AESO/FA

April 27, 2000

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U.S. Army Corps of Engineers
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Dear Mr. Koplin:

This report presents our evaluation and recommendations for the Tres Rios Environmental Restoration Feasibility Study. It is provided pursuant to the Fish and Wildlife Coordination Act (FWCA) (48 stat. 401, as amended; 16 U.S.C. 661 et seq.) and constitutes the U.S. Fish and Wildlife Service (Service) report under Section 2(b) of the FWCA. This report is based on project meetings, field investigations, literature research, file reviews, coordination with the Arizona Game and Fish Department (AGFD), and information provided by the U.S. Army Corps of Engineers (Corps), the Tres Rios River Management Plan (TRRMP) Steering Committee, and various consultants and stakeholders. Literature cited is not a complete bibliography of all literature available on the proposed project, Gila, Salt, and Agua Fria rivers, nor biological resources of the Tres Rios study area.

GENERAL PROJECT DESCRIPTION

Authority and purpose

Under section 6 of the Flood Control Act of 1938, section 321 of the Water Resources Development Act (WRDA) of 1992, and section 321(b)(2) of the WRDA of 1996, the Secretary of the Army is authorized to conduct preliminary examinations and surveys of the Gila River and its tributaries, participate in the study of a water resources project in the vicinity of Phoenix, Arizona, for the purpose of providing flood control and improving water quality, and participate in an ecosystem restoration project in the area identified as the Tres Rios study area. In April of 1997, the Los Angeles District of the Corps completed the reconnaissance phase of their General Investigation Study and concluded there was a Federal interest in proceeding with a feasibility study to be cost-shared with the City of Phoenix, the local sponsor.

Ecosystem restoration is the primary purpose of the proposed project and alternatives are being developed to provide for improving and increasing fish and wildlife habitat values and diversity for threatened and endangered species with potential incidental benefits associated with flood damage reduction, recreation, and water quality and supply (Corps 1999a). The proposed project offers an opportunity to maintain and restore riparian and wetland biotic communities in the Phoenix metropolitan area. Riparian and wetland communities would be sustained by water discharged from local wastewater treatment plants. Study efforts are being conducted in coordination with the City of Phoenix, the TRRMP Steering Committee, and the public.

Study area

The Tres Rios study area is located approximately nine miles west of downtown Phoenix, Maricopa County, Arizona. The general region is characterized by a broad alluvial valley surrounded by steep mountains including the Sierra Estrellas, the South Mountains, and Buckeye Hills to the south; the White Tanks to the west; and the Wickenberg, Hieroglyphic, and New River Mountains to the north; with major watercourses including the Gila, Salt, and Agua Fria rivers. The upstream boundary of the Tres Rios study area is 87th Avenue. From here the study area extends west approximately seven miles through the confluence of the Gila and Agua Fria rivers ending at Bullard Avenue. The study area is about nine miles long, one mile wide, and encompasses approximately 5,600 acres. For maps of the study area, we refer the reader to Figures 2.1 and 2.2 of the Draft feasibility report and Figures 1.4-1 and 1.4-2 of the Draft environmental impact statement (EIS) (Corps 1999a).

Existing land uses in the study area consist of rural residential, agricultural and agribusiness, light industry, wastewater treatment facilities, public and semipublic areas, and vacant land. The study area includes lands under jurisdiction of several local governments and municipalities including: Maricopa County, City of Phoenix, City of Avondale, City of Goodyear, and Gila River Indian Community (GRIC). Two wastewater treatment plants (WWTPs) occur within the study area including the City of Tolleson WWTP, and the 91st Avenue WWTP operated by the Subregional Operating Group (SROG) of the cities of Glendale, Phoenix, Scottsdale, and Tempe. These WWTPs have capacities of 17.4 million gallons per day (mgd) and 153 mgd, respectively. Within the study area, an existing residential development, Holly Acres, is located within the 100-year floodplain as recognized by the Federal Emergency Management Act (FEMA). There is considerable interest from Holly Acres residents to improve flood protection.

North of the project area and outside of the floodplain, warehouse and large distribution concerns have developed. The land closer to the river is mostly undeveloped. Dairies and agricultural fields are the predominant land uses in these areas. The GRIC is mostly located in the southwest portion of the study area. The GRIC boundary, established by Federal Treaty, generally runs through the centerline of the Gila River, although the river centerline and bank locations have changed since the Treaty was signed. Reservation land also exists on the north shore of the river. Phoenix International Raceway is located in the study area just south the Gila River along Indian

Springs Road. For a more detailed study area description, as well as maps and figures, we refer the reader to Corps (1999a).

Problems and opportunities

Local problems and opportunities have been identified and described by the Corps (1999a). Problems include ecosystem degradation, flooding hazards, poor water quality, water quantity problems, vector control concerns, public health issues, and limited recreation. Respective opportunities include ecosystem restoration, flood protection, water quality improvement, water management improvement, vector control, health hazard reduction, and increased recreation.

Reasons for the degradation of riparian ecosystems within the study area include curtailment of natural flood events, unauthorized use, reduced baseflows, diurnal variations in effluent water supply, and invasion of exotic plant species. The opportunity exists to restore riparian ecosystems through river management and restoration of hydrology.

Significant flooding problems identified by the Corps include damages to agricultural and residential areas, destruction of habitat, and erosion of landfills resulting in release of pollutants. The opportunity exists to create additional flood capacity as well as protect habitat within the channel.

Water quality monitoring data in the study area indicates the presence of volatile organic compounds, heavy metals, high nutrient levels, and high total dissolved solids. Ten different stressors on area water quality have been identified, including: floodflows, regulated stormwater runoff, unregulated stormwater runoff, agricultural stormwater runoff, agricultural irrigation drainage, runoff from concentrated animal feeding operations, wastewater treatment plan discharges, landfill leachate, groundwater inflow, and sand and gravel releases. The opportunity exists to improve water quality through natural filtration in constructed wetlands.

Water quantity issues include insufficient flow in the Salt River to support historic riparian vegetation communities, periods of zero discharge from the 91st Avenue WWTP, uncertain discharge from the 91st Avenue and Tolleson WWTPs, unreliability of other water sources such as agricultural return and groundwater to maintain the vegetative community. The opportunity exists to provide water to restore a large area of riparian habitat through water management and potential structural improvements in the Tres Rios area while meeting existing and future water demands.

Vector control concerns in the study area include mosquitos (*Culex* sp.) which are known vectors for encephalitis, dog-heartworm, yellow fever, and malaria; and other mosquito species which are not typically a health threat but are considered a public nuisance. The opportunity exists to reduce existing mosquito breeding areas located within the river channel while providing high quality aquatic habitat. Mosquito control could be conducted through ecosystem management, biological control, or application of pesticides.

Public health concerns in the study area include unsafe levels of organochlorine pesticides and toxaphene in fish from Painted Rock and Buckeye Canals (King *et al.* 1997), and illegal trash dumping. The opportunity exists to reduce the severity of human health hazards through active management, increased public awareness, and law enforcement.

Recreational activities within the study area include the illegal use of firearms, swimming in effluent-dominated waters, and fishing. The opportunity exists to provide high quality recreation in the form of environmental education, hiking, biking, picnicking, bird-watching, and horse-back riding. Increased public awareness and law enforcement should encourage safe recreational activities that would not jeopardize the success of the proposed environmental restoration.

Objectives

Specific planning objectives outlined in the Draft feasibility report (Corps 1999a) were identified through coordination with local and regional agencies, the public involvement process, site assessments, review of prior studies and reports, and review of existing water projects. They are as follows:

> 1) Provide sustainable and diverse native riparian habitat in and around the Tres Rios study area.
>
> 2) Reduce flood damages to the Holly Acres community, surrounding development, and agricultural areas.
>
> 3) Increase environmental education and recreation in the study area.

According to the Draft EIS (Corps 1999a) specific planning objectives include the following:

> 1) Restore and create conditions for sustainable riparian habitat in and around the Tres Rios area. The project design would incorporate a channel configuration that would provide a functional floodplain to mimic natural processes found in other self-sustaining riparian forests in Arizona.
>
> 2) Create a complex and diverse riparian system similar to the natural riparian habitat typical of this area. The restored areas should incorporate a diverse mix of riparian habitat types, including honey mesquite (*Prosopsis glandulosa*), cottonwood (*Populus* sp.) -willow (*Salix* sp.), wetland marsh, and open water.
>
> 3) Reduce flood damages to the Holly Acres community, surrounding development, and agricultural areas.
>
> 4) Increase environmental education and passive recreation opportunities incidental to the restoration effort.

In addition, the TRRMP Steering Committee (1998) described a consensus concept synthesized of four principal objectives: flood control, wildlife habitat, water quality, and water supply. The consensus concept plan contained the following key elements and principles:

1) A flood control levee should be constructed on the north side of the river to protect the areas behind the levee from the 100-year flood.

2) In conjunction with the flood control levee, the plan should include an active channel corridor in the river bottom excavated and kept clear of vegetation to funnel high velocity flood flows.

