corps will monitor and evaluate the effect of reservoir releases on least terns. Information collected under RPM 3, including elevations of sandbars and nests in relationship to water levels, plus any additional information necessary to assess flooding, human disturbance, predation, and impacts to forage fish populations, will be examined.

2. The Corps will utilize its authorities and operational flexibility in adjusting flows and other pertinent actions to reduce the flooding and landbridging of least tern nesting sites. The Corps will coordinate frequently and in a timely manner with the Service when it has determined that increased flow releases may flood terns or decreased flows may landbridge tern nesting sites. During these consultations, the Corps will provide the Service its recommendations to reduce flooding and landbridging. Nesting habitat shall be a priority and other management actions implemented to meet or exceed the minimum adult and fledgling numbers established for each river reach.

3. By January 1, 2007, the Little Rock District of the Corps will develop least tern management guidelines similar to those developed by the Tulsa District. At a minimum this document will include least tern management guidelines for each project and coordination procedures and contacts for April-September of each year. The Corps will coordinate the development of this document with the Service to minimize take of terns. This document, once approved by the Service, will be incorporated into the Corps future actions and will supercede any previous guidelines.

4. The Corps will conduct annual least tern monitoring at all nesting sites on the Arkansas, Canadian, and Red rivers within the Action Area, including reservoirs and the river reaches between reservoirs. The Corps will develop a monitoring plan with specific information on how monitoring will be conducted; this plan should be developed with input from the Interior Least Tern Working Group, but must be approved by the Service. Information to be collected will include, but not be limited to, the number of adult terns, elevation of nests and freeboard representing the highest and lowest nests at each nesting site, locations (as measured with a global positioning system) in latitude and longitude or UTMs of nesting sites, evidence of landbridging, evidence of predation or disturbance, and number of nests, chicks and fledglings. In conducting the annual least tern surveys, the Corps will continue to collect information on mortality, injury, and productivity. The number and type of mortality (in categories currently used by the Corps) will be recorded for adults, chicks, eggs, and nests along with any other useful observations. The Corps will record mortality caused by its operations, any measures taken to reduce mortality, and the effectiveness of these measures to reduce take. The Corps also will collect information on annual productivity, including the number of fledglings per breeding pair.

5. In accordance with other annual reporting requirements in this BO, the Corps will provide to the Service, by December 31 of each year, the information collected as described by these Terms and Conditions along with analyses, conclusions, and recommendations.

RMP 3. Monitor and evaluate least tern habitat conditions.

1. The Corps shall monitor and map, on a periodic basis (at least once every 3 years), all potential tern nesting habitat on the Arkansas, Canadian, and Red rivers within the Action Area. The mapping information will be used to determine the quantity and quality of least tern habitat over time. Habitat monitoring must include estimates, by reach, of the

average channel width, and area of vegetated and relatively unvegetated (<30 percent) sandbars and islands at flows that represent maximum hydropower releases, and relatively minor flood release flows that would occur during the least tern nesting season. A new habitat monitoring plan will be developed with input from the Interior Least Tern Working Group for each river system. Monitoring must be initiated during the 2007 nesting season. Mapping products or updates on data collection will be provided in the annual report.

RPM 4. Reduce predation and human disturbance of least terns.

1. The Corps will evaluate various measures to reduce predation of least terns. The Corps will prepare a report describing its findings from the predation reduction evaluation, along with its recommendations. This report will be completed by April 1, 2007 and provided to the Service for review.

2. The Corps will implement measures approved by the Service to reduce predation at all constructed or enhanced least tern nesting sites.

3. The Corps shall post signs at least tern nesting sites that the Service and Corps jointly deem could be affected by human disturbance and may benefit from posting signs (e.g., large colonies, areas with high human use, sites used by ATV's or other ORV's, sites with history of human disturbance). The Corps will contact landowners of nesting sites not owned or controlled by the Corps to obtain permission to post signs. With landowner permission, the signs will be placed at strategic locations and densities to best deter human entry. The signs should clearly deny entry, describe the potential for death and injury of least terns from entry, the penalties under the ESA for harming a threatened or endangered species, and general information on the life history of least terns. The Corps will coordinate with Service and State personnel on any nesting sites requiring surveillance and/or enforcement action.

4. All personnel involved with surveying, studying, maintaining habitat, and related activities will be trained to use current methods to avoid impacting terns.

5. At least tern nesting sites owned and managed by the Corps, monitor and manage recreation and other activities to avoid or minimize human disturbance.

6. The Corps will conduct a public outreach and education program on the conservation of the least tern. In addition to using traditional outreach products and activities (e.g., brochures, videos, interpretative programs, posters), the Corps will produce and distribute each year during the least tern nesting season Public Service Announcements about least terns in the Action Area. The Public Service Announcements should be available for public use as well as in the Corps' project offices.

PROCEDURES FOR HANDLING AND DISPOSING OF INTERIOR LEAST TERNS

Upon locating a dead or injured adult or juvenile least tern, the Oklahoma Ecological Services Field Office should be notified as expeditiously as possible. Care will be taken in handling sick or injured specimens to ensure effective treatment and when handling dead specimens to preserve biological materials in the best possible state for later analysis of cause of death. The finder must ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

All dead or moribund individuals will be frozen and the date and location of collection recorded. These specimens should then be furnished to the university, museum, or agency specified by the Service.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the amount or extent of the incidental take limit is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the RPMs and terms and conditions provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs and terms and conditions.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans or develop information. Implementation of these measures would help facilitate recovery of the least tern.

A. The Corps and SWPA should work with the Service to immediately establish a least tern coordination team (LTCT) to identify and implement the goals of this BO. That team will be responsible for ensuring implementation of future conservation measures; tracking, evaluating, and documenting the results of those measures; and tracking and documenting sufficient progress in conserving this listed species. The LTCT should involve additional agencies or groups, as appropriate, with biological and engineering expertise. The LTCT should coordinate with the Interior Least Tern Working Group to improve implementation of monitoring and recovery measures.

B. Conduct least tern monitoring on river reaches upstream of Corps reservoirs. Least tern populations nesting on the Cimarron, Canadian, and Red rivers upstream of Corps reservoirs should be monitored to help determine movements of terns from downstream areas during and after flood events or other disturbances. The reproductive success of these terns should be monitored to determine the comparative nesting success of terns above and below Corps reservoirs.

C. The Corps should initiate other studies as appropriate to investigate the long-term effects of riverbed changes/sediment transport and their impacts to least tern nesting habitat, forage availability, and forage areas.

D. The Corps should initiate studies to evaluate the abundance and availability of forage fish for least terns during the nesting season. The effects of operational flows on forage fish also should be investigated to develop modifications of flows to benefit forage fish populations. The abundance and availability of forage may be a limiting factor to the success of nesting least terns.

E. The Corps should research and develop methods to restore the dynamic equilibrium of sediment transport and associated turbidity in river reaches downstream of reservoirs.

F. The Corps should conduct or assist in research on the ABB to fill data gaps regarding the ecology and biology of the ABB. Data gaps involving the ABB include: suitable reproductive habitat, overwintering habitat, and diurnal active season habitat. The Service recommends coordinating research proposals with the Oklahoma Field Office.

G. The Corps should assist in monitoring and habitat management for Ivory-billed woodpeckers in appropriate portions of the project area.

In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in your biological and environmental assessments. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation of consultation.

Thank you for the information and cooperation provided by the Corps in this consultation. Questions or comments should be referred to Mr. Kevin Stubbs of this office at 918/581-7458 (ext. 236).

Sincerely,

Jerry J. Brabander
Field Supervisor

cc: Regional Director, U.S. Fish and Wildlife Service, Albuquerque, NM (AES/SE).
U.S. Fish and Wildlife Service, ARESFO, Conway, Arkansas
Director, Natural Resource Section, ODWC, Oklahoma City, OK.
Director, Arkansas Game and Fish Commission, Little Rock, AR

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APPENDIX A

Corps Tulsa District Least Tern Management Guidelines and Little Rock District Least Tern Management Plan

Management Guidelines
And Strategies for
Interior Least Terns
USACE-Tulsa District
(Revised 4-1-2003)

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Management Guideline For
Interior Least Terns
USACE-Tulsa District
(Revised 4-1-2003)

1 **Purpose.** To provide comprehensive guidelines for the management and protection of interior least terns nesting below Corps of Engineers water resource projects on the Arkansas, Canadian and Red Rivers in Tulsa District, U. S. Army Corps of Engineers (USACE-TD). This guideline includes a comprehensive approach for both long-term and short-term strategies to achieve compliance with the Endangered Species Act (ESA) to the maximum extent possible while preserving authorized project purposes

2 **Management Strategy**.

a. Long-Term Strategy. The long-term strategy is to provide suitable nesting habitat, which is not adversely impacted by normal operation of water resource projects. The development of these activities will occur concurrently with the short-term strategy. Long-term actions include the following.

(1) Develop and maintain islands with suitable nesting habitat.

(a) Investigate and determine the feasibility of creating or enhancing islands to provide suitable nesting habitat. Identify potential funding sources to perform work. Incorporate least tern habitat evaluations as part of appropriate environmental studies.

(b) Utilize dredging activities from commercial sand plants and/or navigation dredging (Dredge Material Disposal Plan) to create or enhance nesting areas.

(c) Explore and implement ways to maintain and/or improve nesting islands by sand replenishment, vegetation control and removal, and structural methods.

(2) Evaluate and monitor project impacts.

(a) Population Surveys (Upstream and Downstream). Continue performing periodic surveys to identify colonies and nesting success.

(b) Habitat documentation/evaluation. Establish baseline GD&S information and perform periodic updates to monitor and evaluate nesting islands.

(c) Evaluate project impacts and identify methods to recover the species.

b. Short-Term Strategy. The short-term strategy utilizes reasonable and prudent management practices that comply with the ESA by minimizing impacts to habitat and nesting stage and initiate steps to achieve long-term goals.

(1) Non-nesting Period.

(a) Definition. The periods before birds arrive for breeding and after young birds are fledged and able to fly.

(b) High-flow Releases

Objective: Periodically release floodwater with sufficient flow rates and elevations to inundate and scour islands in order to remove vegetation and deposit silt and sand. Durations will be adjusted to provide optimum conditions for material deposition. Releases will be based on sound hydrological opportunities. During years when the hydrological conditions do not allow for this type of a release, the methods described in (c) and (d) may have to be considered.

Impacts: Provide sufficient sand deposits to replenish sand and raise island elevations. May adversely impact project purposes and create an imbalance in project evacuation plans. No significant impact to navigation flows is anticipated by this operation. Releases will have to be decreased at some lakes to make up for the increases at other lakes. The resulting total flow rate in the navigation system will be unchanged. Deviations may be required.

Schedule: Every 2-3 years during non-nesting periods. After coordination with the USFWS on a case-by-case basis, releases may extend into the early nesting periods if determined to be beneficial.

(c) Dredging Operations

Objective: Use dredge materials to replenish sand on existing islands and deepen water around islands to remove land bridges.

Impacts: Requires the voluntary cooperation with sand operators to perform work or O&M funds to hire the work done. Actions may require appropriate permits, access agreements, easements and volunteer agreements.

Schedule: During non-nesting periods

(d) Vegetative Manipulation

Objective: Use physical or chemical methods to remove vegetation from nesting islands to improve nesting habitat.

Impacts: Limited to isolated areas and requires extensive labor and material resources to physically remove vegetation and treat nesting areas. May require multiple applications or treatments. Activities may require landowner access or easements.

Schedule: Late spring before arrival of adults.

(2) Nesting Period

(a) Definition. The period when nests are being established until young birds are fledged and able to fly.

(b) Limit maximum water releases.

Objective. Prevent flooding of active nests

Impacts. Reduces the loss of nest and chicks from flooding. Conserves water in the flood control pool and may improve ability to provide sufficient flows for minimum water releases. May reduce flood storage capacity and extend periods of higher lake elevations.

Schedule. June (Nesting Season). Note: After coordination with USFWS on a case-by-case basis, releases during <u>early</u> nesting periods may be determined to be beneficial.

(c) Provide minimum water releases.

Objective. Prevent land bridging of islands to reduce nesting losses due to predation and human activities.

Impacts. May require extended periods of minimum flow releases could create regional impacts during periods of low lake levels and adversely impact multiple project purposes such as recreation, water supply, hydropower, flood control, navigation and fish and wildlife. Regional hydropower projects in Tulsa, Little Rock, St. Louis and Kansas City Districts could be

required to generate additional energy no longer available from projects involved in tern management.

Schedule. June and July (Could extend into August)

3 **Hydrological Considerations**

a. Seasonal Pool Operations. Seasonal pool plans (SPP) will be implemented (if approved) for Kaw, Keystone, Eufaula, and Texoma to allow water to be stored in the lower part of the flood control pool during June and July. This water could then be used to provide minimum flow requirements during the remainder of the nesting season. This will decrease the amount the pool is drawn down later in the summer. Note: Texoma has an existing SPP and will not be modified. Kaw and Eufaula have existing SPP's that will be modified. A new SPP will be implemented for Keystone.

b. Deviation Request. Any change in the normal operation of the projects will require a deviation approval from SWD. The release of water specifically for least terns will require a deviation.

c. Normal Hydropower Demands. SWPA indicated the normal peak demand for power is approximately 6hrs per day Monday - Friday. OMPA will utilize "run of the river" to meet peak demands and multiple starts to satisfy low flow requirements. OMPA indicated the normal demand for power is approximately 6 hrs per day (2 - 8pm) Monday - Friday.

d. Water Conservation/Operations

(1) Initiate a strategy to schedule releases to maintain minimum water levels over land bridges at targeted sites and during critical periods.

(2) Evaluate various release strategies to determine the most efficient method to conserve water and reduce impacts on project purposes.

(3) Non-Hydropower Releases. There may be occasions where the needed flow to prevent land bridging is significantly less than the outflow from a generator loaded at its lowest safe operating level. In those cases, it <u>may</u> be economically justified to spill the necessary water in order to conserve lake storage to meet future power needs. SWPA has developed a procedure for evaluating the advisability of spilling the water based on the market prices of on-peak and off-peak generation prevailing at the time and will make recommendations to the USACE-TD on a

case-by-case basis. The procedure makes no attempt to evaluate the impacts to other project purposes.

(4) Water Supply Storage Accounting. The H&H Branch is required to begin water supply storage accounting when the conservation pools get to less than 75% full. The water released to protect the least terns from predators, will be treated as a loss to be shared by all storage owners (water supply, water quality, and hydropower). The losses are shared proportionally to a user's remaining storage. This is the same way evaporation losses are accounted for.

(5) Maximum Allowable Draw Down Rate (Dam Safety Criteria). Pool draw down rates shall not exceed the rates established in the water control manuals to allow sufficient time for saturated soil on the embankment to drain and prevent slippage. Generally 1 ft per week and 3 feet per month. Any deviation must be reviewed and approved by SWD after coordination by E&C Division (H&H and Dam Safety).

4 **Stakeholder and Public Coordination**

a. Section 7, Endangered Species Biological Assessments (BA) and Biological Opinions (BO) Consultation. Adjust actions to comply with BO conditions or re-initiate consultations to allow for changes of actions or conditions. Examples include revising the level of take, changing management actions, revising operating plan for least terns, etc.

b. Coordination Meetings.

(1) Pre-season Planning. Annual coordination meetings will be held with all agencies to review and plan for current year plan.

(2) Critical Time Evaluations and Analysis. Routinely meet with agency representatives during critical nesting period to assess current conditions and decide on appropriate courses of action.

(3) Post-season Operational Meeting. Meet with all agencies to review the past years activities and determine areas of improvement.

c. Surveys.

(1) Perform multiple surveys of the river systems in order to evaluate and monitor nesting success. (May - August)

(2) Evaluate habitat and determine allowable levels of discharge rates. (May - August)

d. Communication and Community Relations

(1) Establish lines of communications and protocols for coordinating general and time critical actions. (See Appendix E)

(2) Develop a community relations plan to inform the public, stakeholders and congressional delegations about the actions to protect least terns. (See Appendix G)

5 **Roles and Responsibilities**

a. Project and Program Management Division. (PPMD). Serves as the project manager and is responsible for overall management of least terns program. Serves as the team leader for the interdisciplinary Project Delivery Team (PDT) and is the primary point of contact for executive leadership and cooperating agencies. Provides upward reporting to PRB about the status of PDT activities, guidelines and management efforts. Monitors management activities and facilitates coordination and decision making meetings. Ensures adequate communication and information exchange, both internal and external.

b. PER Division. Coordinates with USFWS in accordance with the ESA. Implements terms and conditions of BO. Conducts annual surveys of nesting least terns for nesting success. Coordinates survey data with elements of USAED-TD and other agencies. Prepares reports of nesting success for USFWS. Responsible for life history, habitat evaluation, and assessment of biological implications of any modifications to Interior Least Tern populations and or habitats. Reviews habitat construction proposals for compliance with CWA Section 404(B)(1) guidelines and Section 10 of the Rivers and Harbors Act of 1899.

c. E&C Division (H&H / Dam Safety). Manages USAED-TD projects for flood control, hydropower, and low flow releases. Has the lead in coordinating any changes in reservoir regulation with appropriate agencies including, USFWS, SWPA, and project field offices. Reviews proposed releases to ensure dam safety criteria are not exceeded.

d. Operations Division. Operates USAED-TD projects for all other project purposes. Area Manager provides input on impacts of proposed actions on other project purposes including recreation. Coordinates with the local communities with respect

to reservoir operations and potential impacts on recreation. Responsible for implementation of management practices within water resource project boundaries and authorities.

e. Office of Counsel. Provides advice on legal sufficiency of proposed actions with respect to the Endangered Species Act.

f. Public Affairs. Supports the management team in efforts to keep the public, stakeholders and congressional delegations apprised of changes in operation of USAED-TD reservoirs for least terns. Provides assistance, advice and communication products to area managers for local use.

6 **Authorities.**

a. Legal Authorities. The Corps of Engineers is under obligation operate water resource projects in compliance with the requirements of the Endangered Species Act and Migratory Bird Treaty Act. That obligation includes using reasonable and prudent alternatives to avoiding further harm to the listed species and to assist in the restoration of the species to a status that no longer requires listing.

b. O&M Authorities.

(1) Rivers and Harbors Act (RHA)
(2) Flood Control Act
(3) Environmental Impact Statement (EIS)
(4) Design Memorandums

c. Regulatory Permits - Certain activities that may be proposed under short-term or long-term strategies will require review and authorization under Section 404 of the Clean Water Act (CWA) and under Section 10 of the Rivers and Harbors Act (RHA) of 1899. Such activities include mechanical or physical manipulation of the riverbed and banks for the creation or enhancement of tern habitat.

d. Congressional Authorities

(1) Continuing Authorities Projects (CAP).

(a) Aquatic Ecosystem Restoration (Sec 206, WRDA96). Authorizes aquatic ecosystem restoration and protection projects if it has been determined that it satisfies the following criteria: (1) it improves the quality of the environment, (2) it is in the public interest and (3) it is cost-effective. Non-federal interest shall provide 35% of the cost of construction and agree to 100% operations and maintenance cost.