3) In order to foster the establishment of riparian vegetation in the TRRMP area, the flood control component of the plan should define an active channel sized to be stable under the present hydrology and sediment regime and a flood prone area to convey the 100-year flood.

4) The existing and future wildlife habitat in the TRRMP area should be maintained and enhanced where possible. Commitments to provide an adequate water supply for at least 50 years for this purpose should be negotiated

5) Wetlands should be constructed to buffer diurnal flowrate fluctuations from the regional wastewater plant and to treat such inputs the river as storm runoff, agricultural runoff, and other currently uncontrolled sources of pollutants.

6) Terrace areas of the riverbank within the project area should be managed for mesquite (*Prosopsis* sp.) reestablishment.

7) A process should be developed with landowners and appropriate stakeholders to establish and implement an integrated river management plan structure for wildlife habitat within the study area.

BIOLOGICAL RESOURCES

Historical

The earliest written records describing the Gila River in Arizona are from European explorers and missionaries. The following brief account is based on information contained in Tellman *et al.* (1997) and Ohmart (1982a,b).

In the 1500's a member of Spanish explorer Francisco Vasquez de Coronado’s party described the Gila River as a “deep and reedy stream.” In 1699, while visiting the Pima villages (near present day Sacaton), Father Eusebio Kino observed huge groves of cottonwood trees along the river and noted that "...all its inhabitants are fisherman, and many have nets and other tackle with which they fish all year, sustaining themselves with the abundant fish..." In 1744, Father Jacobo Sedelmayr wrote:

> Leaving behind these Pima settlements and trekking down stream we came upon broad savannas of reed grass and clumps of willow and a beautiful spring with good land for pasture... Passing on down river another five or six leagues and keeping it always in view with its willows and cottonwoods, we came to its confluence with the Rio de la Asuncion (*Salt*). ...A very pleasant country surrounds this fork of the rivers. Here the eye is regaled with creeks, marshes, fields of reed grass and abundant growth of alders (sic, *willows*) and cottonwood.

In 1825, James Ohio Pattie, while trapping beaver (*Castor canadensis*), described the Gila below the Salt as "about 200 yards wide, with heavily timbered bottoms." On the upper Gila, Pattie sighted grizzly bear (*Ursus arctos*) and mountain lion (*Felis concolor*), and at the confluence with the San Francisco River he noted waterfowl, turkey (*Mealegris gallopavo*), whitetail deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), Merriam elk (*Cervus merriami*), and black bear (*Ursus americanus*). In 1849, John E. Durivage (reporter for New Orleans newspaper) noted that quail and doves were the most abundant wildlife near the Pima villages. In 1854, an explorer described the Gila upstream of the confluence with the Salt as a flowing river with "steep banks 15 feet high and completely overhung with willows and cottonwoods." In March of 1864, near present day Avondale, J.P. Allyn noted a margin of willows and cottonwoods along the river. In March of 1916, along the Gila River near Sacaton, M.F. Gilman observed a large flock of sandhill crane (*Grus canadensis*), as well as pintail (*Anas acuta*) and green-winged teal (*A. crecca*).

In summary, the vegetation along the Gila River and the study area, prior to the 20th century, consisted of impressive cottonwood-willow gallery forests near the channel and large mesquite bosques on the floodplain terraces. Native wildlife species included an abundance of waterfowl, songbirds, big game, small mammals, and reptiles and amphibians. Additionally the aquatic environment was dominated by native fish species such as razorback sucker *(Xyrauchen texanus*), Colorado pikeminnnow (*Ptychocheilus lucius*), roundtail chub (*Gila robusta*), Sonoran sucker (*Catostomus insignus*), desert sucker (*Pantosteus clarki*), Gila topminnow *(Poeciliopsis occidentalis occidentalis*), and longfin dace (*Agosia chrysogaster*) (Minckley 1973).

Human activity has since resulted in dramatic changes to the Gila River. The Gila River has experienced a multitude of anthropogenic impacts resulting in dramatic changes in hydrologic regime and biological resources. Mining in the late 1800's resulted in the cutting of miles of mesquite thickets for charcoal. During the same time period ranching and farming contributed to ecosystem degradation through the stocking of thousands of heads of cattle and construction of canals diverting the entire flow of the river in some areas. Coupled with these forces were the introductions of various non-native plants and animals. The introduced salt cedar (*Tamarix* sp.) is believed to have increased fire in riparian areas, resulting in significant losses of cottonwood which are not fire tolerant. However, perhaps the most profound human impacts have been the dams and diversions constructed for irrigation, water storage, and flood control. Dams along the Gila include: Coolidge Dam built 65 miles upstream of Florence in 1929, Ashurst-Hayden Dam built at Florence in 1928, Gillespie Dam built just north of Gila Bend in 1921, and Painted Rock Dam built along the lower Gila in 1959. These projects caused dramatic modifications to the aquatic and riparian environments resulting in significant declines and shifts in fish and wildlife communities associated with the Gila River.

Existing

Biotic communities, as described by Brown (1994), within the study area include Sonoran desertscrub in upland areas; and Sonoran riparian deciduous woodland, Sonoran riparian scrubland, Sonoran interior strand, and Sonoran interior marshland along the river channel, floodplain, and terraces. The existing riparian and wetland vegetation, and fish and wildlife communities within the study area have been recently described by the Bureau of Reclamation (1993), Ch2m Hill *et al*. (1997), and the TRRMP Habitat Committee (1998).

Vegetation: Dominant plant species in woodland areas include Fremont cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), salt cedar, velvet mesquite (*Prosopsis velutina*), and honey mesquite. Riparian woodlands occur in a relatively patchy fashion within the study area. A good example of this vegetation association is immediately south and adjacent to the 91st Avenue WTTP.

Typical plant species in scrubland areas include seepwillow (*Baccharis salicifolia*), desert broom (*B. sarothroides*), arrow-weed (*Pluchea sericea*), lycium (*Lycium* sp.), catclaw acacia *(Acacia greggii*), and desert hackberry (*Celtis pallida*). Riparian scrublands are scattered throughout the study area along the river channel. Other patches of scrubland within the study area include dense stands of salt cedar interspersed with mesquite and quailbush *(Atriplex lentiformis*), such as that which occurs downstream of 115th Avenue along the east bank.

Typical plant species in interior strand areas include seepwillow, tree tobacco (*Nicotiana glauca*), and nightshade (*Solanum* sp.). Riparian interior strand in the study area occurs within portions of the river channel subject to the heaviest scouring during flood events.

Dominant emergent vegetation species in marshland areas include cattail (*Typha* sp.) and bulrush (*Scirpus* sp.). This community is relatively scarce within the study area, although small pockets of marshland occur downstream of 107th Avenue, 115th Avenue, and El Mirage Road. Similar to marshlands are the constructed wetlands located at the 91st Avenue WTTP. Species planted at the wetlands include cattail, bulrush, canary grass, and knotweed.

Ch2m Hill *et al*. (1997) utilized methods developed by Anderson and Ohmart (1984) to further classify the riparian and wetland vegetation communities within the study area. The system is a structural classification based on percentage of total foliage density of three height categories.

The total area of each "habitat type" within the study area was broken into categories based on dominant canopy species. These include cottonwood-willow (9%), salt cedar (24%), honey mesquite (2.7%), quailbush/cobble (27.4%), constructed wetlands (0.4%), desert/desert wash (2.9%), open water/marsh (8%), and agriculture /residential (25.3%). For a map depicting locations of these habitat types, we refer the reader to Figure 3.5-1 of the Draft EIS (Corps 1999a).

<u>Wildlife</u>: Riparian and wetland vegetation communities within Arizona typically support a diversity and abundance of wildlife species. Mammalian species utilizing the various vegetation communities within the Tres Rios study area may include mule deer, javelina (*Tayasu tajacu*), bobcat *(Felis rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), beaver, muskrat *(Ondatra zibethicus*), raccoon (*Procyon lotor*), ringtail (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), deer mice (*Peromyscus* sp.), pocket mice (*Perognathus* sp.), white-throated woodrat (*Neotoma albigula*), kangaroo rats (*Dipodomys* sp.), squirrels (*Spermophilus* sp.), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), big brown bat (*Eptesicus fuscus*), and myotis (*Myotis* sp.).

Reptile and amphibian species may include Sonoran mud turtle (*Kinosternon sonoriense*), banded gecko (*Coleonyx variegatus*), regal-horned lizard (*Phrynosoma solare*), tree lizard (*Urosaurus ornatus*), western whiptail (*Cnemidopherus tigris*), chuckwalla (*Sauromalus obesus*), gopher snake (*Pituophis melonaleucus*), common kingsnake (*Lampropeltis getulus*), garter snakes (*Thamnophis* sp.), rattlesnakes (*Crotalus* sp.), Couch's spadefoot toad (*Scaphiopus couchii*), great plains toad (*Bufo cognatus*), lowland leopard frog (*Rana yavapaiensis*), and the non-native spiny softshell turtle (*Trionyx spiniferus*) and bullfrog (*Rana catesbiana*).

The avifauna represents the most diverse group of vertebrates in the study area. Ch2m Hill (1997) identified 122 bird species and Maricopa Audubon Society and Multi-City Subregional Operating Group (1998) list over 150 bird species in the study area. Some of the more rare noteworthy species include yellow-billed cuckoo (*Coccyzus minor*), American bittern (*Botaurus lentiginosus*), white-faced ibis *(Plegadis chihi*), hooded mersanger (*Lophodytes cucullatus*), Baird's sandpiper (*Calidris bairdii*), short-billed dowitcher (*Limnodromus griseus*), black tern (*Chlidonias niger*), American redstart (*Setophaga ruticilla*), pine siskin (*Carduelis pinus*), and American goldfinch (*Carduelis tristis*). A few common birds include great blue heron (*Ardea herodias*), pied-billed grebe (*Podilymbus podiceps*), turkey vulture (*Cathartes aura*), cinnamon teal (*Anas cyanoptera*), ruddy duck (*Oxyura jamaicensis*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Gambel's quail (*Callipepla gambelii*), killdeer (*Charadrius vociferus*), black-necked stilt (*Himantopus mexicanus*), common snipe (*Gallinago gallinago*), mourning dove (*Zenaida macroura*), greater roadrunner *(Geococcyx californianus*), Gila woodpecker *(Melanerpes uropygialis*), black phoebe (*Sayornis nigricans*), verdin (*Auriparus flaviceps*), cactus wren (*Campylorhynchus brunneicapillus*), northern mockingbird (*Mimus polyglottos*), yellow-rumped warbler (*Dendroica coronata*), northern cardinal (*Cardinalis cardinalis*), red-winged blackbird (*Agelaius phoeniceus*), great-tailed grackle (*Quiscalus mexicanus*), brown-headed cowbird (*Molothrus ater*), house finch (*Carpodacus mexicanus*), song sparrow (*Melospiza melodia*), and the non-native rock dove (*Columba livia*), and European starling (*Sturnus vulgaris*).

Fish: The aquatic ecosystem of the Gila River is now dominated by non-native fish species largely introduced through active stocking programs or small scale bait bucket emptying. Several species of non-native fishes are likely found in the study area including common carp *(Cyprinus carpio*), bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), goldfish *(Carassius auratus*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), red shiner (*Notropsis lutrensis*), threadfin shad (*Dorosoma petenense*), bullhead (*Ameiurus* sp.), Tilapia (*Tilapia* sp.), and mosquitofish (*Gambusia affinis*). It is likely that Sonoran sucker, desert sucker, longfin dace, and perhaps roundtail chub still occur in the study area as these native species have shown that they are at least minimally capable of maintaining their populations despite the large numbers of introduced fishes that now dominate the waters of Arizona. All other native fish species are believed to be extirpated.

The aquatic ecosystem in the study area is also home to a variety of invertebrate organisms. These include mayflies (Ephemeroptera), aquatic beetles (Coleoptera), damsel and dragonflies (Odonata), blackflies (Diptera), and snails (Gastropoda). Non-native crayfish, most likely *Oronectes virilis* and/or *Procambrus clarki*, are also common in the Gila River (Inman *et al.* 1998).

THREATENED AND ENDANGERED SPECIES

Species listed as threatened or endangered under the Endangered Species Act (ESA) of 1973, as amended, that are known to occur, or have the potential to occur, in the Tres Rios study area include the Yuma clapper rail (*Rallus longirostris yumanensis*), southwestern willow flycatcher (*Empidonax traillii extimus*), cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), bald eagle (*Haliaeetus leucocephalus*), and lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*).

The American peregrine falcon (*Falco peregrinus anatum*) may also occur within the study area. However, on August 25, 1999, the Service removed the American peregrine falcon from the list of endangered and threatened wildlife (Service 1999a). The delisting of the species removes all protections provided under the ESA, although protection is still provided by the Migratory Bird Treaty Act. The ESA does require monitoring for at least five years after delisting. If during the monitoring period the species is not maintaining recovered status, it could be relisted under the ESA. The Service is currently developing a monitoring plan for the American peregrine falcon.

Yuma clapper rail

The Yuma clapper rail is a medium sized marsh bird with a long, down-curved beak that is listed as endangered without critical habitat. The species' range extends from the Colorado River Delta in Mexico north to Laughlin Bay, Nevada. Large breeding population centers occur along the Colorado River. Smaller populations also occur along the Gila and Salt Rivers east to Picacho Reservoir in central Arizona. Habitat requirements of the Yuma clapper rail include freshwater or brackish stream sides and marshlands associated with heavy riparian and wetland vegetation such as cattail and bulrush (Grinnell and Miller 1944). Openings within the wetland, especially channels with flowing water, are also important. Habitat edges between marshes and terrestrial vegetation are important but the main factors determining habitat use are the annual range of water depth and the existence of residual mats of marsh vegetation (Eddleman 1989). The most productive clapper rail areas consist of a mosaic of uneven-aged marsh vegetation interspersed with open water of variable depths (Conway *et al* 1993).

Nesting behavior begins in February with nesting commencing in mid-March and running through early July. Nests are primarily built in mature cattail/bulrush stands which provide nest building materials and cover. Most hatching occurs during the first week of June and it is thought that young rails fledge within 63-70 days. Young clapper rails experience high mortality from predation. The preferred prey of the Yuma clapper rail is crayfish, predominantly the non-native *Procambarus clarki* (Todd 1986) which is abundant along the Colorado River. The rails will also take isopods, aquatic and terrestrial beetles, damselfly and dragonfly nymphs, earwigs, grasshoppers, spiders, freshwater shrimp, freshwater clams, leeches, plant seeds, and small fish.

In recent years, Yuma clapper rails have consistently been detected in the study area. Based on information contained in our survey files, during the following years the following number of rails were detected: 1999, 3 rails; 1998, 3 rails; 1997, 4-5 rails; 1996, 7 rails; 1995, 2 rails. Many of the rails detected in the study area have consistently been located near the river crossing of 115th Avenue, although some have been found downstream near El Mirage and Dysart Roads. Most rails were found within patches of cattails, although a few were found near inundated salt cedar. On occasion, rails have also been detected downstream, out of the study area near the confluence of the Hassayampa and Gila Rivers and near the Highway 85 river crossing.

Southwestern willow flycatcher

The southwestern willow flycatcher is a small passerine bird listed as endangered with critical habitat designated along portions of the San Pedro River, Verde River, Wet Beaver Creek, West Clear Creek, Colorado River, and the Little Colorado River. The sub-species is a neotropical migrant that breeds in the southwestern United States and winters in Mexico, Central America, and northern South America (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). McCarthey *et al.* (1998) reported the greatest concentrations of southwestern willow flycatchers in Arizona in 1997 near the confluence of the Gila and San Pedro rivers; at the inflows of Roosevelt Lake; between Fort Thomas and Solomon on the middle Gila River; Topock Marsh on the Lower Colorado River; Verde River at Camp Verde; Alpine/Greer on the San Francisco River/Little Colorado River; and Alamo Lake on the Bill Williams River.

The southwestern willow flycatcher breeds in dense riparian environments. Four basic habitat types have been described for the southwestern willow flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.*1997). The species primarily nests in willow although other plants such as salt cedar are commonly used. Open water, marshes, or saturated soil are typical of flycatcher territories. The southwestern willow flycatcher arrives on breeding grounds in late April and May (Sogge and Tibbitts 1992, Sogge *et al.* 1993, Sogge and Tibbitts 1994, Muiznieks *et al.* 1994, Maynard 1995, Sferra *et al*. 1995, 1997) and nesting begins in late May and early June. Young fledge from late June through mid-August (Willard 1912, Ligon 1961, Brown B.T. 1988a,b, Whitfield 1990, 1994). Brown-headed cowbird parasitism has been implicated in flycatcher population declines or, at a minimum, has resulted in reduced or complete nesting failure (Muiznieks *et al.* 1994, Whitfield 1994, Maynard 1995, Sferra *et al.* 1995, Sogge 1995a,b,c, Whitfield and Strong 1995, Brown B.T. 1988a,b, Whitfield 1990, Hull and Parker 1995). The flycatcher is an insectivore, foraging primarily on true flies; ants, bees, and wasps (Hymenoptera); and true bugs (Hemiptera) (Drost *et al.*1998), although other insect prey are probably taken.

Although the species is not known to nest in the study area, migrant flycatchers have been detected during surveys in 1999 (Jones and Stokes 1999b) and 1996 (Sferra *et al*. 1997). Vegetation communities structurally suitable for nesting and foraging within the study area include monotypic stands of dense salt cedar and mixed stands of cottonwood-willow/salt cedar.