(b) Environmental Restoration (Section 1135, WRDA 96) Authorizes the review of water resource projects to determine the need for modifications in the structures and operations of such projects for the purpose of improving the quality of the environment in the public interest and to determine if the operation of such project contributes to the degradation of the quality of the environment. If the water resource project contributes to the degradation of the quality of the environment, measures may be undertaken for restoration and enhancement of environmental quality if such measures do not conflict with the authorized project purposes. Non-federal share of the cost of any measure of modification shall be 25%.

(2) General Investigations (GI). Studies to address ecosystem restoration opportunities could also be conducted under the General Investigation program. The following authorities are utilized to examine water resource problems and identify solutions. Reconnaissance studies could be initiated if funded by U.S. Congress. Feasibility studies, if recommended during the reconnaissance phase, require non-Federal cost share sponsors.

(a) Arkansas River and Tributaries, Great Bend, Kansas to Tulsa, OK Study authorized by Section 208, 1965 Flood Control Act. No current studies underway.

(b) Canadian River and Tributaries, OK, TX and NM. Authorized by the Flood Control Act 1937, PL525. No current studies underway.

(c) Red River Waterway, LA, AR, OK, TX (Index, Arkansas to Denison Dam, Texas) Reconnaissance Study authorized by the Rivers and Harbor Act of 1968 (PL 90-483). A reconnaissance study is funded in the FY02 Budget and is underway.

7 **Partnerships.**

a. Environmental Organizations. Identify and encourage interested environmental groups to participate in voluntary efforts to monitor tern activities, modify habitat, increase public awareness, education programs, etc.

b. Corporate Sponsors

(1) Sand and Gravel Operators. Identify ways or incentives to encourage operators to beneficially maintain, modify, or improve least tern nesting islands and habitat.

(2) Water Storage Customers. Identify water users who benefit from long-range goals. (i.e. SWPA Customers, PSO, Private Power, concessionaires, water supply customers, etc)

c. Section 404 CWA Permits - Evaluates proposed actions in least tern territory for potential habitat improvement opportunities. Inform permit applicants and the public regarding the qualities and importance of least tern nesting habitat and practices that best maintain and protect habitat. Consider how potential incentive plans for private landowners may be integrated into the Regulatory Permit program.

d. Special Interest Groups and Associations. Identify and encourage individual groups or associations involved with water resource projects to participate in long-term actions. These groups include individual lake associations at Kaw, Keystone and Eufaula and the Lake Texoma Advisory Council.

Appendix A

Kaw Lake and Arkansas River Operation Plan

Appendix A
Interior Least Tern
Project Operation Plan
Kaw Lake and Arkansas River System

1 **Area Description.** Kaw Lake, located at river mile 653.7 near Ponca City, and the Arkansas River from Kaw Dam to Keystone Lake.

2 **Kaw Lake - Least Tern Operation Plan.**

a. Upper limit for flood control protection of the terns is elevation 1021.5 (25% of flood pool). A rainfall event resulting in 2.0 inches of runoff over the 6250 square mile drainage basin will fill the remaining flood storage. This is about a 5-year frequency event. When the pool is above this level, the project will be operated for flood control according to the approved water control plan.

b. Use the current seasonal pool modified from 15 May through 15 August, with a 3 feet rise to elevation 1013 from 1 June through 15 July.

c. Stop making low flow releases when the pool gets to elevation 1008.0 (90% of conservation storage). This allows net inflows to be generated by OMPA and keep the pool at or above elevation 1008.0 by 30 September. Operations Division identified elevation 1008.0 as being a critical low pool condition.

d. Limit drawdown rate to a maximum of 1 foot per week and 3 feet in a consecutive 4-week period when pool elevation is below 1010.

e. Minimum release capacity. The average flow requirement to protect least terns below Kaw Lake is 2,200 cfs.

f. The upper and lower pool limits are intended as a guide and serves as triggers to activate technical review. These limits may be exceeded on a case-by-case basis after the PDT reviews all pertinent data and circumstances.

3 Kaw Lake - Least Tern Operation Plan Table

Pool Level	Elevation	Percent Full	Potential Actions
Top Flood Pool	1044	100% (flood)	
Upper Limits	>1021.5	25% (flood)	Stop flood protection of nest
Top Seasonal Pool	1013	100% (cons)	
Drawdown Limit	<1008	90% (cons)	Stop low flow releases
Critical Low Pool	1008	90% (cons)	

Appendix B

Keystone Lake and Arkansas River Operation Plan

Appendix B
Interior Least Tern
Project Operation Plan
Keystone Lake and Arkansas River System

1 **Area Description.** Keystone Lake, located at river mile 538.8 near Tulsa, OK, and the Arkansas River from Keystone Dam to Muskogee, OK.

2 **Keystone Lake - Least Tern Operation Plan**

a. Beginning 1 June of each year, CESWT-EC-HM begins computing 2-week average inflows for Keystone. These flows will be compared with median inflows to predict a trend. This process will be repeated every 2 weeks through the end of the nesting period. This data will be used to forecast pool drawdowns due to minimum flow requirements for the terns as well as hydropower generation. This process identifies the maximum release rate, which will not exceed the drawdown limits identified for the lake.

b. Upper limit for flood control protection of the terns is elevation 730 (10% of flood storage). This limit is required because Keystone Lake has a frequent rate of filling the flood control storage and has a high population center immediately downstream. A rainfall event resulting in 1.2 inches of runoff over the 14,500 square mile contributing drainage basin will fill the remaining flood storage. This is about a 2-year frequency event.

c. Implement a Seasonal Pool Plan (SPP) to elevation 726 from 1 June through 15 July.

d. Assuming median (normal) inflow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 719.8 (60% of conservation storage remaining) by 31 July. This provides adequate storage to generate hydropower to meet peaking power demands and stay above elevation 718.0 (51% of conservation storage remaining) by 30 September. Operations Division identified elevation 718 as being a critical low pool condition.

e. Assuming 5-year frequency low flow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 724.0 (86% of conservation storage remaining) by 31 July. This provides enough storage to generate hydropower to meet peaking power demands and stay above elevation 718.0 (51% of conservation storage remaining) by 30 September.

f. Limit drawdown rate to a maximum of 1 foot per week and 3 feet in a consecutive 4-week period when the pool elevation is below 723.

g. Minimum release requirements. The average flow requirement for the Arkansas River below Keystone Lake is 4,500 cfs. The minimum outflow from a hydropower generator at its lowest safe operating level is 5,200 cfs

h. The upper and lower pool limits are intended as a guide and will serve as triggers to activate technical review. These limits may be exceeded on a case-by-case basis after the PDT reviews all pertinent data and circumstances.

3 **Keystone Lake -Least Tern Operation Plan Table**

Pool Level	Elevation	Percent Full	Potential Actions
Top Flood Pool	754	100% (flood)	
Upper Limits	>730	10% (flood)	Stop flood protection of nest
Top Seasonal Pool	726	100% (cons)	
Drawdown Limit	* <724	86% (cons)	Stop low flow releases
Drawdown Limit	**<719.8	60% (cons)	Stop low flow releases
Critical Low Pool	718	51% (cons)	

*Based on 5-year low flow conditions **Based on median flows

Appendix C

Canadian River Operation Plan

Appendix C
Interior Least Tern
Project Operation Plan
Canadian River

1 **Area Description.** Eufaula Lake, located at river mile 27 and the Canadian River from Eufaula Dam to RS Kerr L&D Reservoir.

2 **Eufaula Lake - Least Tern Operation Plan**

a. Beginning 1 June of each year, CESWT-EC-HM will begin computing 2-week average inflows for Eufaula Lake. These flows can be compared with median inflows to predict a trend. This process will be repeated every 2 weeks through the end of the nesting period. This data will be used to forecast pool drawdowns due to minimum flow requirements for the terns as well as hydropower generation. This process identifies the maximum release rate, which will not exceed the drawdown limits identified for Eufaula Lake.

b. Upper limit for flood control protection of the terns is elevation 588.0 (22% of flood storage). This limit is required because elevations above this limit cause extensive shoreline erosion and endanger private property. A rainfall event resulting in 2.5 inches of runoff over the 8,700 square mile contributing drainage basin will fill the remaining flood storage. This is about a 5-year frequency event.

c. Modify the existing seasonal pool plan to allow for a pool rise to elevation 587 from 1 June through 15 July.

d. Assuming median (normal) inflow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 581.8 (78% of conservation storage remaining) by 31 July. This provides adequate storage to generate hydropower to meet peaking power demands and stay above elevation 580.0 (67% of conservation storage remaining) by 30 September. Operations Division identified elevation 580 as a critical low pool condition.

e. Assuming 5-year frequency low flow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 583.2 (87% of conservation storage remaining) by 31 July. This provides enough storage to generate hydropower to meet peaking power demands and stay above elevation 580.0 (67% of conservation storage remaining) by 30 September.

f. Limit the drawdown rate to a maximum of 1 foot per week and 3

feet in a consecutive 4-week period when the pool is below elevation 585.

g. The upper and lower pool limits are intended as a guide and serves as triggers to activate technical review. These limits may be exceeded on a case-by-case basis after the PDT reviews all pertinent data and circumstances.

3 **Eufaula Lake - Least Tern Operation Plan Table**

Pool Level	Elevation	Percent Full	Potential Actions
Top Flood Pool	507	100% (flood)	
Upper Limits	>588	22% (flood)	Stop flood protection of nest
Top Seasonal Pool	587	100% (cons)	
Drawdown Limit	* <583.2	87% (cons)	Stop low flow releases
Drawdown Limit	**<581.8	78% (cons)	Stop low flow releases
Critical Low Pool	580	57% (cons)	

*Based on 5-year low flow conditions **Based on median flows

Appendix D

Denison Dam and Red River Operation Plan

Appendix D
Interior Least Tern
Project Operation Plan
Denison Dam and Red River

1 **Area Description.** Denison Dam, located at river mile 725.9 near Denison, TX, and the Red River from Denison Dam to Index, AR.

2 **Lake Texoma - Least Tern Operation Plan**

a. Beginning 1 June of each year, CESWT-EC-HM will begin computing 2-week average inflows for Lake Texoma. These flows can be compared with median inflows to predict a trend. This process will be repeated every 2 weeks through the end of the nesting period. This data will be used to forecast pool drawdowns due to minimum flow requirements for the terns as well as hydropower generation. This process identifies the maximum release rates, which will not exceed the drawdown limits identified for Lake Texoma.

b. The upper limit for flood control protection for the terns is elevation 624 (25% full). A rainfall event resulting in 1.4 inches of runoff over the 26,100 square mile drainage basin will fill the remaining flood storage. This is about a 5-year frequency event. When the pool is above this level, the project will be operated for flood control according to the approved water control plan.

c. The current permanent seasonal pool plan will be followed. This plan provides for a pool rise to elevation 619 (2 feet above normal) from 1 June through 15 July.

d. Assuming median (normal) inflow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 613.5 (74% of conservation storage remaining) by 31 July. This provides adequate storage to generate hydropower to meet peaking power demands and stay above elevation 613.0 (72% of conservation storage remaining) by 30 September. Operations Division identified 613 as being a critical low pool condition.

e. Assuming 5-year frequency low flow conditions, low flow releases will be discontinued when the pool is forecast to fall to elevation 616.1 (85% of conservation storage remaining) by 31 July. This provides enough storage to generate hydropower to meet peaking power demands and stay above elevation 613.0 (72% of conservation storage remaining) by 30 September.

f. The maximum pool draw down rate will be limited to 1 foot per

week and 3 feet in a consecutive 4-week period when the pool elevation is below 617.

g. The upper and lower pool limits are intended as a guide and will serve as triggers to activate technical review. These limits may be exceeded on a case-by-case basis after the PDT reviews all pertinent data and circumstances.

3 Texoma Lake - Least Tern Operation Plan Table

Pool Level	Elevation	Percent Full	Potential Actions
Top Flood Pool	640	100% (flood)	
Upper Limits	>624	25% (flood)	Stop flood protection of nest
Top Seasonal Pool	619	100% (cons)	
Drawdown Limit	* <616.1	85% (cons)	Stop low flow releases
Drawdown Limit	**<613.5	74% (cons)	Stop low flow releases
Critical Low Pool	613	72% (cons)	

*Based on 5-year low flow conditions **Based on median flows

Appendix E

Notification Responsibilities, Protocols and Contacts

Appendix E
Notification Responsibilities, Protocols and Contacts.

1. Notification of least tern arrival for nesting season. The responsibility for notification that least terns have arrived on the Arkansas River, Canadian River, and Red River is a joint responsibility of the USFWS and USACE-TD.

Protocol. As soon as USFWS and CESWT-PE-E field personnel observe birds on these rivers, CESWT-PE-E POC's or alternates initiates the following notification protocol.

CESWT-PE-E notifies: CESWT-PP-C,CESWT-EC-HM, USFWS and ODWC.
CESWT-PP-C notifies: Area Managers, CESWT-OD-R and CESWT-PA
CESWT-EC-HM notifies: reservoir regulator, SWPA and OMPA
Area Managers notifies: local news media and interest groups

Copies of the notification are sent to all POCs and the least tern committee members. All notifications are by phone and followed by e-mail for recording purposes.

See list of phone numbers and e-mail addresses in paragraph 9 for appropriate POCs.

2. Notification that least terns have begun nesting. Notification that least terns have begun nesting is a joint responsibility of the USFWS and USACE-TD.

Protocol. As soon as USACE-TD or USFWS personnel determine the start of nesting, CESWT-PE-E initiates the following notification protocol.

CESWT-PE-E or alternate notifies: CESWT-PP-C, CESWT-EC-HM, USFWS and ODWC
CESWT-PP-C notifies: Area Manager, CESWT-OD-R and CESWT-PA.
CESWT-HM notifies: OMPA and SWPA.
Area Managers notifies: local news media and interest groups

CESWT-PA will prepare a news release about the nesting terns in accordance with the communication plan and provide to Area Managers and major news media.

Survey Coordination. CESWT-PE-E and USFWS schedules dates for conducting summer surveys and reporting results to CESWT-EC-HM who contacts appropriate reservoir regulators.

All notifications are by phone and followed by e-mail for recording purposes. See list of phone numbers and e-mail in

paragraph 9 addresses for POCs.

3. Determination of least tern nesting locations and freeboard. Upon completion of the initial survey, data results including locations and numbers of nesting colonies, and critical elevations are furnished to CESWT-EC-HM.

Protocol. As soon as USACE-TD and USFWS personnel compiled the first summer survey data, CESWT-PE-E initiates the following notification protocol.

CESWT-PE-E notifies: CESWT-PP-C, CESWT-EC-HM, USFWS and ODWC
CESWT-EC-HM notifies: OMPA and SWPA
CESWT-PP-C notifies: Area Manager, CESWT-OD-R, CESWT-PA

All notifications are by phone and followed by e-mail for recording purposes. See list of phone numbers and e-mail addresses in paragraph 9 for appropriate POCs.

4. Notification of flood control operation. During the nesting period, it may be necessary to begin flood control operation. CESWT-EC-HM will determine if the required changes in reservoir regulation will potentially impact nesting least terns.

Protocol. As soon as CESWT-EC-HM determines when flood operations will begin and the magnitude, the following notification protocol will be initiated.

CESWT-E-HM notifies: CESWT-PP-C, CESWT-EC, CESWT-EC-DD, and CESWT-PE-E, OMPA and SWPA
CESWT-PE-E notifies: ODWC and USFWS.
CESWT-PP-C notifies: Area Manager, CESWT-OD-R, CESWT-PA
Area Managers notifies: local news media and interest groups

CESWT-PA updates a news release about the nesting terns and provide to Area Managers and major news media. All notifications are by phone and followed by an e-mail for recording purposes. See list of phone numbers and e-mail addresses in paragraph 9 for appropriate POCs.

5. Notification of flood control to conservation transition. When it becomes necessary to reduce or cease flood control operations during the least tern-nesting season and birds have not fledged, it is necessary to predict when flows will be reduced. This permits consideration of special flow conditions to prevent land bridging of islands.

Protocol. CESWT-EC-HM has the lead in predicting when flood operations will cease. As soon as practicable and to provide

critical lead-time the CESWT-EC-HM will initiate the following notification protocol.

CESWT-EC-HM notifies: CESWT-PP-C, CESWT-EC, CESWT-PE-E, OMPA and SWPA.
CESWT-PE-E notifies: USFWS and ODWC
CESWT-PP-C notifies: Area Manager, CESWT-OD-R, and CESWT-PA.

CESWT-PP-C will convene the least tern committee to discuss and evaluate probable impacts to least terns and reservoir operations. The tern committee evaluates all data and impacts and makes a recommendation about special operations for least terns. CESWT-PP-C and CESWT-EC-H notifies and brief the commander on the committee recommendation.

CESWT-PP-C notifies all members of the tern committee by phone and by e-mail of the USACE-TD Commander's decision.

CESWT-PA provides a news release to Area Managers, major news media and notify congressional delegation about the nesting terns and any special low flow releases that might be required.

If the least tern committee recommends special low flow releases for least terns, the CESWT-EC-HM notifies SWD-EC-HH of the proposed action and requests a deviation. All notifications involving SWD are by phone and email followed up by written notification.

All notifications are by phone and followed by an e-mail for recording purposes. See list of phone numbers and e-mail addresses in paragraph 9 for appropriate POC's.

6. Notification of special low flow operations. Under certain conditions it may become necessary to provide special low flow releases from selected reservoirs. CESWT-EC-HM has the lead in providing these releases.

Protocol. Based upon the recommendation of the least tern committee, and the USACE-TD Commander, CESWT-EC-HM shall initiate the following notification protocol.

CESWT-EC-HM notifies: CESWST-EC, CESWT-EC-DD, OMPA and SWPA
CESWT-PP-C notifies: Area Managers, CESWT-OD-R, CESWT-PE-E,
CESWT-PE-E notifies the ODWC and USFWS.

CESWT-PE-E is responsible for conducting any special studies or surveys associated with any special releases and reporting requirements. Field project offices may be called upon to help with special operations or surveys.

CESWT-PA may choose to provide a media release and notify congressional delegation about the status of nesting terns and any special low flow releases that might be required, and potential impacts to reservoirs.

7. Notification upon end of Nesting Season. Upon completion of the tern-nesting season all parties will be notified.

Protocol. After USFWS and CESWT-PE-E biologist review of survey data and upon a joint consensus the nesting season will be declared to be officially over. The consensus shall be based upon the fact that (1) all least terns have fledged or (2) that most of the least terns have a chance to fledge have been adequately protected. Upon reaching this consensus CESWT-PE-E initiates the following notification protocol.

CESWT-PE-C notifies: CESWT-PP-C, CESWT-EC-HM and ODWC.
CESWT-PP-C notifies: CESWT-OD, Area Managers, CESWT-PA
CESWT-EC-HM notifies: SWPA and OMPA

Copies of the e-mail notification will be furnished to all POC's and members of the least tern committee.

CESWT-PA provides a media release and notify congressional delegations of this event.

8. Emergency Notifications (After Hours Protocol) During periods when flow releases are required after normal working hours that will result in flooding nests or causing land bridging, all parties will be notified as soon as possible.

Protocol. CESWT-EC-HM has the lead in determining the necessity for releases that may flood some or all the nest. This necessity will usually be caused by large rainfall events that may occur at night or on weekends.

9. Point of Contacts

USFWS
Primary: Kevin Stubbs, 918-581-7458 x236, Kevin_Stubbs@fws.gov
Alternate: Hayley Dikeman, 918-581-7458 x239, Hayley_Dikeman@fws.gov
Alternate: Ken Collins, 918-581-7458 x230, Ken_Collins@fws.gov

ODWC
Primary: Mark Howery, 405-521-4619, mhowery@odwc.state.ok.us
Alt: Ron Suttles, 405-521-4602, rsuttles@odwc.state.ok.us

CESWT-PE-E
Primary: Steve Nolan, 918-669-7660, Stephen.L.Nolen@usace.army.mil
Alt: Sandra Stiles, 918-669-7662, Sandra.Stiles@usace.army.mil
Alt: Jerry Sturdy, 918-669-7232, Jerry.Sturdy@usace.army.mil

CESWT-EC-HM
Primary: Ron Bell, 918-669-7306, Ron.W.Bell@swt03.usace.army.mil
Alt 1: Greg Estep, 918-669-7132, Gregory.Estep@swt03.usace.army.mil
Alt 2: William Chatron, 918-669-7094, William.Chatron@swt03.usace.army.mil
Alt 3: Kelita Stephens,918-669-7002, Kelita.Stephens@swt03.usace.army.mil

CESWT-EC-DS
Primary: Randy Mead, 918-669-7145, Randy.J.Mead@usace.army.mil
Alt 1: Mark Burkholder, 918-669-7146, Mark.Burkholder@usace.army.mil

CESWT-OD-R
Project Manager: Michael Diggs, 918-669-7398, Michael.Diggs@usace.army.mil
Alt: Jim Harris, 918-669-7410, Jim.L.Harris@usace.army.mil

Northern Oklahoma Area
Primary: Jay Jones, 918-443-2250, Jay.L.Jones@usace.army.mil
Alt Keystone Lake: Kent Dunlap, 918-865-2621, Kent.Dunlap@usace.army.mil
Alt Kaw Lake: Jim Anderson, 580-762-5611, Jim.M.Anderson@usace.army.mil

Texoma Area Office
Primary: Mike Calavan, 903-455-4990, Mike.Calavan@usace.army.mil
Alt Texoma Lake: Ron Jordan, 903-465-4990, Ron.W.Jordon@usce.army.mil

Eastern Oklahoma Area Office
Primary: John Marnell, 918-484-5135, John.Marnell@usace.army.mil
Alt Eufaula Lake: James Holder, 918-484-5135, James.A.Holder@usace.army.mil

CESWT-PA
Primary: Ross Adkins, 918-669-7366, Ross.Adkins@usace.army.mil
Alt: Mary B. Hudson, 918-669-7361, Mary.B.Hudson@usace.army.mil

CESWT-PPC
Primary: Jan Holsomback, 918-669-7089, Janet.Holosomback@usace.army.mil

SWPA
Primary: David Kannady, 918-595-6682, david.kannady@swpa.gov
Alt: George Robbins, 918-595-6680, george.robbins@swpa.gov

OMPA
Primary: Jake Langthorn, 405-340-5047, jlangthorn@ompa.com
Alt: Harry Dawson, 405-340-5047, hdawson@ompa.com

Appendix F

Milestones and Schedule

Kaw Lake and Arkansas River Activity Office Funding Source Year 1 Year 2 Year 3 Year 4 Year 5 Monitor Nesting Activity and Success CESWT-PE Gen O&M $ 25.00 $ 25.00 $ 25.00 $ 25.00 $ 25.00 Section 7 Consultation CESWT-PE Gen O&M $ - $ 25.00 $ - $ - $ - Short Term Management CESWT-EC-H Gen O&M $ 10.00 $ 10.00 $ 10.00 $ 10.00 $ 10.00 Nesting Site Maint. CESWT-OD Gen O&M $ - $ - $ - $ - $ - Identify Potential Nesting Sites CESWT-PE $ - $ 10.00 $ - $ - $ - Island Development Methods CESWT-PE $ - $ - $ - $ - $ - Habitat Development Projects CESWT-PE $ - $ - $ - $ - $ 200.00 Habitat Baseline Surveys CESWT-PE Gen O&M $ - $ - $ - $ - $ - Monitoring Upstream Activities CESWT-PE Gen O&M $ - $ - $ - $ - $ - $ 35.00 $ 70.00 $ 35.00 $ 35.00 $ 235.00 Keystone Lake and Arkansas River Activity Office Funding Source Year 1 Year 2 Year 3 Year 4 Year 5 Monitor Nesting Activity and Success CESWT-PE Gen O&M $ 25.00 $ 25.00 $ 25.00 $ 25.00 $ 25.00 Section 7 Consultation CESWT-PE Gen O&M $ - $ 25.00 $ - $ - $ - Short Term Management CESWT-EC-H Gen O&M $ 20.00 $ 20.00 $ 20.00 $ 20.00 $ 20.00 Nesting Site Maint CESWT-OD Gen O&M $ - $ - $ - $ - $ 10.00 Identify Potential Nesting Sites CESWT-PP Gen Inv. $ - $ - $ - $ - Arkansas River Nav. Study Island Development Methods CESWT-PE $ - $ - $ - $ - $ - CAP with City of Tulsa Habitat Development Projects CESWT-PE $ - $ - $ - $ 200.00 $ - Habitat Baseline Surveys CESWT-PE Gen O&M $ - $ 50.00 $ - $ - $ - Monitoring Upstream Activities CESWT-PE Gen O&M $ - $ - $ - $ - $ - $ 45.00 $ 120.00 $ 45.00 $ 245.00 $ 55.00 Denison Dam Lake and Red River Activity Office Funding Source Year 1 Year 2 Year 3 Year 4 Year 5 Monitor Nesting Activity and Success CESWT-PE Gen O&M $ 100.00 $ 100.00 $ 100.00 $ 100.00 $ 100.00 Section 7 Consultation CESWT-PE Gen O&M $ 10.00 $ 10.00 $ - $ - $ - Short Term Management CESWT-EC-H Gen O&M $ 20.00 $ 20.00 $ 20.00 $ 20.00 $ 20.00 Nesting Site Maint CESWT-OD Gen O&M $ - $ - $ - $ 10.00 $ 10.00 Identify Potential Nesting Sites CESWT-PP Gen Inv. $ - $ - $ - $ - $ - Red River Waterway Study Island Development Methods CESWT-PE $ - $ - $ - $ - $ - Habitat Development Projects CESWT-PE $ - Habitat Baseline Surveys CESWT-PE Gen O&M $ - $ - $ - $ 80.00 $ - Monitoring Upstream Activities CESWT-PE Gen O&M $ - $ - $ 80.00 $ - $ - $ 130.00 $ 130.00 $ 400.00 $ 210.00 $ 130.00 Eufaula Dam Lake and Canadian River Activity Office Funding Source Year 1 Year 2 Year 3 Year 4 Year 5 Monitor Nesting Activity and Success CESWT-PE Gen O&M $ 30.00 $ 30.00 $ 30.00 $ 30.00 $ 30.00 Section 7 Consultation CESWT-PE Gen O&M $ 10.00 $ 10.00 $ - $ - $ - Short Term Management CESWT-EC-H Gen O&M $ 20.00 $ 20.00 $ 20.00 $ 20.00 $ 20.00 Nesting Site Maint CESWT-OD Gen O&M $ 5.00 $ 5.00 $ 10.00 $ 10.00 $ 10.00 Identify Potential Nesting Sites CESWT-PE $ - $ - $ - $ - $ - Island Development Methods CESWT-PE $ - $ - $ - $ - $ - Habitat Development Projects CESWT-PE $ - $ 200.00 $ - $ - $ - Habitat Baseline Surveys CESWT-PE Gen O&M $ - $ - $ 25.00 $ - $ - Monitoring Upstream Activities CESWT-PE Gen O&M $ - $ - $ - $ - $ - $ 65.00 $ 265.00 $ 85.00 $ 60.00 $ 60.00 Summary: Monitor Nesting Activity and Success CESWT-PE Gen O&M $ 180.00 $ 180.00 $ 180.00 $ 180.00 $ 180.00 Section 7 Consultation CESWT-PE Gen O&M $ 20.00 $ 70.00 $ - $ - $ - Short Term Management CESWT-EC-H Gen O&M $ 70.00 $ 70.00 $ 70.00 $ 70.00 $ 70.00 Nesting Site Maint CESWT-OD Gen O&M $ 5.00 $ 5.00 $ 10.00 $ 20.00 $ 30.00 Identify Potential Nesting Sites CESWT-PE $ - $ 10.00 $ - $ - $ - Island Development Methods CESWT-PE $ - $ - $ - $ - $ - Habitat Development Projects CESWT-PE $ - $ 200.00 $ 200.00 $ 200.00 $ 200.00 Habitat Baseline Surveys CESWT-PE Gen O&M $ - $ 50.00 $ 25.00 $ 80.00 $ - Monitoring Upstream Activities CESWT-PE Gen O&M $ - $ - $ 80.00 $ - $ - $ 275.00 $ 585.00 $ 565.00 $ 550.00 $ 480.00

Appendix G

Community Relations Plan

Appendix G

Interior Least Terns Management Communications/Community Relations Plan

Overview - This document sets forth the Communications/ Community Relations Plan for Tulsa District's Interior Least Tern Management Program.

Goal - To establish effective communications and community relations in order to foster communication, public awareness, and mutual trust among the federal agencies involved, their partners and stakeholders, and the public.

Expectations - This Communications/Community Relations Plan is intended to:

- Educate employees and the public on efforts to meet requirements of the Endangered Species Act while continuing to fulfill mission mandates;
- Enhance public understanding of the Interior Least Tern Management and Protection Program;
- Keep the public and customers informed in a timely and effective manner.

Communication methods - Internal communication among project delivery team members is vital, and certain crucial steps have been outlined in the Implementation Guideline. In addition to those, the following **Tools and Strategies** will be employed:

- **Interagency Coordination** - The Project Delivery Team consists of representatives from Tulsa District, SWPA, OMPA USFWS, and ODWC. Members will be invited to attend all team meetings and any public meetings scheduled.

- **Talking Points** - Prior to 1 May, the PDT for informational purposes will develop Talking Points. They will be provided to all PDT members and any others in a position to speak about the program. They will always include Command Messages and will be updated bi-weekly throughout the program's span to address current issues.

- **Briefing Presentation** - An educational PowerPoint presentation will be developed by PM and PAO before 1 May for use in the district office and to be localized and used at affected lake projects.

- **News Releases** - Information of interest to the public and stakeholders will be provided by PAO through news releases to media outlets.

An educational release coordinated with PDT member agencies will be made in early May before the birds arrive. Another will be made between arrival and nesting (mid to late May). During manipulation of water releases, the media will be informed of coordination efforts as is situationally warranted. Once the birds have fledged (Aug 1 - 15), a final news release will be made.

Each news release will be provided by PAO to the major media outlets. Copies will be furnished lake project offices for localization and release to their regional media entities. Any project-generated news releases will be staffed through the Public Affairs Office. PAO-generated media releases will be coordinated with appropriate agencies and the program manager. All news releases will also be posted on the Tulsa District's Internet news page.

PAO will also coordinate with PER on the plausibility of inviting a reporter along for an inspection or surveillance trip.

- **Project Facts and Information Products** - Educational information will be created by PDT and PAO and provided to appropriate lake office for posting on their project web page. Information for the page will be provided by 19 April.

- **Subscriptions to local or regional newspapers -** Public Affairs Office will scan the Tulsa World each day and project offices will review local papers. Articles related to the least tern management program will be clipped and sent to Public Affairs Office for distribution, archiving, and response, if appropriate

- **Web Meeting Announcements** - All public meetings or events will be announced on the Tulsa District's Internet calendar. (Coordinate with PAO.)

Methods of evaluating success - The following indicators will help determine the effectiveness of the communication plan:

- Was publicity generated?
- Were media reports balanced?
- Was accurate information used in reports?
- Was there evidence of effective communications among the elements of the PDT?

Lessons Learned - PDT and Area Managers prepare after-action report describing both successful and unsuccessful communication strategies.

Emergency Notification -- The Tulsa District Public Affairs Office (918) 669-7366 should always be contacted when an emergency situation arises in connection with any Tulsa District project or program.

Internal Communications Reporting Requirements

- Keep PDT members, district management, and other action offices abreast of the community relation's aspects of this project. All District Office News releases will be coordinated through PAO. Reports of media interviews or significant public contact will be provided to PAO.

- The activities outlined in this Communications/Community Relations Plan will be subject for discussion at appropriate Project Review Board Meetings.

Points of Contact

Project Activities - Michael Diggs, program manager, OD-R, x7398

Communication Resources - Mary Beth Hudson, PA Spec, PAO, x7366

US Army Corps
of Engineers
Little Rock District

MANAGEMENT PLAN

For the Recovery of the Interior Least Tern

Along the McClellan-Kerr Arkansas River Navigation System in Arkansas

MAY 1986

MANAGEMENT PLAN
For the Recovery of The Interior Least Tern
(Sterna antillarum)
along the McClellan-Kerr Arkansas River Navigation System
in Arkansas

INTRODUCTION: Least terns are the smallest members of the subfamily Sterninae, measuring about 20-22 cm (8-10 in.)long with a 50 cm (19-20 in.) wingspread. Sexes are alike, characterized by a black crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, orange legs, and a black-tipped yellow bill. Immature birds have darker plumage, a dark bill, and dark eye stripes on their white heads. The interior least tern is migratory, breeding on sandbars and islands on the Arkansas, lower Colorado, Mississippi, Missouri, Ohio, Red, and Rio Grande Rivers, and wintering at various locations along the coasts of Central and South America.

GENERAL: Prior to the construction of the McClellan-Kerr Arkansas River Navigation System, the Arkansas River was a meandering stream subject to severe seasonal flooding, channel carving, and sediment deposition. The numerous islands and sand bars that were created and reformed provided desirable nesting habitat for the interior least tern. With the completion of construction in 1970, the Arkansas River became a navigable waterway from its confluence with the Verdigris River near Muskogee, Oklahoma to the Arkansas Post canal that connects the Arkansas River to the White River for the remainder of the navigation system to the confluence of the White River with the Mississippi River. The revetments, dikes, and channel cutoffs that were necessary to stabilize the banks, straighten and deepen the channel, and increase the navigational capability of the river, inundated a portion of the nesting habitat of the least tern. There are no records of the least tern nesting along the Arkansas River for a number of years after the navigation system became operational. The continued natural deposition of sediment and placement of dredged material into slackwater areas and behind revetments has created new islands and sand bars in and along the Arkansas River that are being used as nesting sites by the least tern. The breeding habitat of the least tern is generally characterized as open sand, soil, or dried mud in the proximity of a lagoon, estuary, or river close to feeding areas. These feeding areas are usually fairly extensive areas of shallow water.

CURRENT PRACTICE: The location of problem areas that may require maintenance dredging are located and reported by reconnaissance survey crews. These crews monitor the depths in each navigation pool a minimum of once every 2 weeks when flows are less than 70,000 cubic feet per second (cfs) and as needed when flows are above 70,000 cfs. The locations of problem areas are reported to the resident offices and the Little Rock District Office. A second survey crew from each resident office of the Corps of Engineers performs detailed surveys of the problem areas. The priority of dredging locations is determined from the detailed

surveys, long range flow forecasts, and the availability of dredging equipment. The quantity of material removed and the location of the disposal field determine the amount of money that the contractor is paid. The progress and alignment of the dredge are checked and the disposal areas are monitored on a daily basis.

SPECIAL CONSIDERATIONS: Nesting sites generally are characterized as unstable areas created and maintained by sediment deposition in association with flooding. Due to the sometimes transitory nature of nesting habitat, least terns have been described as having strong group adherance and weak site tenacity. This characteristic may aid them in the discovery of newly created habitat. Least tern colonies have been reported to continue to use an area year after year for as long as the site remains suitable. Other reports indicate that the least terns returned to and nested at sites where colonies were completely wiped out the previous year when such sites had been in use for several years. It has also been documented that least terns tend to nest in the vicinity of their natal colonies.

OBJECTIVE: The interior population of the least tern has been placed on the Endangered Species List by the Department of the Interior, U.S. Fish and Wildlife Service because of the loss of suitable habitat by overvegetation, regulation of rivers, and human disturbance. The actions presented in this plan are derived from the draft of the Least Tern Recovery Plan prepared by the Endangered Specie Division of the Department of the Interior, U. S. Fish and Wildlife Service. The objective of this plan is to stabilize or increase the available nesting habitat for the population of the interior least tern along the Arkansas River in Arkansas.

PROPOSED ACTIONS:

1. On or about May 22, 1986, and at approximate 3 week intervals thereafter, 4 aerial reconnaissance survey flights of the McClellan-Kerr Arkansas River Navigation System will be conducted to locate pre-nesting populations and nesting colonies of the interior least tern. The surveys will be coordinated and conducted in cooperation with state and federal agencies responsible for managing endangered species. These multiagency surveys will be confirmed with on site censuses to establish the size of the populations of each colony. The number and frequency of aerial surveys in subsequent years will be determined by the success of this management plan. The information gained from the aerial surveys will be reported to the endangered species program representative of the U. S. Fish and Wildlife Service.

2. During 1986, contour line surveys of 1- or 2-foot intervals will be made to ascertain the physical characteristics of the sand bars and islands on which the least tern nested along the Arkansas River. Parameters that will be recorded in the physical description of the area will include the size and shape of the area, elevation of nesting areas above pool levels, frequency and

time of flooding, slope profiles, amount and density of vegetation, and location with respect to nearby water areas.

3. The importance of identifying and locating populations of the least tern will be stressed to the personnel of the Pine Bluff and Russellville Resident Offices. The navigation survey crews and the natural resource management staff of these resident offices will be trained in the identification characteristics of the least tern. This training will include both in-flight and on-ground identification of the least tern.

4. The navigation reconnaissance survey crews and the detailed survey crews will include any observations of the least tern as an integral part of the navigation surveys conducted during the months of May, June, July, and August that are performed on the Arkansas River. The locations of least tern sightings will be entered into the daily log and reported to the Resident Engineer and the project biologist or ranger with wildlife management/environmental responsibilities. The district biologist in the Recreation-Resource Management Branch will be notified within 3 working days of the sightings. The sightings will be confirmed and any potential nesting sites will be examined. Any nesting sites located as a result of the river surveys will be documented and reported to the state agencies involved with endangered species and to the endangered species program coordinator of the Department of the Interior, U. S. Fish and Wildlife Service. The dredged materials will be discharged into designated areas so as to not affect any known nesting colonies of the least tern. No disturbance of a nesting area by a dredge crew or survey crew will be allowed. No equipment will be moved through a nesting area. No discharge of dredged material and water will be allowed within 100 meters of a nesting site.

5. The information collected in the contour line surveys of the sites previously used for nesting by the least tern will be used to establish tentative environmental parameters of the nesting sites. Dredged material disposal practices will be modified in selected locations to experimentally create nesting sites to provide additional nesting and feeding habitat for the least tern. The effectiveness of the attempts to create additional nesting sites will be documented and reported to the Least Tern Recovery Team.