Cactus ferruginous pygmy-owl

The cactus ferruginous pygmy-owl is a small bird whose Arizona population was listed as endangered on March 10, 1997, and was effective on April 9, 1997. The sub-species is known to occur from lowland central Arizona south through western Mexico to the States of Colima and Michoacan, and from southern Texas south through the Mexican States of Tamaulipas and Nuevo Leon. The 1998-99 survey season resulted in 41 adult pygmy-owl documented in Arizona (S. Richardson, AGFD, pers. comm., 1999). The Service designated critical habitat (64 FR 37419) July 12, 1999, on approximately 296,115 ha (731,712 ac) of riverine riparian and upland habitat in Pima, Cochise, Pinal, and Maricopa counties in Arizona, effective August 11, 1999. Six adult pygmy-owls were documented in southern Pinal County, 11 adults in the northwest Tucson area, 19 adults in riparian and xeroriparian woodlands in semi-desert grasslands and upland Sonoran desertscrub in southern Arizona, and five adults at Organ Pipe Cactus National Monument. Nesting was confirmed at 11 of these sites.

The pygmy-owl is crepuscular/diurnal, with a peak activity period for foraging and other activities at dawn and dusk (Collins and Corman 1995). The species is known to use a variety of habitat types. Within Arizona, they are known to occur in riparian woodlands, mesquite bosques, and Sonoran desertscrub communities. While plant species diversity differs between these communities, there are certain unifying characteristics in each of these occupied habitat types, including the presence of vegetation in dense thickets or woodlands, the presence of trees or cacti large enough to support cavity nesting, and elevations below 1,616 m (4,000 ft). Cottonwood trees, large mesquites, and mature saguaros (*Carnegiea gigantea*) can provide cavities for nesting. Dense mid- and lower-story vegetation provides necessary protection from predators and an abundance of prey.

CFPOs begin nesting activities in late winter to early spring. Breninger (1898) noted that nesting along the Salt and Gila rivers began about the 20th of April. Arizona Game and Fish Department (AGFD) has determined a nesting chronology for Arizona CFPOs. Copulation was observed on March 31, and egg laying was estimated to have taken place from April 6 to April 11, with the onset of incubation estimated to have taken place from April 7 to April 12. Hatching was estimated at May 9. Fledging was confirmed on June 4 (Abbate *et al*. 1996). Dispersal occurred approximately 63 days after the young first left the nest. Dispersal distances ranged from 2.3 km (1.4 mi) to 20.7 km (12.9 mi) and the mean was 10 km (6.2 mi) (S. Richardson, AGFD, pers. comm., 1998). As with other owls and raptors, a high mortality (50 percent or more) of young is typical during the first year of life. Their diet includes birds, lizards, insects, small mammals (Bendire 1888, Sprunt 1955, Earhart and Johnson 1970, Oberholser 1974), and frogs (Proudfoot *et al*. 1994).

Cactus ferruginous pygmy-owls have not been detected in the study area since 1898 when it commonly occurred in the cottonwood forests near the confluence of the Gila and Salt Rivers (Breninger 1898). The Service is unaware of recent detections of cactus ferruginous pygmy-owl in the study area. However, the presence of large cottonwood trees in the study area could potentially provide cavities for nesting.

Bald eagle

The bald eagle is a large bird of prey that was listed as endangered south of the 40th parallel on March 11, 1967 (Service 1967), and was reclassified to threatened status on July 12, 1995 (Service 1995). No critical habitat is designated. The bald eagle was proposed for delisting on July 6, 1999 (Service 1999b), but a final rule has not been published and the species is protected under the ESA. Declines in the number of waterfowl and shorebirds, loss of nesting habitat, and the widespread use of dichloro-diphenyl-trichloroethane (DDT) and other organochlorine compounds in the 1940s resulting in reproductive failure have all contributed to declines in the bald eagle population. Threats persist largely due to the proximity of bald eagle breeding areas to major human population centers and recreation areas and include entanglement in monofilament fish line; overgrazing of riparian vegetation; malicious and accidental harassment such as shooting, off-road vehicle use, watercraft use, and low-level aircraft overflights; alteration of aquatic and riparian systems for water distribution systems; collisions with transmission lines; poisoning; and electrocution.

The bald eagle historically ranged throughout North America except extreme northern Alaska, Canada, and central and southern Mexico. The species occurs in association with aquatic ecosystems such as estuaries, lakes, reservoirs, major riverine systems, and some seacoast areas. All breeding areas in Arizona are located in close proximity to aquatic habitats. Southwestern bald eagles establish breeding territories in December or January and lay eggs in January or February. Young eagles remain in the vicinity of the nest until June (Hunt *et al*. 1992). Arizona also provides habitat for wintering bald eagles, which migrate through the state between October and April each year. The most concentrated population of wintering bald eagles is found at Lake Mary and Mormon Lake, Coconino County (Beatty and Driscoll 1996). Their primary food is fish but also includes waterfowl and carrion.

Ch2m Hill (1997) reports that immature bald eagles were observed in the study area during surveys in early May of 1996. No nesting bald eagles are known to occur in the study area. Reasons for the lack of nesting bald eagles in the study area are difficult to ascertain, although it may be due to a lack of suitable nesting trees, inadequate fish prey base, and/or proximity to human population centers.

PROPOSED ACTION

Several alternative restoration and flood control designs have been evaluated by the Corps and the TRRMP Steering Committee throughout the reconnaissance and feasibility study processes. Several ecosystem restoration and flood control components were developed and combined in different manners to develop alternatives. This FWCA report does not contain a detailed comparison of all project alternatives as we actively participated with the Corps and TRRMP Steering Committee in the selection of the proposed plan. The following description of the proposed action in based on Corps (1999a,b). For a more complete description and comparison of all project alternatives, we refer the reader to those documents.

General components

<u>Cottonwood-willow riparian corridors</u>: These would be restored or created within the channel and primarily located in areas currently dense with salt cedar and/or areas with water quality problems due to stagnation. The corridors would use water from existing flow that would be conveyed by regrading portions of the channel, water discharged from constructed wetlands along the banks and flowing downslope, and dewatering well water that would be discharged within the channel into the corridors. In addition, reshaping of the ground surface could create groundwater conditions conducive to growth. It is anticipated that the succession of cottonwood-willow habitat would have an initial, low vegetation stage consisting of 0-7 years of growth following planting, a medium height stage taking 7-14 years, and a mature stage taking over 21 years to reasonably mature.

<u>Open water/marsh</u>: These areas would be created through excavation and/or by providing minor impoundments to restrict flow within the river thereby creating large ponds. As with the riparian corridors, these areas would primarily be located where salt cedar would be removed. Peripheral and emergent marsh and cottonwood-willow would be planted and allowed to grow along the fringe of the open water. Excavation and lowering the river bottom to approach groundwater and

create areas of permanent open water would be expected to increase the cross-sectional area of the river and provide lower frictional resistance to channel flows, thus alleviating flooding problems.

Salt cedar eradication: Removal of salt cedar to enhance conveyance and provide habitat values by replacing with riparian corridors and/or open water/marsh. Cutting and plowing of the roots would take place along with removal by bull dozers or other physical removal methods. Salt cedar eradication alone would not be considered, unless the area could be modified to prevent salt cedar from regrowing in the same location. Removal of salt cedar is expected to increase the carrying capacity of the river by providing more conveyance volume and removing potential debris and impediments to flow. Replacement of salt cedar with cottonwood-willow and/or open water/marsh is expected to improve flood conveyance by reducing the friction factor compared to the denser salt cedar.

Constructed wetlands: Construction of wetlands to achieve habitat value and to improve water quality of the WWTP discharge would require construction of a pump station and pipeline from the treatment plant to the wetlands site. Thereafter, water would be conveyed through two types of wetlands, in series. Regulating wetlands would remove diurnal variations while simultaneously providing habitat. Removal of diurnal variations is expected to improve the health of the river by providing and improving habitat value. Regular, constructed wetlands provide a more controllable environment by maintaining a uniform water surface elevation. This wetland also provides more uniform and continuous discharge into the river. Discharge from the wetland system may also provide water for the open water/marsh and riparian corridors. In this case, the wetlands include a pipeline outlet for conveying water further downstream, and/or gated outlets for discharge immediately downslope from the overbank. Any excavation required to construct the overbank wetlands that results in benching facilities into the bank would increase the cross-sectional area of the river.

Distribution system for existing dewatering well water: A system of wells currently exists at the treatment plant that offers a water source with which to create additional habitat. The existing well infrastructure is already in place, so this component would only require construction of a collection pump and pipeline conveyance system. Groundwater would be conveyed through the system directly into the river along the north bank or via a conveyance system to the south side of the river between approximately 91st and 83rd Avenues. The well water would augment river water for riparian corridors and/or open water/marsh at appropriate locations. The water also provides “effluent free” water to areas within GRIC-owned land, which is desirable within the community.

Specific plan design

The proposed plan, is identified as Alternative 3.5 and is shown in Figure 5.7 in Corps (1999a). This plan was selected because it most closely meets the planning objectives identified for the study and optimizes National Economic Development and National Environmental Restoration benefits. In addition to the securement of effluent water to sustain the desired biotic communities for a 50 year period, the selected plan includes the following features.