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Brubeck, M. V., B. C. Thompson, and R. D. Slack. 1981. The effects of trapping, banding, and patagial tagging on the parental behavior of least terns in Texas. Colonial Waterbirds 4:54-60

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Youngworth, William. 1930. Breeding of the least tern in Iowa. Wilson Bulletin, June 1930.

Lindsay -
Look these over - it seems the Oct 86 must be the revised plan. I'm assuming it was sent electronically by Corps to our office.
- Linda

MAIL
Send, Read or Scan: READ

To: CSWL (ACE2046)
To: FWS201
From: CSWL (ACE2046) Posted: Thu 9-Oct-86 9:27 EDT Sys 57 (283)
Subject: tern

MANAGEMENT PLAN

For the Recovery of The Interior Least Tern

(Sterna antillarum)

along the McClellan-Kerr Arkansas River Navigation System

in Arkansas

INTRODUCTION: Least terns are the smallest members of the subfamily Sterninae, measuring about 20-22 cm (8-10 in.)long with a 50 cm (19-20 in.) wingspread. Sexes are alike, characterized by a black crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, orange legs, and a black-tipped yellow bill. Immature birds have darker plumage, a dark bill, and dark eye stripes on their white heads. The interior least tern is migratory, breeding on sandbars and islands on the Arkansas, lower Colorado, Mississippi, Missouri, Ohio, Red, and Rio Grande Rivers, and wintering at various locations along the coasts of Central and South America.

GENERAL: Prior to the construction of the McClellan-Kerr Arkansas River Navigation System, the Arkansas River was a meandering stream subject to severe seasonal flooding, channel carving, and sediment deposition. The numerous islands and sand bars that were created and reformed provided desirable nesting

construction in 1970, the Arkansas River became a navigable waterway from its confluence with the Verdigris River near Muskogee, Oklahoma to the Arkansas Post canal that connects the Arkansas River to the White River for the remainder of the navigation system to the confluence of the White River with the Mississippi River. The revetments, dikes, and channel cutoffs that were necessary to stabilize the banks, straighten and deepen the channel, and increase the navigational capability of the river, inundated a portion of the nesting habitat of the least tern. There are no records of the least tern nesting along the Arkansas River for a number of years after the navigation system became operational. The continued natural deposition of sediment and placement of dredged material into slackwater areas and behind revetments has created new islands and sand bars in and along the Arkansas River that are being used as nesting sites by the least tern. The breeding habitat of the least tern is generally characterized as open sand, soil, or dried mud in the proximity of a lagoon, estuary, or river close to feeding areas. These feeding areas are usually fairly extensive areas of shallow water.

CURRENT PRACTICE: ~~The location of~~ Problem areas that may require maintenance dredging are located and reported by reconnaissance survey crews. These crews monitor the depths in each navigation pool a minimum of once every 2 weeks when flows are less than 70,000 cubic feet per second (cfs) and as needed when flows are above 70,000 cfs. The locations of problem areas are reported to the resident offices and the Little Rock District Office. A second survey crew from each resident office of the Corps of Engineers performs detailed surveys of the problem areas. The priority of dredging locations is determined from the detailed surveys, long range flow forecasts, and the availability of dredging equipment. The quantity of material removed and the location of the disposal field determine the amount of money that the contractor is paid. The progress and alignment of the dredge are checked and the disposal areas are monitored on a daily basis.

SPECIAL CONSIDERATIONS: Nesting sites generally are characterized as unstable areas created and maintained by sediment deposition in association with flooding. Due to the sometimes transitory nature of nesting habitat, least terns have been described as having strong group adherance and weak site tenacity. This characteristic may aid them in the discovery of newly created habitat. Least tern colonies have been reported to continue to use an area year after year for as long as the site remains suitable. Other reports indicate that the least terns returned to and nested at sites where colonies were completely wiped out the previous year when such sites had been in use for several years. It has also been documented that least terns tend to nest in the vicinity of their natal colonies.

OBJECTIVE: The interior population of the least tern has been placed on the Endangered Species List by the Department of the Interior, U.S. Fish and Wildlife Service because of the loss of suitable habitat by overvegetation, regulation of rivers, and human disturbance. The actions presented in this plan are derived from the draft of the Least Tern Recovery Plan prepared by the Endangered Species Division of the Department of the

plan is to stabilize or increase the available nesting habitat for the population of the interior least tern along the Arkansas River in Arkansas.

PROPOSED ACTIONS:

1. Survey for terns

On or about 15 May of each year, and at approximate 3 week intervals thereafter, aerial reconnaissance survey flights of the McClellan-Kerr Arkansas River Navigation System will be conducted, weather and scheduling permitted, to locate pre-nesting populations and nesting colonies of the interior least tern. The surveys will be coordinated and conducted in cooperation with state and federal agencies responsible for managing endangered species. These multiagency surveys will be confirmed with on site censuses to establish the size of the populations of each colony. The number and frequency of aerial surveys in subsequent years will be determined by the success of this management plan. The information gained from the aerial surveys will be reported to the endangered species program representative of the U. S. Fish and Wildlife Service.

2. Create new nesting habitat

During years of successful nesting, contour line surveys of 1- or 2-foot intervals will be made to ascertain the physical characteristics of the sand bars and islands on which the least tern nested along the Arkansas River. Parameters that will be recorded in the physical description of the area will include the size and shape of the area, elevation of nesting areas above pool levels, frequency and time of flooding, slope profiles, amount and density of vegetation, and location with respect to nearby water areas. The information collected in the contour line surveys of the sites previously used for nesting by the least tern will be used to establish tentative environmental parameters of the nesting sites. Dredged material disposal practices will be modified in selected locations to experimentally create nesting sites to provide additional nesting and feeding habitat for the least tern. The effectiveness of the attempts to create additional nesting sites will be documented and reported to the endangered specie coordinator of the U. S. Department of the Interior, Fish and Wildlife Service.

3. Protection of existing tern habitat

3.1 Personnel training. The importance of identifying and locating populations of the least tern will be stressed to the personnel of the Pine Bluff and Russellville Resident Offices. The navigation survey crews and the natural resource management staff of these resident offices will be trained in the identification characteristics of the least tern. This training will include both in-flight and on-ground identification of the least tern.

3.2 Tern observation and reporting procedures. The navigation reconnaissance survey crews and the detailed survey crews will include any observations of the least tern as an integral part of the navigation surveys conducted during the months of May, June, July, and August that are performed on the Arkansas River. The

locations of least tern sightings will be entered into the daily log and reported to the Resident Engineer and the project biologist or ranger with wildlife management or environmental responsibilities. The district biologist in the Recreation-Resource Management Branch will be notified within 3 working days of the sightings. The sightings will be confirmed and any potential nesting sites will be examined. Any nesting sites located as a result of the river surveys will be documented and reported to the state agencies involved with endangered species and to the endangered species program coordinator of the Department of the Interior, U. S. Fish and Wildlife Service.

3.3 Standards for protection of habitat

3.3.1 The dredged materials will be discharged into designated areas so as to not affect any known nesting colonies of the least tern. Direction will be provided to the detailed survey crews by the district biologist, Recreation-Resource Management Branch, in consultation with personnel of the previously identified state and Federal agencies.

3.3.2 No disturbance of a nesting area by a dredge crew or survey crew will be allowed. The survey personnel will be trained to identify the least tern and to recognize the characteristics of a nesting area and the behavior of the least tern during nesting season.

3.3.3 No equipment will be moved through a nesting area. The nesting area is defined as the area where the least tern create the conical depressions that are used as nests, or the area defended as nesting grounds by the least terns, whichever is greater.

3.3.4 No discharge of dredged material and water will be allowed within 100 meters of a nesting site or in such a manner as to allow the dredged material to flow within 100 meters of a nesting site.

3.4 SECTION 7 CONSULTATIONS. Actions occurring within 300 meters of an interior least tern colony site that are proposed or permitted by the Little Rock District Corps of Engineers will be coordinated with U.S. Fish and Wildlife Service. An assessment of potential effect of the proposed action will be determined and remedies to any 'may affect' situations will be discussed. Formal consultation proceedings will be instigated if the 'may affect' judgement can not be resolved through the informal consultation process.

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Arkansas. Report to the Least Tern Recovery Team, U. S. Fish and Wildlife Service. 17pp.

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Disposition:

End of Mail.

Send, Read or Scan: Q

>OFF
Off At 12:21 10/09/86 EDT

Connect Mins = 4
Compute Secs = 4/1

Mail call (1 Read)
301 241 DISCONNECTED 00 40 00:00:03:30 223 13

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June 3, 1986

IN REPLY REFER TO:
Log No. 4-3-86-321

Colonel Robert W. Whitehead
Little Rock District, Corps of Engineers
P.O. Box 867
Little Rock, Arkansas 72203-0867

Dear Colonel Whitehead:

This refers to your May 23, 1986, letter (received May 27, 1986) which provided the Management Plan for the Recovery of the Interior Least Tern. The document contains several excellent points which will contribute significantly to the conservation of this endangered species. We were particularly impressed with your plans to survey terns, create new nesting habitat, and train field crews to report colony sightings. These efforts will contribute to fulfilling Tasks 11., 111., and 21 of the draft Recovery Plan for the Interior Population of the Least Tern.

In addition to these contributions, the plan provides an opportunity which, if taken, will allow the Service to process your requirements under Section 7 of the Endangered Species Act. There are two obvious channels, either of which allows our respective agencies to achieve compliance. Please evaluate the following options and let us know how you wish to proceed:

(a) engage in endangered species consultation now on project-wide activities covered by the Operation and Maintenance Environmental Impact Statement for the McClellan-Kerr Arkansas River Navigation System, 1974, and the tern management plan; or

(b) reach an agreement between our agencies on a process which will ensure Section 7 compliance for those individual, specific activities under the project which may affect the terns.

Discussions between Mr. Clyde Gates of your staff and Fred Bagley of our office indicate that a single project-wide consultation (a above) would likely be unwieldy in dealing effectively with the many considerations of specific dredging and spoiling situations and their impacts to

terns. If, in a single Biological Opinion, we are to deal with all the possible variation in conditions of specific situations (such as distances between the navigation channel and tern habitat, presence or lack of line of sight barriers between dredging locations and nesting sights, etc.), it seems rather rigid requirements would be necessary to ensure that needed protection is provided in all possible cases.

Alternative b would allow our agencies to implement a process which would provide for coordination on individual, specific situations which might "affect" the endangered tern. This coordination would allow for recognition of the unique condition of each specific situation in question and would lead to either: 1.) agreement that a 'may affect' situation does not exist; 2.) identification and implementation of provisions to remove the 'may affect' situation; or 3.) initiation of formal consultation. This process allows for increased flexibility and would result in measures taken specifically to achieve needed protection of terns. We anticipate that most such coordination efforts could be handled by phone and would result in agreement that there was not an affect situation or the identification of and agreement on action to be taken to remove the effects.

Certainly, this process would require some coordination. However, we feel this is necessary and appropriate if both our agencies are to achieve compliance under the provisions of the Endangered Species Act.

We have outlined a procedure to implement alternative b (on page 2, Section 7 Coordination section) of our attached rewrite of the Proposed Actions section of the plan. Please be assured that we support your plan. We do, however, feel that it must go farther to ensure Section 7 compliance. If our agencies do not carry out either alternative a or b above, it is our opinion that your Section 7 responsibilities will not be met. We feel that alternative b best meets the needs of our agencies.

Aside from our major comment above, we have only two other remarks. On page 3, item 4, the last four sentences of the paragraph you seem to be establishing standards for protection of habitat. The significance of these statements can be enhanced by following each statement with another discussing how you intend to accomplish that statement. Finally, we took the liberty of rearranging the Proposed Actions sections to, in our opinion, add clarity and consolidate ideas.

We hope our comments will be received in the positive spirit in which they are intended. We feel you have a plan which incorporates some fine ideas which if implemented will enhance least tern conservation. We are recommending you go one step further and incorporate Section 7 compliance at the same time.

In regard to Public Notice LRD-85-87, we recommend the above comments be incorporated in the subject plan and that plan be made a part of the

Public Notice. If you wish to discuss this matter further, please contact Mr. Fred Bagley of our staff (FTS 490-4900).

We appreciate the opportunity to review and comment on your plan.

Sincerely yours,

Dennis B. Jordan
Field Supervisor
Jackson Endangered Species Office

Attachment

cc: ES, FWS, Vicksburg, MS
Regional Director, FWS, Atlanta, GA (AFA/SE)
Game and Fish Commission, Little Rock, AR
Arkansas Natural Heritage Program

FMB:vs 6/3/86
SURNAME

Bagley

Proposed Actions

1. Survey for terns

On or about May 22, 1986, and at approximate 3 week intervals thereafter, 4 aerial reconnaissance survey flights of the McClellan-Kerr Arkansas River Navigation System will be conducted to locate pre-nesting populations and nesting colonies of the interior least tern. The surveys will be coordinated and conducted in cooperation with state and federal agencies responsible for managing endangered species. These multiagency surveys will be confirmed with on site censuses to establish the size of the populations of each colony. The number and frequency of aerial surveys in subsequent years will be determined by the success of this management plan. The information gained from the aerial surveys will be reported to the endangered species program representative of the U.S. Fish and Wildlife Service.

2. Create new nesting habitat

During 1986, contour line surveys of 1- or 2-foot intervals will be made to ascertain the physical characteristics of the sand bars and islands on which the least tern nested along the Arkansas River. Parameters that will be recorded in the physical description of the area will include the size and shape of the area, elevation of nesting areas above pool levels, frequency and time of flooding, slope profiles, amount and density of vegetation, and location with respect to nearby water areas.

The information collected in the contour line surveys of the sites previously used for nesting by the least tern will be used to establish tentative environmental parameters of the nesting sites. Dredged material disposal practices will be modified in selected locations to experimentally create nesting sites to provide additional nesting and feeding habitat for the least tern. The effectiveness of the attempts to create additional nesting sites will be documented and reported to the Least Tern Recovery Team.

3. Protect existing tern habitat

3.1 Train personnel - The importance of identifying and locating populations of the least tern will be stressed to the personnel of the Pine Bluff and Russellville Resident Offices. The navigation survey crews and the natural resource management staff of these resident offices will be trained in the identification characteristics of the least tern. This training will include both in-flight and on-ground identification of the least tern.

3.2 Establish tern observation reporting procedures - The navigation reconnaissance survey crews and the detailed survey crews will include any observations of the least tern as an integral part of the navigation surveys conducted during the months of May, June, July, and August that are performed on the Arkansas River. The locations of least tern sightings will be entered into the daily log and reported to the Resident Engineer and the project biologist or ranger with wildlife management/environmental responsibilities. The district biologist in the Recreation-Resource Management Branch will be notified within 3 working days of the sightings. The sightings will be confirmed and any potential nesting sites will be examined. Any nesting sites located as a result of the river surveys will be documented and reported to the state agencies involved with endangered species and to the endangered species program coordinator of the Department of the Interior, U.S. Fish and Wildlife Service.

3.3 Standards for protection of habitat -

3.3.1 The dredged materials will be discharged into designated areas so as to not affect any known nesting colonies of the least tern. This will be accomplished by direction provided to navigation reconnaissance survey crews and the detailed survey crews by the district biologist, Recreation-Resource Management Branch and by . . . . . (we left this blank thinking you might want to elaborate on specific criteria you plan to use to ensure disturbance does not occur).

3.3.2 No disturbance of a nesting area by a dredge crew or survey crew will be allowed. This will be accomplished by training personnel in the recognition of least terns and by . . . . . (you may wish to eleborate on standards you will provide crews to ensure they do not affect tern colonies).

3.3.3 No equipment will be moved through a nesting area. The nesting area for purposes of the field crew will be defined as . . . . . (we left this blank thinking you might want to state specifically the area around nest sites which you consider to be the nesting area).

3.3.4 No discharge of dredged material and water will be allowed within 100 meters of a nesting site.

3.4 Section 7 Coordination - Section 7 of the Endangered Species Act states that each agency shall, in consultation with and with the assistance of the Secretary (as represented by the Fish and Wildlife Service) ensure their actions are not likely to jeopardize the continued existence of any

endangered species. The Little Rock District shall meet this responsibility by coordinating with the U.S. Fish and Wildlife Service on all dredge and fill activities which may occur within 1,000 feet of an interior least tern colony site. This coordination will:

3.4.1 discuss whether or not a 'may affect' situation exists;

3.4.2 identify means to remove the 'may affect' situation;

3.4.3 ensure implementation of the means identified above by modifications placed in permits or provided directly to field crews; and

3.4.4 ensure that if the 'may affect' situation can not be removed through the informal consultation discussed above, formal consultation will be initiated.