Pump station and wetland facilities: A pump station facility having an approximate capacity of 2,900 gpm would be constructed to convey effluent from the 91st Avenue WTTP to the regulating, or diurnal wetland. The diurnal wetland, approximately 184 acres and averaging 5 feet deep, would be constructed between 91st and 99th Avenue, and would buffer diurnal flow rate fluctuations from the wastewater plant. The linear, overbank wetland, approximately 128 acres and averaging 4-5 feet deep, would receive flow discharged from the diurnal wetland and would be constructed between 99th and 113th Avenues. The basins would be planted with various species of bulrush, cattails, water lilies and other aquatic and terrestrial plants to create a riparian community attractive to wildlife.

Riparian corridors and open water/marsh: Discharge from the wetlands would be conveyed in a 36-inch diameter steel pipe that leads to four riparian corridors west of El Mirage Road, totaling approximately 19 acres. The cottonwood/willow stringers would be riparian corridors consisting of a 20-foot wide, 4-foot deep low flow channel with a 75-foot wide, 3 foot deep bench. They would be planted with predominantly Fremont cottonwood and Goodding willow trees. Water that flows through the riparian area would continue downslope into four open water/marsh areas, totaling approximately 134 acres, between El Mirage Road and the Agua Fria River. The open water/marsh areas along the river's north side would thereby receive water from water continuing through the riparian corridors, natural flow in the river, and local groundwater. Each open water/marsh would consist of a 300 feet to 500 feet wide, 5-foot deep pond. Ponds would be clay lined to prevent loss of water by infiltration. Ponds would be connected in series by riprap lined connecting riffles. Control gates at the pond outlet would be used to control the flow to each pond. A 100-foot wide, 2 foot deep bench would be constructed at the bank of each pond. The bench would be planted with marsh plants while the deeper section of the pond would be left as open water. Nesting islands for waterfowl would be constructed in the center of the ponds. In addition, the channel would be graded to convey surface water to supply two cottonwood-willow corridors between 111th Avenue and El-Mirage Road that total approximately 69 acres.

South side distribution system and open water/marsh: Groundwater from existing dewatering wells within the treatment plant would be pumped in a 5,200 foot-long pipe into an existing impoundment of water just east of 83rd Avenue. This water would then outlet into the main channel into a secondary distribution system of pipes and canals in order to create cottonwood-willow riparian corridors (approximately 16 acres) and 5 open water/marsh areas (approximately 206 acres). The salt cedar that primarily vegetates this area, between 91st and 115th Avenues, would be cleared and replanted as appropriate.

Flood control levee: A flood control levee would be constructed just north of the proposed features along the entire length of reach between the regulating wetland and approximately Dysart Road. The levee would extend as close to the north bank of the river as possible, and would take advantage of any existing protection levees along the bank. The levee height would range from 4 feet to 10 feet high. The river side would have an 8-inch thick riprap armor with 1 vertical on 2 horizontal slopes. Any interior drainage between 91st Avenue and 113th Avenue would be routed directly into the overbank wetland, providing water quality polishing for stormwater discharge.

GRIC land: A variation of the selected plan would remove project features from land owned by the GRIC. This includes the dewatering well water conveyed by a south side distribution system into habitat features and salt cedar eradication. The Corps and TRRMP Steering Committee continue to coordinate with GRIC regarding their participation in the project.

Operation and maintenance

The features of the Tres Rios Project would be subject to damage by recurrent flood flows and periods of inundation, resulting in the need for periodic maintenance to ensure successful flood prevention and habitat restoration. Operation and maintenance would include levee and interior drainage maintenance, pumps and pipeline maintenance, vector control, periodic sediment removal, vegetation planting, recreation plan implementation, and monitoring and adaptive management plan implementation. This is intended to ensure that restoration features are preserved and property is protected at design flow levels. In compliance with authorizing legislation and cost-sharing requirements, non-Federal sponsors must assume responsibility for operation and maintenance of project features during the life of the project.

Levee and interior drainage: The existing levee would be extended upstream and downstream from its present location. Maintenance of the levee is expected to occur annually and would consist of clearing debris from drainage structures and general earthwork activity.

Pumps and pipelines: Restoration features would require a supply of running water to prevent stagnation, reduce water temperature, and provide a suitable habitat for plants and wildlife. A system of pumps and pipelines that would provide water and keep it moving throughout the project area would require replacement and maintenance.

Vector control: The design of the restoration features are constrained by the goal of not increasing disease transmitting mosquito populations in the project area. Specifically, channel cross-sections, basin morphology, vegetation selection and planting schemes would, to the extent practicable, minimize potential mosquito breeding areas. Further, wetland vegetation selection and community structure design would allow for easy access of mosquito-eating fish and macroinvertebrates.

To reduce potential impacts to animal species utilizing the restoration project's habitat features, the use of chemical agents to control adult and larval mosquito stages would be minimized. Ideally, control would be achieved through design and biological methods. Broad-spectrum pesticides would not be used except in the case of a true public health threat stemming from adult mosquitoes. In that case, ultra low volume fogging using industry accepted pesticides and application methods would be employed. In all other efforts, mosquito specific agents would be the only option. The following management measures and mosquito controls would be implemented to control mosquito populations in the selected plan.

Design and Construction Measures: Flow through conditions would be established via grading and providing surface water discharge from over-bank wetland areas to eliminate stagnant and quiescent conditions. Removal of salt cedar would be conducted to reduce potential mosquito food source, eliminate adult mosquito refuge, and facilitate mosquito larvicide application if necessary. Wetland and marsh basins would be configured to minimize mosquito breeding. Maximum basin width(s) would be determined by the distance larvicide application equipment can achieve. Steep basin side-slopes would be utilized to minimize vegetative growth immediately adjacent to water surface. Internal deep zones would be constructed to provide refuge for macrophytes and fish during drawdown. Emergent zones would be able to be rapidly (within 36 hours) drained.

A diverse assemblage (5 to 10 species) of aquatic macrophytic vegetation would be used, including emergent, submergent, and semi-submergent species. Emergent species growing at densities $\geq$ 800 stems/m^2 would make up no more than 5% of total emergent area plantings. Terrestrial and riparian plant species would be used to shade the water surface. Emergent macrophytes would be planted in species specific polygons. Polygons would be spaced on liberal centers (3.5 to 7.5 m's') to allow for fish and macroinvertebrate access and provide for vegetation life cycle needs. Semi-submerged aquatic plants would be intermingled with emergent zone vegetation to reduce vegetation density. Routine adult and larval mosquito monitoring would be conducted at predetermined locations within the project area and within specific habitat features. Water levels and irrigation schedules would be managed such that floodwater mosquito breeding is minimized. Complete basin dry-out can be used to break breeding cycles of mosquitos.

Biological controls: A diverse assemblage of aquatic, riparian, and terrestrial vegetation would be used to encourage the development of a robust population of macroinvertebrates. Some of these, such as predacious diving beetles, damselflies, and dragonflies should assist in reducing mosquito larvae and adults by foraging on them. Fish which prey on mosquito larvae, such as the non-native mosquitofish (*Gambusia affinis)* or the native Gila topminnow, may be stocked in the study area for vector control.

Biological larvicides: Application of either liquid suspension or granular larvicides can effectively reduce mosquito larval counts. Larvicides that would be used to control mosquitos include *Bacillus thuringiensis* (trade-name: VectoBac, Bti) and *Bacillus sphaericus* (trade-name: VectoLex). Typically, it takes 24 hours after treatment with VectoBac for complete mortality; however, residual killing is on the order of 3 to 5 days. Complete mortality after treatment with VectoLex can occur in 48 to 72 hours and residual activity can control larvae for up to 25 days post application. Both larvicides are specific to mosquito larvae.

Adulticides: Ultra low volume fogging with Malathion is another method employed to control outbreaks of adult mosquitoes and typically consists of applying 98% pure Malathion with an application of 1- 2 ounces per acre. It is immediately effective, but is not selective to mosquitoes. This would only be used for a true public health threat stemming from adult mosquitos in the project area.

Sediment removal: The low flow channels would remain the primary floodway with the marshes and wetlands constructed at elevations slightly above it along the north and south banks. However, more extreme flood events are expected to inundate the restoration features causing sediment deposition and requiring infrequent removal.

Vegetation management: Cottonwood/willow riparian vegetation would be planted along the riparian corridors and along the edge of open water marshes. After the initial five years, these habitats are expected to become self-sustaining, provided that the water distribution system is maintained.

Recreation: The recreation component of the selected plan is designed to provide for high quality experiences in a unique riparian area. For planning purposes the recreation component has been divided into three primary areas; the bank, the terrace, and the channel. The bank would provide experiences including hiking, biking, horseback riding to scenic overlooks, and leisure walking in a restored desert riparian area. The terrace would have a permanent water source and is expected to create a balance between trails and interpretive experiences between people and preservation of native desert flora and fauna. The channel would change in response to seasonal flows and flooding, and would contain few manmade features allowing one to observe the natural forces of land and water which define and shape desert rivers. For a more complete description of the recreation plan, refer to report prepared by the TRRMP Recreation Technical Committee (1997).

Recreation Features: The Tres Rios Project provides a unique opportunity for resource-based recreation and environmental education. The restoration of the Rio Salado, Agua Fria and Gila River channels would bring a riparian open space feature to the West Valley. A desert riparian area near an urban area could provide many unique recreation opportunities for residents and out of town visitors. It is estimated that visitation to the Tres Rios project could top one half million annually. Primary use times for this unique resource would coincide with the “visitor season” between October and May when temperatures are moderate.