APPENDIX B

Data for Phase I Effects at Keystone Lake, 1992 Example

Existing		60,000 cfs		Different?	Existing	60,000 cfs	Difference
Day	1992 elev	Day	1992 elev				
177	731.32	177	732.22	TRUE	731.32	732.22	0.9
178	731.24	178	731.25	TRUE	731.24	731.25	0.01
179	731.19	179	732.32	TRUE	731.19	732.32	1.13
180	731.46	180	731.03	TRUE	731.46	731.03	-0.43
181	730.38	181	731.32	TRUE	730.38	731.32	0.94
182	730.74	182	733.12	TRUE	730.74	733.12	2.38
183	730.93	183	733.40	TRUE	730.93	733.40	2.47
184	731.14	184	733.90	TRUE	731.14	733.90	2.76
185	730.94	185	734.45	TRUE	730.94	734.45	3.51
186	730.78	186	733.54	TRUE	730.78	733.54	2.76
187	730.35	187	732.77	TRUE	730.35	732.77	2.42
188	730.72	188	732.68	TRUE	730.72	732.68	1.96
189	727.79	189	732.58	TRUE	727.79	732.58	4.79
190	728.15	190	732.45	TRUE	728.15	732.45	4.3
191	728.50	191	732.08	TRUE	728.50	732.08	3.58
192	728.82	192	731.95	TRUE	728.82	731.95	3.13
193	728.26	193	732.12	TRUE	728.26	732.12	3.86
194	728.53	194	732.34	TRUE	728.53	732.34	3.81
195	727.14	195	730.03	TRUE	727.14	730.03	2.89
196	727.47	196	730.24	TRUE	727.47	730.24	2.77
197	727.99	197	730.62	TRUE	727.99	730.62	2.63
198	727.47	198	728.33	TRUE	727.47	728.33	0.86
199	728.26	199	729.15	TRUE	728.26	729.15	0.89
200	728.52	200	729.99	TRUE	728.52	729.99	1.47
201	729.48	201	730.72	TRUE	729.48	730.72	1.24
202	730.23	202	731.23	TRUE	730.23	731.23	1
203	729.69	203	731.42	TRUE	729.69	731.42	1.73
204	729.25	204	731.50	TRUE	729.25	731.50	2.25
205	727.15	205	731.70	TRUE	727.15	731.70	4.55
206	727.38	206	731.84	TRUE	727.38	731.84	4.46
207	727.83	207	732.02	TRUE	727.83	732.02	4.19
208	728.22	208	732.12	TRUE	728.22	732.12	3.9
209	728.50	209	731.17	TRUE	728.50	731.17	2.67
210	728.98	210	731.38	TRUE	728.98	731.38	2.4
211	729.53	211	731.62	TRUE	729.53	731.62	2.09
212	728.11	212	731.96	TRUE	728.11	731.96	3.85
213	728.28	213	732.15	TRUE	728.28	732.15	3.87
214	728.76	214	732.10	TRUE	728.76	732.10	3.34
215	729.19	215	731.99	TRUE	729.19	731.99	2.8
216	729.43	216	731.61	TRUE	729.43	731.61	2.18
217	728.84	217	728.56	TRUE	728.84	728.56	-0.28
218	727.19	218	729.03	TRUE	727.19	729.03	1.84
219	726.76	219	730.37	TRUE	726.76	730.37	3.61
220	730.44	220	729.94	TRUE	730.44	729.94	-0.5
221	730.10	221	728.33	TRUE	730.10	728.33	-1.77
222	727.57	222	729.95	TRUE	727.57	729.95	2.38
223	728.97	223	727.78	TRUE	728.97	727.78	-1.19
224	730.25	224	729.06	TRUE	730.25	729.06	-1.19
225	728.42	225	730.13	TRUE	728.42	730.13	1.71

226	729.51	226	728.75	TRUE	729.51	728.75	-0.76
227	730.28	227	730.64	TRUE	730.28	730.64	0.36
228	730.70	228	731.37	TRUE	730.70	731.37	0.67
229	730.53	229	731.63	TRUE	730.53	731.63	1.1
230	727.13	230	731.48	TRUE	727.13	731.48	4.35
231	727.69	231	731.11	TRUE	727.69	731.11	3.42
232	728.30	232	730.74	TRUE	728.30	730.74	2.44
233	728.79	233	727.94	TRUE	728.79	727.94	-0.85
234	728.22	234	728.46	TRUE	728.22	728.46	0.24
235	728.56	235	728.79	TRUE	728.56	728.79	0.23
236	728.78	236	729.01	TRUE	728.78	729.01	0.23
237	727.22	237	729.00	TRUE	727.22	729.00	1.78
238	727.49	238	727.15	TRUE	727.49	727.15	-0.34
239	727.58	239	727.43	TRUE	727.58	727.43	-0.15
240	727.39	240	727.69	TRUE	727.39	727.69	0.3
241	727.63	241	727.94	TRUE	727.63	727.94	0.31
242	727.13	242	728.02	TRUE	727.13	728.02	0.89
243	727.07	243	727.93	TRUE	727.07	727.93	0.86
244	726.87	244	727.71	TRUE	726.87	727.71	0.84
245	727.04	245	727.91	TRUE	727.04	727.91	0.87
246	726.60	246	727.13	TRUE	726.60	727.13	0.53
247	726.71	247	727.40	TRUE	726.71	727.40	0.69
248	726.70	248	727.41	TRUE	726.70	727.41	0.71
249	727.24	249	727.42	TRUE	727.24	727.42	0.18
250	726.76	250	727.25	TRUE	726.76	727.25	0.49
251	726.25	251	727.02	TRUE	726.25	727.02	0.77
252	726.47	252	727.14	TRUE	726.47	727.14	0.67
253	726.99	253	727.35	TRUE	726.99	727.35	0.36
254	727.28	254	728.02	TRUE	727.28	728.02	0.74
255	727.87	255	728.55	TRUE	727.87	728.55	0.68
256	727.95	256	728.89	TRUE	727.95	728.89	0.94
257	728.26	257	728.73	TRUE	728.26	728.73	0.47
258	727.81	258	727.41	TRUE	727.81	727.41	-0.4

Existing		60,000 cfs		Different?	Existing	60,000 cfs	Difference
Day	1992 elev	Day	1992 elev				
177	731.32	177	732.22	TRUE	731.32	732.22	0.9
178	731.24	178	731.25	TRUE	731.24	731.25	0.01
179	731.19	179	732.32	TRUE	731.19	732.32	1.13
180	731.46	180	731.03	TRUE	731.46	731.03	-0.43
181	730.38	181	731.32	TRUE	730.38	731.32	0.94
182	730.74	182	733.12	TRUE	730.74	733.12	2.38
183	730.93	183	733.40	TRUE	730.93	733.40	2.47
184	731.14	184	733.90	TRUE	731.14	733.90	2.76
185	730.94	185	734.45	TRUE	730.94	734.45	3.51
186	730.78	186	733.54	TRUE	730.78	733.54	2.76
187	730.35	187	732.77	TRUE	730.35	732.77	2.42
188	730.72	188	732.68	TRUE	730.72	732.68	1.96
189	727.79	189	732.58	TRUE	727.79	732.58	4.79
190	728.15	190	732.45	TRUE	728.15	732.45	4.3
191	728.50	191	732.08	TRUE	728.50	732.08	3.58
192	728.82	192	731.95	TRUE	728.82	731.95	3.13
193	728.26	193	732.12	TRUE	728.26	732.12	3.86
194	728.53	194	732.34	TRUE	728.53	732.34	3.81
195	727.14	195	730.03	TRUE	727.14	730.03	2.89
196	727.47	196	730.24	TRUE	727.47	730.24	2.77
197	727.99	197	730.62	TRUE	727.99	730.62	2.63
198	727.47	198	728.33	TRUE	727.47	728.33	0.86
199	728.26	199	729.15	TRUE	728.26	729.15	0.89
200	728.52	200	729.99	TRUE	728.52	729.99	1.47
201	729.48	201	730.72	TRUE	729.48	730.72	1.24
202	730.23	202	731.23	TRUE	730.23	731.23	1
203	729.69	203	731.42	TRUE	729.69	731.42	1.73
204	729.25	204	731.50	TRUE	729.25	731.50	2.25
205	727.15	205	731.70	TRUE	727.15	731.70	4.55
206	727.38	206	731.84	TRUE	727.38	731.84	4.46
207	727.83	207	732.02	TRUE	727.83	732.02	4.19
208	728.22	208	732.12	TRUE	728.22	732.12	3.9
209	728.50	209	731.17	TRUE	728.50	731.17	2.67
210	728.98	210	731.38	TRUE	728.98	731.38	2.4
211	729.53	211	731.62	TRUE	729.53	731.62	2.09
212	728.11	212	731.96	TRUE	728.11	731.96	3.85
213	728.28	213	732.15	TRUE	728.28	732.15	3.87
214	728.76	214	732.10	TRUE	728.76	732.10	3.34
215	729.19	215	731.99	TRUE	729.19	731.99	2.8
216	729.43	216	731.61	TRUE	729.43	731.61	2.18
217	728.84	217	728.56	TRUE	728.84	728.56	-0.28
218	727.19	218	729.03	TRUE	727.19	729.03	1.84
219	726.76	219	730.37	TRUE	726.76	730.37	3.61
220	730.44	220	729.94	TRUE	730.44	729.94	-0.5
221	730.10	221	728.33	TRUE	730.10	728.33	-1.77
222	727.57	222	729.95	TRUE	727.57	729.95	2.38
223	728.97	223	727.78	TRUE	728.97	727.78	-1.19
224	730.25	224	729.06	TRUE	730.25	729.06	-1.19
225	728.42	225	730.13	TRUE	728.42	730.13	1.71

226	729.51	226	728.75	TRUE	729.51	728.75	-0.76
227	730.28	227	730.64	TRUE	730.28	730.64	0.36
228	730.70	228	731.37	TRUE	730.70	731.37	0.67
229	730.53	229	731.63	TRUE	730.53	731.63	1.1
230	727.13	230	731.48	TRUE	727.13	731.48	4.35
231	727.69	231	731.11	TRUE	727.69	731.11	3.42
232	728.30	232	730.74	TRUE	728.30	730.74	2.44
233	728.79	233	727.94	TRUE	728.79	727.94	-0.85
234	728.22	234	728.46	TRUE	728.22	728.46	0.24
235	728.56	235	728.79	TRUE	728.56	728.79	0.23
236	728.78	236	729.01	TRUE	728.78	729.01	0.23
237	727.22	237	729.00	TRUE	727.22	729.00	1.78
238	727.49	238	727.15	TRUE	727.49	727.15	-0.34
239	727.58	239	727.43	TRUE	727.58	727.43	-0.15
240	727.39	240	727.69	TRUE	727.39	727.69	0.3
241	727.63	241	727.94	TRUE	727.63	727.94	0.31
242	727.13	242	728.02	TRUE	727.13	728.02	0.89
243	727.07	243	727.93	TRUE	727.07	727.93	0.86
244	726.87	244	727.71	TRUE	726.87	727.71	0.84
245	727.04	245	727.91	TRUE	727.04	727.91	0.87
246	726.60	246	727.13	TRUE	726.60	727.13	0.53
247	726.71	247	727.40	TRUE	726.71	727.40	0.69
248	726.70	248	727.41	TRUE	726.70	727.41	0.71
249	727.24	249	727.42	TRUE	727.24	727.42	0.18
250	726.76	250	727.25	TRUE	726.76	727.25	0.49
251	726.25	251	727.02	TRUE	726.25	727.02	0.77
252	726.47	252	727.14	TRUE	726.47	727.14	0.67
253	726.99	253	727.35	TRUE	726.99	727.35	0.36
254	727.28	254	728.02	TRUE	727.28	728.02	0.74
255	727.87	255	728.55	TRUE	727.87	728.55	0.68
256	727.95	256	728.89	TRUE	727.95	728.89	0.94
257	728.26	257	728.73	TRUE	728.26	728.73	0.47
258	727.81	258	727.41	TRUE	727.81	727.41	-0.4

C.5

Terrestrial Habitat Evaluation Procedures

C.5 Terrestrial Habitat Evaluation Procedures

C.5.1 Introduction

The U.S. Army Corps of Engineers (USACE), Little Rock and Tulsa Districts, in association with the preparation of an Environmental Impact Statement (EIS) to evaluate the environmental impacts of the proposed dredging and flow changes on the McClellan-Kerr Arkansas River Navigation System (MKARNS), have completed Habitat Evaluation Procedures (HEP) to determine impacts resulting from dredge disposal on terrestrial habitat along the MKARNS and ecological benefits resulting from the proposed mitigation. The use of a community habitat assessment approach for a HEP application in a navigation study demonstrates the effectiveness of these models in the evaluation of potential impacts and mitigation success.

The HEP methodology is an environmental accounting process developed to appraise habitat suitability for fish and wildlife species in the face of potential change (USFWS, 1980a-c). Designed to predict the response of habitat parameters in a quantifiable fashion, HEP is an objective, reliable, and well-documented process used nationwide to generate environmental outputs for all levels of proposed projects and monitoring operations in the natural resources arena. When applied correctly, HEP provides an impartial look at environmental effects, and delivers measurable products to the user for comparative analysis.

In HEP, a Suitability Index, or SI is a mathematical relationship that reflects a species' or community's sensitivity to a change in a limiting factor (i.e., variable) within the habitat type. These suitability relationships are depicted using scatter plots and bar charts (i.e., suitability curves). The SI value ranges from 0.0 to 1.0, where an SI = 0.0 represents a variable that is extremely limiting, and an SI = 1.0 represents a variable in abundance (not limiting) for the species or community. In HEP, a Habitat Suitability Index (HSI) model is a quantitative estimate of habitat conditions for an evaluation species or community. HSI models combine the SIs of measurable variables into a formula depicting the limiting characteristics of the site for the species/community on a scale of 0.0 (unsuitable) to 1.0 (optimal).

The HEP was designed to evaluate the future changes in quantity (acres) and quality (habitat suitability and functional capacity) of terrestrial ecosystems. Outputs were calculated in terms of annualized changes anticipated over the life of the project [i.e., Average Annual Habitat Units (AAHUs)] in the HEP analyses.

C.5.2 Building a Multidisciplinary Evaluation Team

Early in the evaluation process, a Multiagency Ecosystem Evaluation Team (MEET) was convened. This was a multidisciplinary team that included various interests and technical expertise. To date, the following team members have contributed to the effort:

- Mr. Johnny McLean, USACE Little Rock District
- Mr. Tony Hill, USACE Little Rock
- Ms. Sandra Stiles, USACE Tulsa District
- Mr. Wesley Fowler, USACE Tulsa District
- Mr. Charles Schrodt, USACE Tulsa District

- Mr. Richard Stark, U.S. Fish and Wildlife Service (USFWS), Oklahoma
- Mr. Kevin Stubbs, USFWS, Oklahoma
- Mr. Lindsey Lewis, USFWS, Arkansas
- Ms. Marge Harney, USFWS
- Mr. Craig Uyeda, Arkansas Game & Fish Commission (AGFC)
- Mr. Jeff Quinn, AGFC
- Mr. J.D. Ridge, Oklahoma Department of Wildlife Conservation (ODWC)
- Mr. Gary Peterson, ODWC
- Mr. Mike Plunkett, ODWC
- Mr. Randy Hyler, ODWC
- Mr. Stephen Weber, Oklahoma Department of Environmental Quality
- Ms. Antisa Webb, U.S. Army Engineer Research and Development Center Environmental Laboratory (ERDC-EL)
- Ms. Kelly Burks-Copes, ERDC-EL
- Mr. Richard Hall, Contractor, Parsons Corp.
- Mr. Randy Norris, Contractor, Parsons Corp.
- Ms. Virginia Flynn, Contractor, Parsons Corp.
- Ms. Enid McNutt, Contractor, Parsons Corp.
- Mr. Luke Eggering, Contractor, Parsons Corp.

C.5.3 Defining the Project

C.5.3.1 Geographic Location, Watersheds, and Primary Water Resources

The affected environment includes the MKARNS from the Port of Catoosa near Tulsa, Oklahoma downstream to the confluence of the Mississippi River in southeastern Arkansas as well as 11 reservoirs in Oklahoma that influence river flow within the MKARNS.

The MKARNS is approximately 445 miles in length and consists of a series of 18 locks and dams (17 existing and 1 currently under construction). The principal components of the MKARNS waterways include:

- A 50 mile portion of the Verdigris River (navigation miles 445-394);
- Lower Arkansas River, which comprises 375 miles of the MKARNS (navigation miles 394 to 19);
- The Arkansas Post Canal, a nine mile canal connecting the Arkansas River to the lower portion of the White River (navigation miles 19 to 10); and
- The lower 10 miles of the White River (navigation miles 10 to 0);

- The Lower Arkansas River downstream of Dam 2 (not formally part of the MKARNS). This portion of the Arkansas River is included in the Arkansas River Navigation Study project area because MKARNS river flows may also influence this segment of the river.

River flows on the MKARNS are primarily influenced by flows on the upper Arkansas River upstream of the confluence with the Verdigris River (river mile 394); as well as water storage and release from 11 reservoirs in Oklahoma. These reservoirs provide flood control, water supply, hydroelectric power, fish & wildlife, recreation, and other benefits.

More detailed information on the MKARNS environment is available in Section 4 of the EIS.

C.5.3.2 Lead District

The MKARNS falls under the purview of the USACE, Little Rock District, Arkansas. The effort is being carried out in conjunction with the USACE, Tulsa District, Oklahoma. These Districts are two of four districts that make up the USACE Southwestern Division. The planning lead for the Navigation Study is Mr. Ron Carman (Little Rock District), and the environmental leads for the study are Mr. Johnny McLean (Little Rock District) and Ms. Sandra Stiles (Tulsa District).

C.5.4 Project Purpose

Site-specific HEPs were conducted to evaluate potential impacts of the construction and use of proposed dredge disposal areas. The primary purpose was to assist the study team in formulating a recommended plan by providing a quantitative measure or qualitative evaluation of environmental impacts and estimated habitat replacement costs. Detailed analysis of site-specific impacts, based on any recommended/authorized measures, will not be possible until detailed design information for those measures is available. Should future construction activities be recommended, detailed site-specific evaluations would be completed for each incremental step towards completion of the action. Site surveys would be conducted to determine the potential for environmental impacts.

C.5.5 Determining Goals and Objectives, Project Life, and Target Years.

A meeting was convened early in March of 2004 to conduct the HEP for the MKARNS EIS. The MEET was asked to outline the primary systems or communities within the project area in order to gauge the impacts of the proposed alternatives. Specifically, these impact parameters focused on the existing habitat quantity and quality. First, the MEET developed a list of existing cover types in the region. These are shown in Table C-1.

Table C-1. Cover Types Within the ARNS Region.

Code	Description
AGCROP	Farms and Croplands
BLHFOREST	Bottomland Hardwood Forest (BLH)
OLDFIELD	Old Fields Dominated by Grasses with > 25% Woody Cover (OLF)
OPENFIELD	Open Fields Dominated by Grasses with < 25% Woody Cover (OF)
OPENWATER	Open Bodies of Water Deeper than 1-3m

Table C-1. Cover Types Within the ARNS Region.	
PARKS	Parks and Recreation Areas
PASTURES	Haylands and Pastures
UPFOREST	Upland Forest (UPL)
URBAN	Existing Residential, Industrial and Transportation Avenues
DISPOSAL	Disposal Pit Footprint
Source: ERDC-EL, 2004	

The MEET then outlined the potential project alternatives and mitigation activities, and created a list of proposed changes to the cover types over time resulting from natural succession or mitigation activities. These changes resulted in "newly developed" cover types including those listed in Table C-2. The MEET chose two alternatives for the study to intensively evaluate with HEP:

- Dredge disposal from deepening, and/or continued operation and maintenance of the ARNS; and
- No action alternative.

Table C-2. Potential Newly Created Cover Types Within the ARNS.	
Code	**Description**
NEWBLHFOR	Newly Developed Bottomland Hardwood Forest
NEWOLD	Newly Developed Old Field (> 25% Woody Cover)
NEWOPEN	Newly Developed Open Fields (< 25% Woody Cover)
NEWUPFOR	Newly Developed Upland Forest
NEWMARSH	Newly Developed Emergent Marsh
Source: ERDC-EL, 2004	

C.5.6 Cover Type Mapping the Sites

To evaluate the habitat conditions for a species or community using HEP, the study area was divided into manageable sections and quantified in terms of acres. This process is known as cover typing. A cover type in HEP is a parcel of land (or water) that has similar physical, chemical, and biological characteristics contained within its borders. Cover typing includes defining the differences between vegetative covers (e.g., tall grass prairie, forested wetlands, shrub lands, lakes, and streams, etc.), and clearly delineating these distinctions on a map. The quality of each cover type for the selected species or community is determined by measuring individual variables within the site. Some examples of HEP variables used in this study included the amount of herbaceous cover, the amount of woody cover, the distance to water, the number of pools, number of species, and adjacent land use for a given cover type. In most instances, these variables are measured using aerial photographs, maps and/or onsite sampling activities.

Cover type for each site evaluated was mapped using existing aerial photography and information from transects in the field. All areas adjacent to and within the proposed site were mapped.

C.5.7 Capturing Changes Over Time in HEP Applications

In studies spanning several years, Target Years (TYs) must be identified early in the process. Target Years are units of time measurement used in HEP that allow users to anticipate and identify significant changes (in area or quality) within the project (or site). As a rule, the baseline TY is always TY = 0, where the baseline year is defined as a point in time before proposed changes would be implemented. As a second rule, there must always be a TY = 1 and a TY = X_2. TY1 is the first year land- and water-use conditions are expected to deviate from baseline conditions. TYX_2 designates the ending target year or the span of the project's life. A new target year must be assigned for each year the user intends to develop or evaluate change within the site or project. The habitat conditions (quality and quantity) described for each TY are the expected conditions at the end of that year. It is important to maintain the same target years in both the environmental and economic analyses, and between the baseline and future analyses. In studies focused on long-term effects, Habitat Units (HUs) generated for indicator species/communities are estimated for several TYs to reflect the life of the project. In such analyses, future habitat conditions are estimated for both the without-project (e.g., No Action Alternative) and with-project conditions. Projected long-term effects of the project are reported in terms of AAHUs. Based on the AAHU outcomes, alternative designs can be formulated and trade-off analyses can be conducted to promote environmental optimization (ERDC-EL, 2004a).

The USACE designated a "Project Life" of 50 years for the ARNS, and asked the MEET to develop a series of Target Years within this 50-year setting to generate projections of both Without Project and With Project activities. Target years for the ARNS therefore included TY0 (Baseline Conditions), TY1 (Year of Construction), TY11 (Early in Project), T31 (Middle of Project) and TY51 (End of Project) to capture this 50-year span. The TY11 and TY31 were added to capture important anticipated changes in vegetative cover and structure in the study area.

C.5.8 Selecting, Modifying, and/or Creating Models

With the cover types identified, and their distributions and quantities revealed, the MEET attempted to set quantifiable impact measures and mitigation performance measures for the proposed actions. The impact measures focused on the quantity (measured in acres) and quality (measured in terms of Habitat Suitability Indices or HSIs) of habitat lost or created throughout the life of the project. The mitigation criteria focused on the recovery of a specific habitats, defined on the basis of quantity recovered, and obtainable habitat quality.

HSI models can be tailored to a particular situation or application and adapted to meet the level of effort desired by the user. Thus, a single model (or a series of inter-related models) can be adapted to reflect a site's response to a particular design at any scale (e.g., species, community, ecosystem, regional, or global dimensions). HEP combines both the habitat quality (HSI) and quantity of a site (measured in acres) to generate habitat units (HUs). Once the HSI and habitat quantities have been determined, the HU values can be mathematically derived with the following equation: HU = HSI x Area (acres). Under the HEP methodology, one HU is equivalent to one acre of optimal habitat for a given species or community (ERDC-EL, 2004a).

Three HSI models, each with three sub-models, were deployed in the HEP assessments. The forest and grassland models applied to the impact sites, while the marsh model applied to the mitigation sites. The HSI models were developed and modified by the MEET, and used to evaluate the relationships within terrestrial and marsh communities in the Arkansas River ecosystem setting.

Table C-3. HSI Model List for ARNS EIS.

Model	Model Codes	Description
FORESTS	FBIOTA	Biota of the Forest Community
	FWATER	Water Component of the Forest Community
	FLANDSCAPE	Landscape Component of the Forest Community
GRASSLANDS	GBIOTA	Biota of the Grassland Community
	GLANDSCAPE	Landscape Component of the Grassland Community
MARSH	MBIOTA	Habitat (Biota) Component for Marsh Community
	MLANDSCAPE	Landscape Component for Marsh Community

Source: ERDC-EL, 2004b

C.5.9 Site Data Collection

In the spring of 2004, members of the MEET completed intensive baseline habitat sampling at 22 sites across the Arkansas River ecosystem. These sites were considered upland/terrestrial sites. Of the 22 HEP sites, 6 sites served as reference standard sites (RSS) for the calibration of the HEP models. These sites were not potential dredge disposal sites, but examples of typical forest and grassland habitat within the study area. Twelve of the HEP sites were targeted as potential dredge disposal locations above the floodplain. These sites were used as reference impact sites (RIS) to develop baseline conditions in the HEP analysis and used to extrapolate impacts to sites not surveyed. A total of 13 HSI variables were measured during the field sampling effort in an attempt to develop a description of the baseline (Spring 2004) conditions at these sites. Variables ranged from measurements of vegetative cover to the counting of the number of species. These variables are described in detail in Table C-4 below. The sampling effort could be completed efficiently on 100-meter (m) transects.

Some variables could be obtained through various historical records, aerial photos or mathematical calculations rather than through active field sampling. Six HSI variables were obtained from Geographic Information System (GIS) resources and spreadsheet calculations. These variables are described in detail in Table C-5.

The following methods were used to obtain some of those variables:

- Landcover types were mapped using aerial photography and information from transects in the field. Mapped areas were immediately adjacent to proposed sites.
- Acreage for PATCH variable was calculated within the GIS software.
- A 100m buffer was applied inside patch and acreage of buffer calculated using GIS software. Buffer acreage was divided by the PATCH variable to obtain an edge variable.

- Buffer acreage was subtracted from total PATCH variable acreage to obtain core acreage. The difference in PATCH acreage and buffer acreage was divided by PATCH acreage to obtain the CORE variable.
- An automated routine within the GIS software was used to determine a centerpoint for each patch. Using the centerpoint, the DISTOPW (distance to open water) variable was measured using the measure tool in ArcGIS. The NEIGHBOR (nearest neighbor) variable was determined the same way.
- The ADLAND variable was obtained by generating 30 random points within the patch and visually determining the adjacent land use.

Table C-4. Variables Measured in the Field.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
CANEMERG	Emergent Herbaceous Vegetation Canopy Cover (%)	Starting at a random location within each marsh-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the percent of the water surface shaded by a vertical projection of the canopies of emergent herbaceous vegetation, both persistent and nonpersistent.	MARSH MBIOTA	NEWMARSH	100-m Transect Tape and 1-m2 Quadrat
CANFORB	Proportion of the Herbaceous Canopy Cover Comprised of Forbs (%)	Starting at a random location within each grassland-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the proportion of the herbaceous canopy cover within the quadrat that is comprised of forbs. Repeat the process two more times (total number of data points = 30 per cover type).	GRASSLANDS GBIOTA	OLDFIELD NEWOLD OPENFIELD NEWOPEN	100-m Transect Tape and 1-m2 Quadrat
CANHERB	Herbaceous Canopy Cover (%)	Starting at a random location within each grassland-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the herbaceous canopy cover within the quadrat. Repeat the process two more times (total number of data points = 30 per cover type).	GRASSLANDS GBIOTA	OLDFIELD NEWOLD OPENFIELD NEWOPEN	100-m Transect Tape and 1-m2 Quadrat
CANHMAST	Proportion of the Tree Canopy Comprised of Hard Mast Species (%)	Starting at a random location within each forest-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground. Stand in the center of this quadrat and use an optic tube to determine the percent of the tree canopy within the viewer that is comprised of hard mast species. By definition, trees must be at least 20 feet tall and/or have a dbh of 6 inches to be included in this measurement. Repeat the process two more times (total number of data points = 30 per cover type).	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape, 1-m2 Quadrat and Optic Tube

Table C-4. Variables Measured in the Field.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
CANNATIVE	Proportion of the Herbaceous Canopy Cover Comprised of Native Species (%)	Starting at a random location within each grassland-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the proportion of the herbaceous canopy cover within the quadrat that is comprised of native species. Repeat the process two more times (total number of data points = 30 per cover type).	GRASSLANDS GBIOTA	OLDFIELD NEWOLD OPENFIELD NEWOPEN	100-m Transect Tape and 1-m2 Quadrat
CANSHRUB	Shrub Canopy Cover (%)	Starting at a random location within each grassland-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the shrub canopy cover within the quadrat. By definition, shrubs are defined as woody vegetation less than 20 feet tall (dbh < 6 inches). Repeat the process two more times (total number of data points = 30 per cover type).	GRASSLANDS GBIOTA	OLDFIELD NEWOLD OPENFIELD NEWOPEN	100-m Transect Tape and 1-m2 Quadrat
CANSMAST	Proportion of the Tree Canopy Comprised of Soft Mast Species (%)	Starting at a random location within each forest-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground. Stand in the center of this quadrat and use an optic tube to determine the percent of the tree canopy within the viewer that is comprised of soft mast species. By definition, trees must be at least 20 feet tall and/or have a dbh of 6 inches to be included in this measurement. Repeat the process two more times (total number of data points = 30 per cover type).	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape, 1-m2 Quadrat and Optic Tube
CANTREE	Percent Tree Canopy Cover (%)	Starting at a random location within each forest-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground. Stand in the center of this quadrat and use an optic tube to determine the percent tree canopy within the viewer. By definition, trees must be at least 20 feet tall and/or have a dbh of 6 inches to be included in this measurement. Repeat the process two more times (total number of data points = 30 per cover type).	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape, 1-m2 Quadrat and Optic Tube

Table C-4. Variables Measured in the Field.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
CANWOOD6	Percent Canopy Cover of Woody Vegetation < 6m Tall (%)	Starting at a random location within each marsh-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and estimate the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation.	MARSH MBIOTA	NEWMARSH	100-m Transect Tape and 1-m2 Quadrat
DBHTREE	Average Tree Diameter (dbh) (cm)	Starting at a random location within each forest-based cover type, lay out a 100-m transect tape. Establish a 10-m wide belt transect parallel to the 100-m transect tape (5-m on each side of the tape). Walk along this belt for 10-m, and measure the diameter at breast height of all trees >10 dbh or taller than 20 feet within the belt. Repeat the 10x10 belt approach for the length of the 100-m transect tape (10 sets of data points are collected per 100-m transect). Repeat the process two more times (total number of data point sets = 30 per cover type).	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape and DBH Tape
DEPTHWATER	Average Water Depth in centimeters (cm)	Starting at a random location within each marsh-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a graduated rod or meter stick perpendicular to the ground and measure the water depth (cm).	MARSH MBIOTA	NEWMARSH	100-m Transect Tape and Graduated Rod or Meter Stick
DIVERSVEG	Diversity of Indicator Species	Starting at a random location within each marsh-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, walk out 5m in all 4 directions of the tape and record the category of indicator species that best represents the 10-m square section along the belt.Class Data:0 = No Data Collected1 = Cattails, Cordgrasses, Bulrushes2 = Bluejoint Reedgrass, Reed Canary-Grass, Sedges3 = Buttonbush, Mangrove4 = Other Growth Forms not listed.	MARSH MBIOTA	NEWMARSH	100-m Transect Tape and 10-m2 belt section

Table C-4. Variables Measured in the Field.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
NUMSPP	Number of Species Present (Count)	Starting at a random location within each grassland-based cover type, lay out a 100-m transect. At every 10-m interval along the transect, place a 1-m2 quadrat on the ground and record then total number of species present within the quadrat. Repeat the process two more times (total number of data points = 30 per cover type).	GRASSLANDS GBIOTA	OLDFIELD NEWOLD OPENFIELD NEWOPEN	100-m Transect Tape and 1-m2 Quadrat
NUMTREESP	Number of Tree Species Present (Count)	Starting at a random location within each forest-based cover type, lay out a 100-m transect tape. Establish a 10-m wide belt transect parallel to the 100-m transect tape (5-m on each side of the tape). Walk along this belt for 10-m, and identify (to species) trees within the belt. By definition, trees must be at least 20 feet tall and/or have a dbh of 6 inches to be included in this measurement. Repeat the 10x10 belt approach for the length of the 100-m transect tape (10 sets of data points are collected per 100-m transect). Repeat the process two more times (total number of data point sets = 30 per cover type). Sum the number of species found per transect.	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape and DBH Tape
VEGSTRATA	Number of Vegetation Strata Present (Count)	Starting at a random location within each forest-based cover type, lay out a 100-m transect tape. Establish a 10-m wide belt transect parallel to the 100-m transect tape (5-m on each side of the tape). Walk along this belt for 10-m, and identify all vegetative layers present (see list below). Repeat the 10x10 belt approach for the length of the 100-m transect tape (10 sets of data points are collected per 100-m transect). Repeat the process two more times (total number of data point sets = 30 per cover type). Vegetative Layers to Record Include: Herbaceous - herbaceous vegetation layer less than 1m (39 inches) in height. Shrubs - woody vegetation layer less than 3m (~10ft) in height. Midstory Tree Canopy - woody vegetation layer 3-6m (~10-20 ft) in height.	FORESTS FBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	100-m Transect Tape

Table C-4. Variables Measured in the Field.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
		Overstory Tree Canopy - woody vegetation layer greater than 6m (~20 ft) in height. Vines - woody vines allowing for travel lanes Duff, Twigs, Leaf Litter - down or dead wood or herbaceous litter Coarse Woody Debris - down or dead wood debris greater than or equal to 10 cm (2.5 inches) diameter. Snags - dead but standing trees. Micro Relief - small pockets or mounds that may allow for cover or ponding water.			

Source: ERDC-EL, 2004b

Table C-5. Variables Gathered via GIS & Historical Records.					
VAR Code	**Variable Description**	**Methodology, Techniques and Assumptions**	**Model Applicability**	**Cover Type Cross-Reference**	**Equipment List**
ADJLANDUSE	Identification of Adjacent Lands Use (Class Data)	Using GIS, select 30 random points within each cover type and identify the predominant adjacent landuse type based on the following categories. Class data: NEED Better definitions 1 = Pristine, Uninhabited Areas 2 = Parks 3 = Pasturelands 4 = Utility Rights-of-way and Rail Roads 5 = Dirt and Gravel roads, Oil and Gas Fields 6 = Agricultural Croplands 7 = Residential and Golf Courses 8 = Paved Roads, Highways 9 = Commercial/Industrial	FORESTS FLANDSCAPE GRASSLANDS GLANDSCAPE MARSH MLANDSCAPE	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR OLDFIELD NEWOLD OPENFIELD NEWOPEN NEWMARSH	GIS & Calculations
CORE	Proportion of Total Area that is Core (%)	Using GIS, determine the proportion (%) of the total area of the cover type polygon that is core area.	FORESTS FLANDSCAPE GRASSLANDS GLANDSCAPE	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR OLDFIELD NEWOLD OPENFIELD NEWOPEN	GIS & Calculations
DISTOPW	Average Distance to Open Water (m)	Using GIS, use a centroid point in the cover type polygon and measure the distance from the centroid to the edge of the nearest open water body.	FORESTS FLANDSCAPE	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR	GIS & Calculations
NEIGHBOR	Distance to Nearest Neighbor of Similar Cover Type (m)	Using GIS, use a centroid point in the cover type polygon and measure the distance from the centroid to the edge of the nearest neighbor (neighbor = polygon of similar land use classification).	FORESTS FWATER MARSH MBIOTA	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR NEWMARSH	GIS & Calculations

Table C-5. Variables Gathered via GIS & Historical Records.

VAR Code	Variable Description	Methodology, Techniques and Assumptions	Model Applicability	Cover Type Cross-Reference	Equipment List
PATCHSIZE	Patch Size (acres)	Using GIS, calculate the average patch size(in acres) of the polygons for each cover type present.	FORESTS FLANDSCAPE GRASSLANDS GLANDSCAPE MARSH MLANDSCAPE	BLHFOREST NEWBLHFOR UPFOREST NEWUPFOR OLDFIELD NEWOLD OPENFIELD NEWOPEN NEWMARSH	GIS & Calculations
REGIME	Hydrologic Regime (Class Data)	Using the Cowardin Classification System, record the predominant hydrologic regime for the site. Refer to the categories listed below. 1 = Permanently flooded 2 = Intermittently exposed 3 = Semipermanently flooded 4 = Seasonally flooded 5 = Temporarily flooded 6 = Saturated 7 = Intermittently flooded	FORESTS FWATER MARSH MBIOTA	BLHFOREST NEWBLHFOR NEWMARSH	Historical Data

Source: ERDC-EL, 2004b

C.5.9.1 Field Sampling Protocol

As indicated in the HEP variable tables above, three 100-m transect were laid down within the boundaries of the indicated cover type at each site, and variables were measured at 10 meter intervals (i.e., 10 sampling stops or stations per transect were made). In this manner, 750 separate stations (i.e., 25 cover type areas x 30 stations per cover type = 750) of data were recorded in the study. In most instances, data collected on the cover type transects were averaged to generate a cover type score for the site. This strategy reduced the coefficients of variance (i.e., standard deviations of the field data). The one exception to this data-handling rule was the management of class data (e.g., VEGSTRATA), in which the modes were calculated instead of averages across transects within the cover type.

C.5.9.2 Field Sampling Locations

Reference standard sites were not potential or existing dredge disposal sites, but represented low, moderate, and high quality examples of different habitats within the study area. Data collected for these sites was used to calibrate the HSI models and compare them to the dredge disposal sites. These ten sites are listed in Table C-6.

Table C-6. Reference standard sites (non-disposal sites) used in the HEP analysis for the ARNS EIS.

Site Name	Navigation Miles	Size (Acres)	BLH	OF	OLF	UPL	Notes
RSR 1	352.0-356.0	1		X			Sequoyah Refuge, OK
RSR 2	352.0-356.0	1			X		Sequoyah Refuge, OK
RSR 3	352.0-356.0	1			X		Sequoyah Refuge, OK
RSR 4	352.0-356.0	1				X	Sequoyah Refuge, OK
RSR 5	352.0-356.0	1				X	Sequoyah Refuge, OK
RSKR	434.4 – 434.6	1	X				Skelly Ranch (Private)
RBL #1	440.4 – 440.8	1	X				Big Lake, OK
RBL#2	440.1 – 440.2	1	X				Big Lake – East of dam
RBL #3	440.5 – 441.0	1	X				Big Lake, OK
RTGP	Site not along the Arkansas River	1		X			Tallgrass Prairie Preserve west of Bartlesville, Oklahoma

RTGP = Reference Tallgrass Prairie Preserve
RSR = Reference Sequoyah Refuge
RSKR = Reference Skelly Ranch
RBL = Reference Big Lake
OF = Open Field
OLF = Old Field
BLH = Bottomland Hardwood
UPL= Upland Forest

Source: USACE-Tulsa, 2004

Reference impact sites were potential dredge disposal sites that served as the baseline of data with which the rest of the potential dredge disposal sites could be extrapolated from. The reference impact sites along with the extrapolation impact sites are shown in Table C-7.

C.5.10 Performing Data Management and Statistical Analysis

Some limits to the assessment's data should be acknowledged. In some instances, extrapolations or corrections were made several weeks after sampling was concluded. In addition, some of the cover type mapping originally developed was ground-truthed, and found to be inaccurate. As a result of these area-based changes, some transects were thrown out due to incompatibility with the new classification. In those instances where transects were discarded or absent, extrapolations were made from watershed means. When data management problems arose, ERDC-EL consulted with the MEET prior to data handling, and solutions were devised with their knowledge and consent.

C.5.11 Calculating Baseline Conditions

Once the baseline data inventory was conducted, and both the variable means/modes and the cover type acreages were determined, the baseline conditions in terms of HUs were generated by multiplication. Strictly speaking, the means/mode values for each variable were applied to Suitability Index graphs (entered into the "X-axis" on the Suitability Index curve) and the resultant SI score (Y-axis) was recorded. An example Suitability Index graph is shown in Figure C.5-1.

Figure C.5-1 Example HSI Curve (*Source: ERDC-EL, 2004b*).