The goal of the recreation component is to provide opportunities for visitors of all ages and backgrounds to enjoy this unique resource while developing an understanding of desert riparian ecosystems and how they relate to the environment as a whole. Visitors to this day-use area would have the opportunity to participate in a variety of recreation pursuits from enjoying scenic views, picnicking with the family, learning about the area or exploring on foot, by bicycle or horseback.

Public Education Program: The purpose of the Interpretive Education Program would be to provide visitors with educational information to enhance the Tres Rios experience. A major interpretive center would be planned, designed, and funded in cooperation with a consortium of concerned groups such as government and educational agencies, non-profit groups, and commercial sponsors. Additionally, other facilities and amenities such as trails, entry points, and kiosks located throughout the Tres Rios project would allow for the development of interpretive signs, displays and supplemental materials.

School districts, organizations, and individuals within the community as well as governmental agencies may fund or manage certain public use features and / or provide volunteer services. Individual volunteers or a student program may be organized to help with planting and replanting within the project. School districts and local organizations which become partners may set up or rotate interpretive displays within the facility.

Support materials for school curricula would be developed for pre- and post- visit activities as well as for onsite visits. These could include a packet of teaching materials to provide some hands on experience prior to a class visit. The packet could contain wildlife specimens, maps, diagrams, field guides for plant and animal identification, water-quality testing kits, and perhaps dip nets for viewing and identifying species during the visit. The curriculum could also be presented in an outdoor classroom setting at the site.

A monthly schedule of guided nature walks would complement the interpretive education program. These walks could be developed and led by volunteers. Environmental and wildlife organizations such as the Phoenix Audubon Society, Sonoran Anthropod Studies Institute, and the Arizona Native Plant Society as well as agencies such as the AGFD could periodically sponsor events which would be open to the general public.

Monitoring:

Cottonwood/willow riparian corridors: Initial monitoring would include monthly site inspection reviews for the first six months; thereafter, the site would be monitored every other month for a year. The site will be monitored to ensure that it remains free of all non-native shrubs throughout this 18 month period. Should the survival rate of plantings indicate that species composition does not meet objectives, a replanting effort will be developed and implemented to ensure that the species composition is maintained.

All plantings shall be monitored to have a minimum of 80% survival the first year of the monitoring phase and 100% survival the second and third years of the monitoring phase. A 40% cover after 5 years is a goal. Ninety percent cover is expected in the riparian corridors after 10 years. There will be zero tolerance of exotic shrubs the first 5 years. If the survival and cover requirements are not met during the initial 5 years, the additional effort for replacement planting would be cost-shared. After 5 years, the non-Federal Sponsor will be responsible for maintaining the restoration sites for the remaining life of the project. Species composition would be maintained and site monitoring would be performed yearly throughout the life of the project.

Constructed wetland marsh: The same monitoring frequency outlined for the cottonwood/willow riparian corridor restoration sites would be followed for the constructed wetland sites. Although some planting of marsh vegetation will occur, most wetland vegetation is expected to establish naturally around permanent source of open water. The conveyance system of ditches, canals, and pipes will be inspected during vegetation monitoring to ensure a consistent supply of water to the wetlands.

Open water/marsh: The same monitoring frequency and percent survival outlined for the cottonwood/willow riparian corridors will be followed for the open water/marsh. The marsh vegetation on the riverside rim is expected to become readily established around the permanent source of water.

Vegetation Damaged by Floods: All cottonwood/willow will be planted in the flood-prone lower terraces and is expected to be regularly affected by flooding events. The cottonwood/willow sites will be evaluated after large storm events to determine the need for revegetation and adaption of the water supply distribution. All open water/marsh will be in the in the floodplain and it too is expected to be regularly affected by flooding events. Marsh vegetation is expected to regenerate naturally.

Water quality and aquatic invertebrates: Aquatic invertebrate surveys will be used primarily as indicators of water quality in the open water/marsh and the constructed wetlands. Aquatic insects surveys and water quality measurements of the wetland marshes will be conducted during late spring and late summer for the first 5 years after initial construction. Aquatic surveys will be used to verify water quality in the marshes and the health of the marsh's aquatic environment.

Riparian and wetland birds: Bird surveys will be performed in the restored habitats during each of the four seasons for the first 5 years following construction. The abundance and diversity of bird species will be used as an indicator of the ability of habitat to support native avifauna. After the first five years, summer/spring bird surveys will be performed every other year to document abundance and diversity trends.

Small mammals: Small mammal trapping (live or snap) will be conducted during the summer for the first five years to document the diverse species expected to re-colonize restored habitats.

<u>Adaptive management</u>:

Success criteria and reporting: The success or failure of the restoration effort will be measured against two parameters which should indicate whether the goal of this restoration effort is being achieved; they are: 1) whether the actual established plant species compositions and/or percent cover requirements outlined for the various habitat types meet the design objectives, 2) whether native wildlife re-colonize the restored habitats, and 3) whether the restoration sites naturally regenerate.

Monitoring will occur as described above; reports would be prepared at the end of the year by the Corps and local sponsor for the first 5 years after initial construction. The need to make adjustments to the constructed project will be based on the results of the monitoring reports. If the restored habitats achieve the plant species composition identified and achieve a diverse native wildlife assemblage, no modifications will be made. After the first five years, the non-Federal Sponsor will prepare the monitoring reports.

Technical committee: The Corps and/or the non-Federal sponsor will be responsible for collecting monitoring data and preparing annual monitoring reports. A technical committee consisting of, at least, the Service, Bureau of Reclamation, and AGFD, will assist in collection of monitoring data, review monitoring data results, and providing recommendations of possible adaptive management measures.

The technical committee will recommend adaptive management measures to the existing project's design should either wildlife habitat or wildlife abundance/diversity not achieve the identified goal and objectives. If designed vegetation species composition are not achieved: replanting, additional irrigation, and/or removal of vegetation (especially exotics) may be necessary. Herbicides would only be used if more natural options are unsuccessful.

Should aquatic invertebrate surveys indicate that the wetland marshes are providing poor aquatic habitat, adjustments to the water quantity and/or quality may need to be made. This could include a re-design or modification of the water delivery system, decrease or increase of watering frequency or duration, measures to improve water quality, or construction modifications of the stream channel or the wetland.

Should wildlife (bird and small mammal) surveys indicate that the restored habitats are not attracting or supporting the abundance and diversity of species expected, adjustments to the prescribed vegetation species composition or modification of the vegetative structure (i.e., overstory and understory layers) may be necessary. This could include vegetation manipulative measures mentioned earlier (e.g., removal, replanting, etc...) or include placing brush piles in the project area.

Executive committee: Annual monitoring reports and adaptive management measures recommended by the technical committee will be forwarded to an executive committee which will consist of, at least, a representative of the non-Federal sponsor and the Corps. The executive committee will decided whether to adopt adaptive management measures recommended by the technical committee.

FUTURE WITHOUT-PROJECT SCENARIO

Under the future without-project scenario, the Corps would not participate in an ecosystem restoration project in the Tres Rios study area. Amenities such as riparian stringers and corridors, wetlands, marshes, flood control facilities, recreational facilities, and water supply improvements would not be constructed by the Corps. Predicting the future conditions of biological resources along the Gila River is a difficult task. Several factors could affect the river, riparian environments, and fish and wildlife communities within the study area. These include flood control, changes in human populations and land use, and water quality and supply.

Flood control

Under the future without-project scenario there would continue to be damages associated with flooding, particularly to the community of Holly Acres. Therefore, we anticipate that some level of flood protection would be pursued. The type and extent of flood control measures that may be provided are likely to be somewhat similar to what is proposed with the project. Potential effects of structural levees or dikes include restriction of floodplain function and the loss of localized vegetation and habitat. Potential effects of channelization include the loss, or further reduction, of natural hydrogeomorphic processes within, and perhaps below, the study area.

The Corps (1999a) states that under existing conditions as uncontrolled flood flows reach 10,000 - 15,000 cubic feet per second (cfs) nesting and cover habitat of the Yuma clapper rail would be over-topped with water, and the duration and extent to which habitat is unavailable would have a serious impact on recovery of the species in the study area. The Service believes that, although flows in excess of 10,000 - 15,000 cfs may render habitat unavailable, the recovery of the Yuma clapper rail within the study area is not currently limited by flooding. In southwestern desert ecosystems, flooding from high intensity storms typically occurs after clapper rails have nested and fledged, and therefore is not believed to result in clutch failure. Clapper rail habitat is very dynamic and although a flood event may destroy a marsh site through scouring, the same event usually creates other sites for marsh regeneration through deposition. Surveys after high intensity flood events has seemed to indicate that flood events result in localized movement, not extirpation, of clapper rails in a particular area (Ron McKinstry, pers. comm., 1999). Additionally the clapper rail habitat located at 115th Avenue has shown that it is partially protected by the old road crossing and resistant to scouring by floods.

Human population and land use

We anticipate that human populations will continue to grow adjacent to, and perhaps within, the study area. Although the Service is unable to predict the rate or location of growth, we believe the many agricultural fields that now characterize the landscape near the study area will likely give way to residential and commercial development. Increased human populations may affect the natural resources within the study area through increased human presence and recreational use. Definitive effects are difficult to pinpoint, although increased human presence could cause increased disturbance and stress to animal populations resulting in decreased fecundity, recruitment, and survival. Specific effects will depend on the intensity and duration of disturbance as well as the species evaluated. Some wildlife species can tolerate high levels of human presence while others cannot. Vegetation could be affected by increased human presence as well, through increased collecting, trampling, or efforts to reduce fire hazard. This reach of the Gila River is also included in Maricopa County's Sun Circle Trail System, which is expected to expand recreation use patterns in the study area under existing conditions (TRRMP Recreation Technical Committee 1997).

Increased urban development could also affect the hydrology of the Gila River within the study area. The Corps (1999a) believes that more water will be available in the river channel as urban development increases in the study area. This may be true because residential developments typically require less water per unit area than farmland. However, many developments on the westside are designing their communities with open water and lakes, perhaps utilizing their entire water entitlement to attract residents.

Effluent water supply

As previously stated, two effluent water sources are available in the project area including the SROG's 91st Avenue WWTP and Tolleson's WWTP. Currently both of these plants discharge effluent into the river, thereby playing a large role in sustaining the existing riparian, marsh, and aquatic environments. The future fate of effluent water under the without-project scenario is unclear, although the Corps (1999a) states that discharge from the 91st Avenue WWTP would decrease from purchases, litigation, and conservation, until a zero discharge was realized in approximately 20 years. Also, the City of Phoenix and Bureau of Reclamation analyzed a groundwater recharge, storage, and recovery alternative, which would result in zero discharge, prior to initiation of the Tres Rios constructed wetlands project (Reclamation 1996).

Regardless of the mechanism, if the effluent water supply is discontinued, dramatic shifts in biological resources would be anticipated within the study area. It is difficult to predict specifically how riparian and marsh vegetation would be affected because a number of factors including depth to groundwater, flood events, and surface water play a role in regeneration and survival of riparian vegetation. However, we would expect the loss of 153 mgd of effluent to substantially reduce, and likely eliminate, perennial surface water in the study area. Effects on groundwater and flood events are less clear.

Stromberg *et al*. (1996) found that depth to groundwater exerted the greatest influence on riparian vegetation composition along the San Pedro River, and that even small declines in groundwater tables would be expected to result in loss of canopy vigor and declines in growth, negatively affecting recruitment and survivorship. Additionally, many riparian vegetation species are dependent on hydrogeomorphic processes that disperse seeds, promote germination, and ensure recruitment and survival. For example, cottonwoods depend on nursery-bar development and coalescing to provide suitable conditions for germination (Brady *et al*. 1985).

However, both cottonwood and willow seedlings are dependent upon shallow groundwater tables, rather than discrete flood events, to ensure growth after germination.

If groundwater tables in the study area would be affected by the loss of effluent water, we would then expect relatively immediate shifts in vegetation community composition and distribution. Water deficiencies stressing riparian and wetland plant species could increase plant susceptibility to disease, fire, and dehydration. Dropping the water table below the root zone of sensitive species, such as cottonwood, willow, cattail, and bulrush could severely stress or kill them and may result in invasion by other plants more tolerant of lower water tables, such as salt cedar and arrow-weed. Water stress could also result in decreased germination of riparian vegetation (Siegel and Brock 1990). However, the Corps (1999a,b) states that groundwater levels in the study area will rise in the future. Rising groundwater could continue to support riparian vegetation, provided it does not result in unsuitable soil conditions such as increased salinity.

If effluent releases play any major role in seed bed formation, seed dispersal, or germination, then the loss of effluent in the study area could reduce cottonwood and willow recruitment, perhaps rendering their populations unsustainable. Under this scenario the existing riparian vegetation may temporarily flourish until experiencing senescence as the result of little to no natural regeneration. However, the role effluent plays in completing the life history requirements of cottonwood and willows in the study area is unclear.

If effluent discharges cease, effects on fish and wildlife resources could be significant. The most profound effects in the study area would likely occur to the aquatic ecosystem that is currently supported by perennial flow. Declines in, or loss of, stream flow may result in conditions that could negatively affect, or eliminate, fish populations in the study area. Reduction in aquatic habitat may result in crowding, increased competition, increased transmission of epizootic diseases, decreases in benthos and aquatic invertebrate food base, increased water temperatures, and reduced dissolved oxygen content. Portions of the river in the study area could dry out completely, resulting in the total loss of the aquatic community.

Terrestrial and riparian/wetland obligate wildlife communities could be affected as well. Changes in vegetation species composition and distribution, as well as reduction in available water, could result in shifts in relative abundance and species richness. Again, definitive effects would depend on the life history requirements of a particular species and the specific changes to habitat elements required by the animal. However, changes in habitat structurally heterogeneity or total vegetation volume could result in complementary shifts in the diversity of breeding birds. Other terrestrial species may experience the loss of breeding, sheltering, or feeding habitats. For instance, the elimination of cattail marshes could result in the localized extirpation of Yuma clapper rail. Based on a modified Habitat Evaluation Procedures (HEP) model developed for the project (Corps 1999b, Anderson and Ohmart 1993) the overall "value" of the existing habitat would be expected to decline under the without-project scenario as salt cedar becomes the dominant plant species in the study area.

FUTURE WITH-PROJECT SCENARIO

The future with-project scenario most notably differs from the without-project scenario in that the SROG would commit to continuing effluent discharges from the 91st Avenue WWTP for the life of the project. Affects of human population growth, land use, recreation, and flood control are likely to be similar to the future without-project scenario, except that the Tres Rios project would strive to make recreation and flood control compatible with environmental restoration. Under the future with-project scenario the Corps would implement one of the restoration alternatives described in the Draft feasibility report (Corps 1999a), most likely alternative 3.5 (as described above).

As described in the PROPOSED ACTION section, the project would consist of environmental restoration activities and features including cottonwood and willow riparian corridors, open water and marsh, salt cedar eradication, constructed wetlands, and a water distribution system. Operation and maintenance activities would include levee and interior drainage maintenance, pumps and pipeline maintenance, vector control, periodic sediment removal, vegetation planting, recreation plan implementation, and monitoring and adaptive management plan implementation.

Environmental restoration

Patten *et al*. (1998) concluded that effluent can play a significant role in supporting woody riparian vegetation along a stream course, although the overall riverine system supported by effluent was described as low quality. Birds in particular, took advantage of canopy cover and insect and fish food sources. Effluent dominated reaches supported fewer algal and aquatic invertebrate species than “natural” reaches, but nonetheless supported better biotic communities than reaches without surface flow.

Riparian communities are a valuable resource for a diversity of wildlife species. It has been estimated that 75% of all Arizona's native wildlife species depend on riparian areas during some portion of their life cycle, and these areas are critical to the survival of approximately 60% of Arizona species currently in jeopardy of extirpation (Lofgren *et al*. 1990). The State of Arizona has estimated that up to 90% of riparian habitat along Arizona's major desert watercourses have been either destroyed, altered, or degraded by man's activities (Lofgren *et al*. 1990). The type of riparian vegetation communities that are proposed for restoration at Tres Rios represent a valuable resource that is becoming increasingly scarce within the State.

The creation of cottonwood/willow corridors, open water, marsh, and constructed wetlands would be expected to provide habitats for a diversity of wildlife species. The cottonwood forests of the Verde Valley in central Arizona have been documented as containing some of the highest concentrations of non-colonial, nesting birds noted anywhere in the United States (Johnson, 1970). During wet years, the Gila River downstream of Painted Rock Reservoir provides winter and migration habitats for considerable numbers of shorebirds and waterfowl (Brown, D.E. 1985). The restoration of these environments may serve to significantly increase utilization of the Tres Rios study area by a variety of bird species. The aquatic community in the study area would be expected to remain viable, as the SROG would agree to the continued discharged of effluent water. Sensitive animals, such as threatened and endangered species, could be attracted to the study area if restoration activities were designed to specifically provide habitat elements needed to complete portions of a particular species' life cycle.

Based on the HEP analysis described in Corps (1999b), over the 50-year life of the project there should be a substantial increase in Habitat Units over existing conditions. The increase in Habitat Units would largely be the result of converting an environment dominated by salt cedar, which is believed to provide inferior habitat, into an environment dominated by native riparian vegetation. The Service believes converting salt cedar to cottonwood and willow would generally be a desirable activity, as salt cedar is largely viewed as an invasive pest species.

Research conducted in southwestern riparian ecosystems have indicated that cottonwood-willow communities not only contain higher densities of birds than monotypic stands of salt cedar, but also support higher species richness and diversity (Anderson and Ohmart 1977, 1982, Anderson *et al* 1977, Cohan *et al* 1978). This is generally due to the greater vertical structural complexity provided by mixed stands of cottonwood and willow. However, habitat values of salt cedar stands could be improved by adding native plant species, thus manipulating vegetative structure. Indeed, an understory of salt cedar can contribute significantly to the overall structure within mixed cottonwood-willow and salt cedar stands.