Table C-7. Dredge disposal sites considered in the HEP analysis for the ARNS EIS.

Site Name	Deepening Disposal Site	Long Term Dredge Material Disposal Plan	Navigation Mile(s)	Acres	Cover Type					Comments
					BLH	UPL	OF	OLF	Other	
OK PRL-DI	X	X	1.5PR – 1.8PR	9			9			Poteau River; new O&M site
OK 309.1 R-DI	X	X	309.05 – 309.3	28		5	23			
OK 312.5 R-DI		X	312.5 – 312.9	19			19			
OK 315.4 R-DI	X	X	315.4 – 315.8	36		8		28		
OK 318.3 R-DI		X*	311	80		20			60	Lock 14; new O&M site
OK 335.8 R-DI*	X		335.8 – 336.1	22	8		14			Robert Kerr L&D
OK 335.9 L-DI*	X		335.8 – 336.1	22			22			Robert Kerr L&D
OK 337.2 R-DI*	X		337.7 – 337.5	28		28				Short Mountain Park
OK 338.0 R-DI	X		338.0 – 338.2	28			28			
OK-SBC 8.7 L-DI		X	SBC 8.7 – 9.3	35	8			27		Unconfined island
OK-SBC 9.7 R-DI		X	SBC 9.7 – 10.0	20	10	10				Unconfined island
OK-SBC 10.0 R-DI		X	SBC 10 – 11	20		16		4		Unconfined island
OK 342.3 L-DI	X		342.1 – 342.3	29		14		15		Two diked ponds
OK 366.5 L-DI*	X		366.3 – 366.6	6				6		Old spoil area near Lock 16
OK 382.0 L-DI	X		381.9 – 382.5	23			23			
OK 383.9 R-DI*	X		383.9 – 384.3	42		2	13	27		
OK 394.0 R-DI		X	393.9 – 394.6	48				48		3 Forks Area; new site for O&M
OK 395.2 L-DI		X	395.0 – 395.5	42				42		3 Forks Area
OK 398.2 R-DI*	X		398.2 – 398.8	44			34	10		North of Hwy 16 bridge; old disposal site
OK 400.7 R-DI*	X	X	400.0 – 401.5	31				31		
OK 400.0 L-DI		X	400.2	23				23		New site for O&M
OK 401.6 R-DI	X	X	401.5 – 402.2	39			39			

Table C-7. Dredge disposal sites considered in the HEP analysis for the ARNS EIS.

Site Name	Deepening Disposal Site	Long Term Dredge Material Disposal Plan	Navigation Mile(s)	Acres	Cover Type					Comments
					BLH	UPL	OF	OLF	Other	
OK 407.6 R-DI	X		407.6 – 407.8	10		2		8		
OK 414.9 R-DI	X		414.9 – 415.15	8				8		Old disposal pit
OK 416.4 L-DI	X		416.4 – 416.65	14				14		
OK 420.8 L-DI		X	420.5 – 421.8	63		10	43		10	
OK 421.3 R-DI*	X		421.3 – 421.7	13			13			Old spoil site; closed park
OK 422.9 L-DI	X	X	421.85 – 422.0	7			7			Existing spoil site
OK 434.3 R-DI*	X		434.0 – 434.8	10				10		Old disposal pits
OK 436.1 L-DI*	X		436.1 – 436.3	13			13			
OK 441.1 L-DI*	X		441.0 – 441.5	12			12			Between river and old dredge pit
OK 443.7 L-DI	X		443.7 – 444.0	27			27			Old disposal site
OK 444.6 L-DI		X	444.5 – 445.0	15				15		
OK 444.6 R-DI		X	444.5 – 445.2	9		9				

* Reference impact sites where field, GIS, and historical data was collected for HEP.

BLH = Bottomland Hardwood Forest UPL=Upland Forest OLF = Old Field OF=Open Field

Ag = Agriculture OK = Oklahoma

Source: USACE-Tulsa, 2004

The process was repeated for every associated variable and cover type per model. The individual SI scores were then entered into the HSI formula on a cover type-by-cover type basis, and individual cover type HSIs were generated. Each answer, referred to as the cover type HSI (CT HSI), was weighted by the relative area (RA) of the cover type, and combined with the answers from the remaining associated cover types in an additive fashion. The model's formula was considered to be the sum of the CT HSIs.

The final step was to multiply the HSI result by the habitat acres (i.e., cover type acres associated with the model). The final results, referred to as Habitat Units (HUs), quantified the quality and quantity of the habitats at the site at TY0 (Baseline).

In HEP, the relative area is a mathematical process used to "weight" the various applicable cover types on the basis of quantity. To derive the relative area of a model's cover type for the study, the following equation was utilized:

$$\textit{Relative Area} = \frac{\textit{Cover Type Area}}{\textit{Total Area}}$$

Cover Type Area = only those acres assigned to the cover type of interest
Total Area = the sum of the acres utilized in the model

$$\textit{HSI Model} = \sum (\textit{CT HIS} \times \textit{RA})X$$

CT HSI = Results of the cover type HSI calculation
X = Number of cover types associated with the model

RA = Relative area of each cover type (ERDC-EL, 2004a). The sheer number of calculations necessary to conduct a HEP analysis on a project the size of the ARNS-EIS led the District to utilize the ERDC-EL for technical assistance. Using the latest technological advancements, ERDC-EL performed the necessary evaluations in less than six months. In addition to facilitating the application of HEP in the study, ERDC's biologists used the EXHEP (Expert Habitat Evaluation Procedures) software package to generate habitat loss and mitigation calculations in a timely manner (ERDC-EL, 2004b).

The baseline analysis results for the reference and potential disposal sites sampled in the field are presented in Table C-7.

Table C-7. Baseline HEP Results for RIS and RSS.

Site Name	Model name	Habitat Suitability Index (HSI)	Applicable Acres	Baseline Habitat Units (HUs)
RBL #1	Upland Forest Community Model	0.83	525	435.9
	Grassland Community Model	0.00	0	0.0
RBL #2	Upland Forest Community Model	0.65	158	103.1
	Grassland Community Model	0.00	0	0.0
RBL #3	Upland Forest Community Model	0.55	97	53.3
	Grassland Community Model	0.00	0	0.0

Table C-7. Baseline HEP Results for RIS and RSS.				
Site Name	**Model name**	**Habitat Suitability Index (HSI)**	**Applicable Acres**	**Baseline Habitat Units (HUs)**
RSKR1	Upland Forest Community Model	0.33	55	18.1
	Grassland Community Model	0.00	0	0.0
OK335.8R-DI	Upland Forest Community Model	0.29	8	2.3
	Grassland Community Model	0.31	14	4.3
OK434.3R-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.28	10	2.8
RSR 4	Upland Forest Community Model	0.79	289	228.1
	Grassland Community Model	0.00	0	0.0
RSR 5	Upland Forest Community Model	0.60	132	79.4
	Grassland Community Model	0.00	0	0.0
OK 398.2 R-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.41	44	17.9
OK 337.2 R-DI	Upland Forest Community Model	0.69	28	19.3
	Grassland Community Model	0.00	0	0.0
OK 383.9 R-DI	Upland Forest Community Model	0.69	2	1.4
	Grassland Community Model	0.379	40	15.2
RSR 2	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.65	58	37.6
RSR 3	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.66	113	74.7
OK366.5L-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.59	6	3.6
RSR 1	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.69	1066	739.3
RTGP	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.95	790	751.9
OK 422.9 L-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.16	7	1.1

Table C-7. Baseline HEP Results for RIS and RSS.				
Site Name	**Model name**	**Habitat Suitability Index (HSI)**	**Applicable Acres**	**Baseline Habitat Units (HUs)**
OK441.1L-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.53	12	6.4
OK 421.3 R-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.31	13	4.1
OK 335.9 L-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.30	22	6.5
OK400.7R-DI	Upland Forest Community Model	0.0	0	0.0
	Grassland Community Model	0.39	31	12.0
OK 436.1 L-DI	Upland Forest Community Model	0.00	0	0.0
	Grassland Community Model	0.22	13	2.8
Source: ERDC-EL, 2004b				

C.5.12 Generating Without Project Conditions and Calculating Outputs

Future impacts were projected as change from these baseline conditions over the 50-year project life in the HEP assessments. The ERDC-EL facilitated a series of workshops, beginning in the winter of 2004 and continuing through the summer of 2004, in which the MEET derived future projections for each site.

To analyze impacts to a community or region, it becomes necessary to predict both the short-term and long-term future conditions of the environment. The Without Project condition is universally regarded as a vital and important element of the evaluation. No single element is more critical to the impacts analysis than the prediction of the most likely future conditions anticipated for the study area if no action is taken as a result of the study. NEPA regulations require that the No Action Alternative always be considered during the formulation of plans. The Without Project descriptions had to adequately describe the future. Significant variables, elements, trends, systems, and processes were sufficiently described to support good decision-making. Forecasts were based on appropriate methods, and professional standards were applied to the use of those methods. Without Project conditions are not "before-and-after" comparisons. "Before-and-after" comparisons can overlook the causality that is important to effective plan evaluation. Without Project conditions are future oriented.

Rules and assumptions were developed for acreage projections of the Without Project condition for all ARNS-EIS sites:

- Because of the rural nature of most of the dredge disposal sites, there would likely be little change in ownership and/or change in function of land within these project areas.
- Pasture would likely remain pasture due to grazing pressure.

- Open fields would likely undergo succession and develop into old fields and then forest.
- Old fields would likely undergo succession to develop into forest.
- Forest would likely continue to develop into a more mature forest.
- Marsh would likely undergo succession to develop into a forested wetland.

Some of the projections were based on data collected at the RISs, while others were adjusted based on expert opinion. These assumptions were applied as results to the Habitat Suitability curves and new HSIs and HUs were generated for the without project condition.

C.5.12.1 Calculating Annualized Units for the Without Project Condition

Most Federal agencies use annualization as a means to display benefits and costs. Federal projects are evaluated over a period of time that is referred to as the "life of the project." This is defined as that period between the time that the project becomes operational and the end of the project life. In HEP, HUs are annualized by summing HUs across all years in the period of analysis and dividing the total (cumulative HU) by the number of years in the life of the project. In this manner, pre-start changes can be considered in the analysis. The results of this calculation are referred to as Average Annual Habitat Units (AAHUs).

The total acres of each habitat projected to be gained plus the AAHUs for each terrestrial site under the without project or no action alternative is shown in Table C-8.

Table C-8. Without Project Projected Acres and AAHUs at Target Year 51.

Site Name	Site Type	Habitat	WOP Target Year 51 Size (acres)	Target Year 51 AAHUs
OK PR L-DI	Extrapolated Site	NewOldField	2.3	0.85
		NewUpland	2.3	0.16
		OpenField	4.5	1.69
OK PR L-DI Total			9.0	2.69
OK 309.1 R-DI	Extrapolated Site	NewOldField	5.8	3.00
		NewUpland	5.8	0.81
		OpenField	11.5	6.00
		UplandForest	5.0	3.57
OK 309.1 R-DI Total			28.0	13.38
OK 312.5 R-DI	Extrapolated Site	NewOldField	4.8	1.02
		NewUpland	4.8	0.31
		OpenField	9.5	2.04
OK 312.5 R-DI Total			19.0	3.37
OK 315.4 R-DI	Extrapolated Site	NewUpland	14.0	4.11
		OldField	14.0	7.24

Table C-8. Without Project Projected Acres and AAHUs at Target Year 51.				
Site Name	**Site Type**	**Habitat**	**WOP Target Year 51 Size (acres)**	**Target Year 51 AAHUs**
		UplandForest	8.0	2.35
OK 315.4 R-DI Total			36.0	13.70
OK 318.3 R-DI	Extrapolated Site	UplandForest	20.0	5.88
OK 318.3 R-DI Total			20.0	5.88
OK 335.8R-DI	Reference Impact Site	Bottomland	8.0	3.91
		NewOldField	3.5	0.85
		NewUpland	3.5	3.91
		OpenField	7.0	1.69
OK 335.8R-DI Total			22.0	10.36
OK 335.9L-DI	Reference Impact Site	NewOldField	5.5	0.85
		NewUpland	5.5	0.36
		OpenField	11.0	1.69
OK 335.9L-DI Total			22.0	2.90
OK 337.2R-DI	Reference Impact Site	UplandForest	28.0	20.01
OK 337.2R-DI Total			28.0	20.01
OK 338.0 R-DI	Extrapolated Site	NewOldField	7.0	1.50
		NewUpland	7.0	0.46
		OpenField	14.0	3.01
OK 338.0 R-DI Total			28.0	4.97
OK 342.3 L-DI	Extrapolated Site	NewUpland	7.5	1.05
		OldField	7.5	3.91
		UplandForest	14.0	10.01
OK 342.3 L-DI Total			29.0	14.97
OK-SBC 10.0 R-DI	Extrapolated Site	NewUpland	1.0	0.29
		OldField	1.0	0.52
		UplandForest	16.0	4.70
OK-SBC 10.0 R-DI Total			18.0	5.51
OK-SBC 8.7 L-DI	Extrapolated Site	Bottomland	2.0	0.98

Table C-8. Without Project Projected Acres and AAHUs at Target Year 51.				
Site Name	**Site Type**	**Habitat**	**WOP Target Year 51 Size (acres)**	**Target Year 51 AAHUs**
		NewUpland	4.0	0.56
		OldField	4.0	2.09
OK-SBC 8.7 L-DI Total			10.0	3.63
OK-SBC 9.7 R-DI	Extrapolated Site	Bottomland	5.0	2.44
		UplandForest	5.0	1.47
OK-SBC 9.7 R-DI Total			10.0	3.91
OK 366.5L-DI	Reference Impact Site	NewUpland	3.0	0.72
		OldField	3.0	2.35
OK 366.5L-DI Total			6.0	3.07
OK 382.0 L-DI	Extrapolated Site	NewOldField	5.8	2.38
		NewUpland	5.8	0.39
		OpenField	11.5	4.77
OK 382.0 L-DI Total			23.0	7.54
OK 383.9R-DI	Reference Impact Site	NewOldField	3.3	1.68
		NewUpland	16.8	4.92
		OldField	13.5	6.98
		OpenField	6.5	3.36
		UplandForest	2.0	0.59
OK 383.9R-DI Total			42.0	17.53
OK 394.0 R-DI	Extrapolated Site	NewUpland	24.0	5.78
		OldField	24.0	18.82
OK 394.0 R-DI Total			48.0	24.60
OK 395.2 L-DI	Extrapolated Site	NewUpland	9.0	2.17
		OldField	9.0	7.06
OK 395.2 L-DI Total			18.0	9.23
OK 398.2R-DI	Reference Impact Site	NewOldField	8.5	4.43
		NewUpland	13.5	1.90
		OldField	5.0	2.61
		OpenField	17.0	8.87
OK 398.2R-DI Total			44.0	17.81

Table C-8. Without Project Projected Acres and AAHUs at Target Year 51.				
Site Name	**Site Type**	**Habitat**	**WOP Target Year 51 Size (acres)**	**Target Year 51 AAHUs**
OK 400.0 L-DI	Extrapolated Site	NewUpland	11.5	2.83
		OldField	11.5	6.01
OK 400.0 L-DI Total			23.0	8.84
OK 400.7R-DI	Reference Impact Site	NewUpland	15.5	3.81
		OldField	15.5	8.10
OK 400.7R-DI Total			31.0	11.91
OK 401.6 R-DI	Extrapolated Site	NewOldField	9.8	6.59
		NewUpland	9.8	0.68
		OpenField	19.5	13.18
OK 401.6 R-DI Total			39.0	20.45
OK 407.6 R-DI	Extrapolated Site	NewUpland	4.0	0.56
		OldField	4.0	2.09
		UplandForest	2.0	1.43
OK 407.6 R-DI Total			10.0	4.08
OK 414.9 R-DI	Extrapolated Site	NewUpland	4.0	0.96
		OldField	4.0	3.14
OK 414.9 R-DI Total			8.0	4.10
OK 416.4 L-DI	Extrapolated Site	NewUpland	7.0	1.69
		OldField	7.0	5.49
OK 416.4 L-DI Total			14.0	7.18
OK 420.8 L-DI	Extrapolated Site	NewOldField	10.8	5.56
		NewUpland	10.8	1.69
		OpenField	21.5	11.11
		UplandForest	10.0	2.94
OK 420.8 L-DI Total			53.0	21.30
OK 421.3R-DI	Reference Impact Site	NewOldField	3.3	1.35
		NewUpland	3.3	0.22
		OpenField	6.5	2.69
OK 421.3R-DI Total			13.0	4.26
OK 422.9L-DI	Reference Impact Site	NewOldField	1.8	0.61

Table C-8. Without Project Projected Acres and AAHUs at Target Year 51.				
Site Name	**Site Type**	**Habitat**	**WOP Target Year 51 Size (acres)**	**Target Year 51 AAHUs**
		NewUpland	1.8	0.12
		OpenField	3.5	1.22
OK 422.9L-DI Total			7.0	1.95
OK 434.3R-DI	Reference Impact Site	NewUpland	5.0	0.52
		OldField	5.0	1.99
OK 434.3R-DI Total			10.0	2.51
OK 436.1L-DI	Reference Impact Site	NewOldField	3.3	1.22
		NewUpland	3.3	0.23
		OpenField	6.5	2.44
OK 436.1L-DI Total			13.0	3.89
OK 441.1L-DI	Reference Impact Site	NewOldField	3.0	2.03
		NewUpland	3.0	0.21
		OpenField	6.0	4.05
OK 441.1L-DI Total			12.0	6.29
OK 443.7 L-DI	Extrapolated Site	NewOldField	6.8	1.45
		NewUpland	6.8	0.44
		OpenField	13.5	2.90
OK 443.7 L-DI Total			27.0	4.79
OK 444.6 L-DI	Extrapolated Site	NewUpland	7.5	1.81
		OldField	7.5	5.88
OK 444.6 L-DI Total			15.0	7.69
Grand Total			**270.0**	**102.59**
Source: ERDC-EL, 2004b				

C.5.13 Generating With Project Conditions and Calculating the Outputs

Between June of 2004 and September of 2004 the MEET met on a regular basis (in person and via conference calls) to develop projection trends for the deepening and maintenance dredging disposal sites across the MKARNS. As they did in the without project setting, the MEET generated a list of general trends for the overall study. It was assumed that if a site was used for disposal, the entire site would be covered by dredged material. The Team made an effort to distinguish clearly between forest vs. open/old field communities, and the outcomes of each were incorporated into the forecasting.

Table C-9 shows with project total acres, AAHUs, and net AAHUs at target year 50.

Table C-9. With Project Total Acres, AAHUs, and Net AAHUs at Target Year 51.

Site Name	Site Type	Habitat	WP TY50 Size (ac)	AAHUs	Net AAHUs
OK 309.1 R-DI	Extrapolated Site	NewOldField	0	0.03	-2.97
		NewUpland	0	0.00	-0.81
		OpenField	0	0.08	-7.10
		UplandForest	0	0.13	-3.45
OK 309.1 R-DI Total			0	0.24	-14.32
OK 312.5 R-DI	Extrapolated Site	NewOldField	0	0.01	-1.01
		NewUpland	0	0.00	-0.64
		OpenField	0	0.03	-2.33
OK 312.5 R-DI Total			0	0.05	-3.97
OK 315.4 R-DI	Extrapolated Site	NewUpland	0	0.01	-4.11
		OldField	0	0.00	-6.59
		UplandForest	0	0.00	-2.35
OK 315.4 R-DI Total			0	0.01	-13.05
OK 318.3 R-DI	Extrapolated Site	UplandForest	0	0.13	-5.75
OK 318.3 R-DI Total			0	0.13	-5.75
OK 335.8R-DI	Reference Impact Site	Bottomland Forest	0	0.02	-3.89
		NewOldField	0	0.01	-0.84
		NewUpland	0	0.02	-3.89
		OpenField	0	0.02	-1.71
OK 335.8R-DI Total			0	0.06	-10.33
OK 335.9L-DI	Reference Impact Site	NewOldField	0	0.01	-1.17
		NewUpland	0	0.00	-0.36
		OpenField	0	0.03	-2.70
OK 335.9L-DI Total			0	0.05	-4.23
OK 337.2R-DI	Reference Impact Site	UplandForest	0	0.13	-19.89
OK 337.2R-DI Total			0	0.13	-19.89
OK 338.0 R-DI	Extrapolated Site	NewOldField	0	0.01	-1.49
		NewUpland	0	0.00	-0.70
		OpenField	0	0.03	-3.45
OK 338.0 R-DI Total			0	0.05	-5.64
OK 342.3 L-DI	Extrapolated Site	NewUpland	0	0.00	-1.05
		OldField	0	0.02	-4.66
		UplandForest	0	0.13	-9.88
OK 342.3 L-DI Total			0	0.15	-15.59
OK 366.5L-DI	Reference Impact Site	NewUpland	0	0.00	-0.72
		OldField	0	0.02	-2.33
OK 366.5L-DI Total			0	0.02	-3.05

Table C-9. With Project Total Acres, AAHUs, and Net AAHUs at Target Year 51.

Site Name	Site Type	Habitat	WP TY50 Size (ac)	AAHUs	Net AAHUs
OK 382.0 L-DI	Extrapolated Site	NewOldField	0	0.01	-2.38
		NewUpland	0	0.00	-0.47
		OpenField	0	0.02	-4.75
OK 382.0 L-DI Total			0	0.02	-7.60
OK 383.9R-DI	Reference Impact Site	NewOldField	0	0.00	-1.68
		NewUpland	0	0.01	-4.91
		OldField	0	0.00	-6.36
		OpenField	0	0.00	-2.84
		UplandForest	0	0.00	-0.59
OK 383.9R-DI Total			0	0.02	-16.38
OK 394.0 R-DI	Extrapolated Site	NewUpland	0	0.00	-5.78
		OldField	0	0.02	-18.80
OK 394.0 R-DI Total			0	0.02	-24.58
OK 395.2 L-DI	Extrapolated Site	NewUpland	0	0.00	-2.17
		OldField	0	0.02	-7.04
OK 395.2 L-DI Total			0	0.02	-9.20
OK 398.2R-DI	Reference Impact Site	NewOldField	0	0.03	-4.40
		NewUpland	0	0.00	-1.90
		OldField	0	0.02	-3.10
		OpenField	0	0.08	-10.53
OK 398.2R-DI Total			0	0.13	-19.92
OK 400.0 L-DI	Extrapolated Site	NewUpland	0	0.00	-2.83
		OldField	0	0.08	-5.93
OK 400.0 L-DI Total			0	0.08	-8.76
OK 400.7R-DI	Representative Site	NewUpland	0	0.00	-3.81
		OldField	0	0.08	-8.02
OK 400.7R-DI Total			0	0.08	-11.83
OK 401.6 R-DI	Extrapolated Site	NewOldField	0	0.01	-6.58
		NewUpland	0	0.00	-0.16
		OpenField	0	0.03	-15.27
OK 401.6 R-DI Total			0	0.05	-22.00
OK 407.6 R-DI	Extrapolated Site	NewUpland	0	0.00	-0.56
		OldField	0	0.02	-2.47
		UplandForest	0	0.13	-1.30
OK 407.6 R-DI Total			0	0.15	-4.34
OK 414.9 R-DI	Extrapolated Site	NewUpland	0	0.00	-0.96
		OldField	0	0.02	-3.11
OK 414.9 R-DI Total			0	0.02	-4.08
OK 416.4 L-DI	Extrapolated Site	NewUpland	0	0.00	-1.69
		OldField	0	0.02	-5.47

Table C-9. With Project Total Acres, AAHUs, and Net AAHUs at Target Year 51.

Site Name	Site Type	Habitat	WP TY50 Size (ac)	AAHUs	Net AAHUs
OK 416.4 L-DI Total			0	0.02	-7.15
OK 420.8 L-DI	Extrapolated Site	NewOldField	0	0.00	-5.56
		NewUpland	0	0.00	-0.67
		OpenField	0	0.00	-9.39
		UplandForest	0	0.00	-2.94
OK 420.8 L-DI Total			0	0.00	-18.56
OK 421.3R-DI	Reference Impact Site	NewOldField	0	0.01	-1.34
		NewUpland	0	0.00	-0.22
		OpenField	0	0.02	-2.68
OK 421.3R-DI Total			0	0.02	-4.24
OK 422.9L-DI	Reference Impact Site	NewOldField	0	0.00	-0.61
		NewUpland	0	0.00	-0.12
		OpenField	0	0.00	-0.98
OK 422.9L-DI Total			0	0.01	-1.71
OK 434.3R-DI	Reference Impact Site	NewUpland	0	0.00	-0.52
		OldField	0	0.02	-1.97
OK 434.3R-DI Total			0	0.02	-2.49
OK 436.1L-DI	Reference Impact Site	NewOldField	0	0.01	-1.21
		NewUpland	0	0.00	-0.23
		OpenField	0	0.01	-1.58
OK 436.1L-DI Total			0	0.01	-3.02
OK 441.1L-DI	Reference Impact Site	NewOldField	0	0.01	-2.01
		NewUpland	0	0.00	-0.21
		OpenField	0	0.03	-4.68
OK 441.1L-DI Total			0	0.05	-6.90
OK 443.7 L-DI	Extrapolated Site	NewOldField	0	0.01	-1.44
		NewUpland	0	0.00	-0.44
		OpenField	0	0.03	-3.32
OK 443.7 L-DI Total			0	0.05	-5.20
OK 444.6 L-DI	Extrapolated Site	NewUpland	0	0.00	-1.81
		OldField	0	0.02	-5.86
OK 444.6 L-DI Total			0	0.02	-7.67
OK 444.6 R-DI	Extrapolated Site	UplandForest	0	0.13	-8.45
OK 444.6 R-DI Total			0	0.13	-8.45
OK PR L-DI	Extrapolated Site	NewOldField	0	0.01	-0.84
		NewUpland	0	0.00	-0.40
		OpenField	0	0.01	-1.09
OK PR L-DI Total			0	0.01	-2.33
OK-SBC 10.0 R-DI	Extrapolated Site	NewUpland	0	0.01	-0.29

Table C-9. With Project Total Acres, AAHUs, and Net AAHUs at Target Year 51.					
Site Name	**Site Type**	**Habitat**	**WP TY50 Size (ac)**	**AAHUs**	**Net AAHUs**
		OldField	0	0.00	-0.47
		UplandForest	0	0.00	-4.70
OK-SBC 10.0 R-DI Total			0	0.01	-5.45
OK-SBC 8.7 L-DI	Extrapolated Site	Bottomland Forest	0	0.02	-0.96
		NewUpland	0	0.00	-0.56
		OldField	0	0.02	-2.47
OK-SBC 8.7 L-DI Total			0	0.04	-4.00
OK-SBC 9.7 R-DI	Extrapolated Site	Bottomland Forest	0	0.02	-2.43
		UplandForest	0	0.00	-1.47
OK-SBC 9.7 R-DI Total			0	0.02	-3.89
Grand Total			0	1.89	-305.57
Source: ERDC-EL, 2004b					

C.5.14 Mitigation

As part of mitigation the MEET selected dredge disposal sites based upon criteria for avoidance and minimization. Wherever possible, potential dredged material disposal sites were not located where they would impact mature upland forest, bottomland hardwoods, or wetlands, and relocating the sites was logistically feasible. Where sites could not be relocated outside these three habitat types, the design of the pit was configured to reduce impacts as much as possible. Priority was given to sites on USACE owned land. If suitable USACE land was not available, the team looked for private agricultural lands and possible in-water disposal locations where there was the potential for beneficial use of the dredged material. This ultimately reduced the acreage of land needed for mitigation.

Ten sites in Oklahoma were chosen as potential mitigation sites. The MEET team evaluated these sites to determine the amount and type of habitat that could be created to mitigate for habitat lost during dredge disposal on terrestrial sites. Many of the potential mitigation sites occurred on agricultural land. Incremental costs analyses were conducted using the procedures identified in the Corps procedures manual for conducting cost effectiveness and incremental cost analyses (IWR Report #95-R-1, Corps, May 1995). The detailed incremental cost analyses report is located in the Feasibility Report for the Arkansas River Navigation Study.

Two sites were ultimately selected that both satisfied all members of the MEET team and fulfilled the acreage and habitat quality requirement needed to mitigate for the potential habitat loss. These sites were adjacent to ODWC currently managed lands, and allowed ODWC to easily maintain and operate the mitigation sites using funds from the USACE. Figure C.5-2 shows a map of the mitigation sites selected.

C.5.14.1. Baseline Assumptions for Mitigation

The assumptions for mitigation were as follows:

- All mitigation sites will be continually disturbed and will have no fish and wildlife value.
- All mitigation sites begin as agricultural cropland (AGCROP).
- Without project – all mitigation sites remain the same cover type & quality (HSI=0) over time.
- It was agreed among the agencies paying for and managing the mitigation land that the sites would be flooded and maintained to facilitate development of marsh and bottomland forest habitat. Between the time the sites are flooded with water and the time that BLHFOREST has developed, the sites were considered "NEWMARSH." ERDC suggested using the Marsh Wren HSI model published by the USFWS with the modifications of adding the landscape parameters to capture the NEWMARSH creation.
- BLHFOREST can only be replaced with NEWBLHFOREST.
- UPFOREST can only be replaced with NEWBLHFOREST.
- OLDFIELD and OPENFIELD can be replaced with NEWBLHFOREST and/or NEWMARSH.

Table C-10 shows the total acres and AAHUs of terrestrial habitat that could potentially be lost during 50 years of dredge disposal.

Table C-10 Acres and AAHUs of each habitat type potentially lost via dredge disposal over the entire 50 years of the project.

BLHFOREST		UPFOREST		OLDFIELD		OPENFIELD	
Acres Lost	AAHUs Lost	Acres Lost	AAHUs Lost	Acres Lost	AAHUs Lost	Acres Lost	AAHUs Lost
-15	**-7.3**	**-287**	**-76.4**	**-220**	**-123.8**	**-170**	**-71.0**

Source: ERDC-EL, 2004b

The mitigation sites were run through HEP, which resulted in 130 acres of newly created bottomland forest and 248 acres of newly created marsh (Table C-11).

Table C-11 Acres and AAHUs gained by habitat type at two mitigation sites over the entire 50 years of the project.

	BLHFOREST		UPFOREST		OLDFIELD		OPENFIELD		MARSH	
Mitigation Site	Acres Gained	Net AAHUs Gained	Acres Gained	AAHUs Gained	Acres Gained	AAHUs Gained	Acres Gained	AAHUs Gained	Acres Gained	AAHUs Gained
OK408.9L-M	**69**	**48.3**	0	0.0	0	0.0	0	0.0	**91**	**66.6**
OK405.0L-M	**61**	**42.7**	0	0.0	0	0.0	0	0.0	**157**	**131.3**

Totals	**130**	**91.0**	0	0.0	0	0.0	0	0.0	**248**	**197.9**
Source: ERDC-EL, 2004b										

C.5.15 Conclusions

It was determined that though the HEP analysis 302 acres of forested habitat and 390 acres of grassland habitat would be lost with the use of all potential dredge disposal sites over the 50 year project life. A total of 130 acres of higher quality bottomland forest habitat and 248 acres of higher quality marsh habitat would mitigate for these lost acres through wetland creation along portions of the MKARNS.

The "Net HSI Gain" column in Table C-12 is the level of quality that the mitigation will be designed to meet. The new bottomland forest and marsh habitat created would mitigate for the impacts from disposing dredge material on the terrestrial sites because the quality of the habitat created through mitigation (HSI = 0.70-0.75) is much higher than that lost through dredge disposal (0.28-0.50), and therefore, far fewer acres of new habitat is required to replace it.

The actual acreages needed to fully mitigate for the forest and grassland habitat lost is 120 acres of bottomland forest and 258 acres of marsh (0.7 HSI * 120 acres = 84 AAHUs of bottomland forest; 0.75 HSI * 248 acres = 194 AAHUs). Approximately 10 surplus acres of NEWBLHFOR created and a shortage of 10 acres of NEWMARSH would be created, resulting in no total surplus or shortage of acres.

Table C-12 Summary of acres, AAHUs, and Annual HSI lost on dredge disposal sites and gained on mitigation sites.

Mitigation Sites Selected: OK408.9L-M, OK405.0 L-M

Cover Type Mitigated For	Sum of Acres Lost	Sum of AAHUs Lost	Average Annual HSI of Acres Lost	Total Acres of Proposed Mitigation Sites Combined	Net Gain in AAHUs from Mitigation Plans	Net HSI Gain	# Acres Needed to Fully Mitigate	Surplus or Shortage of Acres	Mitigation Ratio
FOREST (BLHFOREST, UPFOREST)	**-302**	**-83.7**	**0.28**	**130 (NEWBLHFOR)**	**91.0**	**0.70**	**120**	**10**	**0.4:1**
GRASSLAND (OLDFIELD, OPENFIELD)	**-390**	**-194.8**	**0.50**	**248 (NEWMARSH)**	**187.0**	**0.75**	**258**	**-10**	**0.7:1**
							Total Surplus or Shortage of Acres:	**0**	

Source: ERDC-EL, 2004b

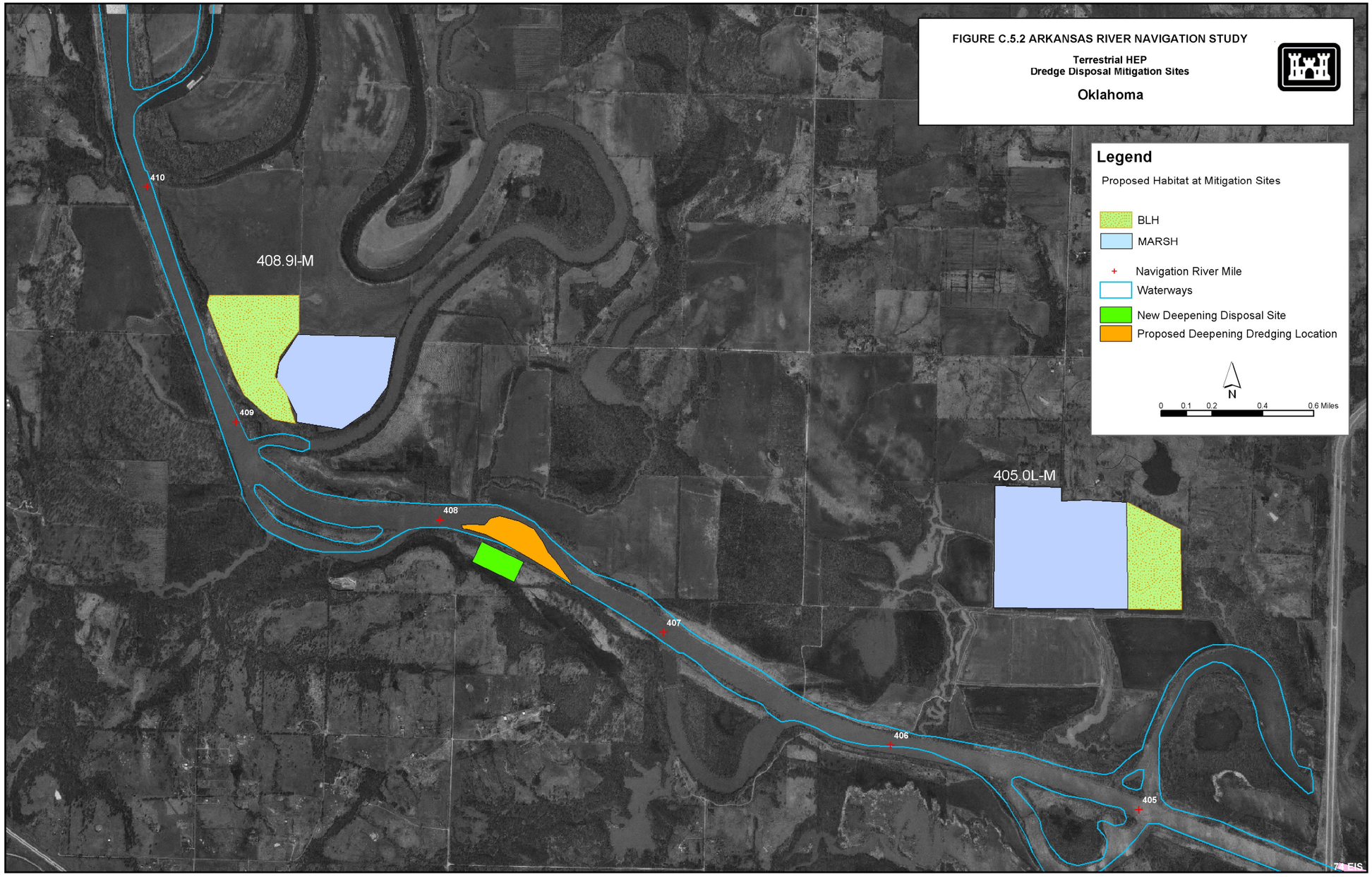
FIGURE C.5.2 ARKANSAS RIVER NAVIGATION STUDY
Terrestrial HEP
Dredge Disposal Mitigation Sites
Oklahoma
Legend
Proposed Habitat at Mitigation Sites
BLH
MARSH
Navigation River Mile
Waterways
New Deepening Disposal Site
Proposed Deepening Dredging Location
N
0 0.1 0.2 0.4 0.6 Miles
408.9I-M
405.0L-M
410
409
408
407
406
405

C.5.16 References

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C.5.17 Acronyms

AAHU	Average Annual Habitat Units
AGFC	Arkansas Game and Fish Commission
cm	centimeters
CT-HSI	Cover Type HSI
dbh	diameter at breast height
EIS	Environmental Impact Study
ERDC-EL	Engineer Research and Development Center – Environmental Laboratory
GIS	Geographic Information Systems
HEP	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
HU	Habitat Units
m	meters
MEET	Multiagency Ecosystem Evaluation Team
MKARNS	McClellan-Kerr Arkansas River Navigation System
ODWC	Oklahoma Department of Wildlife Conservation
RA	Relative Acres
RIS	Reference Impact Sites
RSS	Reference Standard Sites
SI	Suitability Index
TY	Target Year
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service