Although the proposed project is expected to have desirable and beneficial long-term environmental effects, short term effects on wildlife resources associated with the eradication of the existing salt cedar dominated community could be realized. The time lag inherent in replacing the vegetation community would result in the temporal loss of habitat for a variety of wildlife species. Removal of salt cedar may have short term adverse effects on mammal, bird, and reptile communities through the loss of nesting, foraging, hunting, and resting areas. Animals may be killed by clearing operations or displaced to adjacent areas that may already be functioning at, or near, local carrying capacity, resulting in increased stress, disease transmission, and mortality.

One of the more significant potential effects of initial construction are those associated with eradicating vegetation that could potentially provide habitat for threatened and endangered species. However, as a result of the informal section 7 consultation process, the Corps and local sponsor have agreed to assess habitat suitability and conduct surveys if appropriate, prior to vegetation eradication. Therefore, we anticipate the proposed action would have a long term net beneficial effects on threatened and endangered species by maintaining and increasing suitable habitat in the study area.

Operation and maintenance

The proposed operation and maintenance activities could also have various effects on fish and wildlife communities in the Tres Rios study area. Activities such as dredging or vegetation clearing with large equipment could directly harm or kill, temporarily displace, or disturb animals in the immediate vicinity. Sensitive species, including listed species, could be affected if these activities occur in areas that are utilized by or suitable for those species. The degree of effects on wildlife would depend on the nature of the activity, the characteristics of the habitat patch, and the life history of the species of concern.

Recreation could also have varying degrees of effects on biological resources within the study area. Potential effects of increased human presence in the study area have been briefly described in the FUTURE WITHOUT-PROJECT SCENARIO. Again, the degree of effects on wildlife would depend on the nature of the recreation activity, the characteristics of the habitat, and the life history of the species of concern.

Operation and maintenance has the potential to effect listed species that may utilize habitat features created by the project. However, as a result of the informal section 7 consultation process, the Corps and local sponsor have preliminarily agreed to assess habitat suitability and conduct surveys if appropriate, prior to O&M activities. Additionally, the Service and local non-federal sponsor(s) will continue to coordinate regarding the development and implementation of a Safe Harbor Agreement (SHA), Habitat Conservation Plan (HCP), or other appropriate mechanism to address potential effects to, and take of, listed species which may result from O&M. Applicable elements of a SHA or HCP, such as baseline condition, mitigation, and/or monitoring provisions, would be developed prior to the local sponsor(s) acceptance of the project from the Corps to ensure that O&M activities can be conducted in a manner that satisfy the original project goals, including habitat restoration, flood control, vector control, recreation, and environmental education.

DISCUSSION

The Service is pleased to participate in a project aimed at restoring native vegetation communities, particularly valuable wetland and riparian environments. We believe the most important aspect of wetland and riparian restoration projects is the identification and attainment of a secure water source to ensure adequate hydrologic conditions to support the desired wetland and riparian biotic communities. Mitsch and Gosselink (1993) believe that hydrology is the most important variable in wetland creation and restoration activities and state that if proper hydrologic conditions are developed, the biological and chemical conditions will respond accordingly. They offer several parameters that are useful to describe hydrologic conditions of restored wetlands, including hydroperiod, water depth, and seasonal flood pulses. Additionally, they conclude that most wetland creation and restoration activities that fail, do so because of the lack of proper hydrology. We would support efforts to secure WWTP effluent discharges as a source of surface water to sustain the biological resources in the Tres Rios study area.

We are concerned that there are significant information gaps and a lack of thorough understanding regarding the groundwater conditions in the Tres Rios study area. We are also concerned about the proposed removal of salt cedar vegetation and revegetation with cottonwood, willow, and emergent vegetation. Although the Service supports efforts to restore native riparian vegetation, we are concerned that areas currently occupied by salt cedar may not necessarily be suitable environments for establishment, regeneration, and survival by cottonwood and willow. We believe that prior to committing to a restoration program, consideration should first be given to microhabitat conditions such as depth to water table, soil texture, and salinity. Consideration should also be given to large scale ecological processes such as floods, which species such as cottonwood and willow depend upon for seed bed formation, seed dispersal, germination, seedling establishment, recruitment, and survival.

The majority of failed riparian restoration activities that include removal of salt cedar with subsequent native revegetation, failed because of attempts to establish desirable species on degraded sites, typically with incompatible soil moisture or salinity (Briggs *et al*. 1994, Barrows 1998). Furthermore, in the absence of flooding at the time of seed production, it is unlikely that cottonwoods and willows will experience substantial reproduction or recruitment (Anderson 1998). If revegetation is unsuccessful, it is possible that removal of salt cedar may actually result in habitats having lower value for wildlife. We suggest that a thorough assessment of site suitability for cottonwoods and willows be conducted before large scale removal of salt cedar is performed. Consideration should be given to depth to groundwater, soil salinity and texture, flood frequency and intensity, groundwater fluctuations, site preparation, protection of plantings from herbivory, necessity of irrigation, potential for competition from undesirable species, and long term management potential for the site. If assessments indicate that revegetation efforts have a high probability of success, we offer the following specific suggestions to hopefully improve the Corps' proposal.

> We encourage replanting with honey mesquite over other species of mesquite, because woodlands of honey mesquite are probably declining most rapidly. If pole plantings are considered, we encourage the use of cuttings from as near the site as possible, to insure that plants are adapted to site specific environmental conditions. However, seeds rather than rooted cuttings work best for producing mesquite container stock (Rorabaugh 1995).
>
> We support examining soil quality and water table depth to determine the locations for restoration. Anderson (1995) indicates that where depth to the water table exceeds 2.5 meters the growth of cottonwoods and willows is significantly restricted.
>
> Plants will likely need to be protected from mammals such as rabbits, gophers (*Thomomys* spp.), beavers, etc. which have been known to decimate revegetation projects. We suggest protecting trees with 3 foot by 18 inch, 1 inch mesh chicken wire baskets

firmly supported with metal stakes. Honey mesquite may also be attacked by small insects known as psyllids (Psyllidae). Unfortunately, we know of no method to feasibly control psyllids.

The density of plantings will need to be decided. For southwestern willow flycatcher habitat, we would consider planting cottonwoods and especially willow trees only 10 feet from each other. It may be worthwhile to mix-up the density throughout the site. Up to 100 trees per acre may be reasonable. Use of pole plantings is an acceptable method for cottonwood and willow revegetation. Poles should be cut in late winter when plants are dormant. If groundwater is sufficiently shallow the “knock-down” method may be employed, whereby willow cuttings are placed horizontal to the ground to more closely mimic natural regeneration after flood events.

Irrigation should be conducted over the most important time frames or for as long a period as necessary. Irrigation should occur until the plants are dormant in the late fall or early winter. If many plants are found to have died, it may be necessary to increase irrigation (if irrigation is occurring) or to reinitiate irrigation (if irrigation has ceased). This may be a non-issue as the project contains a significant water distribution system.

It may be best to plant trees early in the growing season. If trees are planted in March or April, they should have a sufficient growing season and not be stressed from intense summer heat immediately after planting. Also, plants should be allowed to harden off prior to planting.

In addition to implementing strategies to improve the potential success of restored habitats, the Corps should proceed with restoration in a manner that minimizes or eliminates potential adverse effects on existing biological resources, particularly listed species. The conservation measures developed as a result of informal section 7 consultation should implemented. Also, to the extent feasible and compatible with avoiding seasons important for listed species, dredging and vegetation clearing should occur outside of winter months when open water and wetlands would be expected to have a high density of waterfowl and shorebirds in the area (typically December through February). This should be closely coordinated with the AGFD.

The Service has noted that the proposed plan places a greater emphasis on the creation of open water and marsh over the restoration of cottonwood and willow riparian corridors. We would encourage the incorporation of more cottonwood/willow gallery forests into the proposed restoration project. The suite of animals that would be attracted by native riparian vegetation would be more desirable to the Service as we believe these species, such as neotropical migrant birds, have experienced greater declines in numbers than waterfowl and shorebirds which would be attracted by open water and marsh.

We are also concerned with the proposed sediment removal aspect of the O&M plan. The Service typically encourages efforts to restore a natural hydrograph and scouring flood events to historic river channels such as the Gila River. The proper sequencing of flooding plays an integral role in the maintenance of healthy population structures of Fremont cottonwood and Goodding willow through the deposition of nutrient-rich alluvium, scouring of herbaceous cover, and moistening of riparian soils (Ward 1985, Stromberg and Patten 1991), thereby promoting a sustainable ecosystem that would require minimal active management. Assessments should be conducted to evaluate the potential for native riparian vegetation to regenerate naturally. We suggest that project maintenance should not preclude or hinder natural regeneration of native riparian plant species through the removal of seed beds or established saplings. To the greatest extent compatible with other project amenities, native riparian regeneration should be encouraged.

We are pleased with conservation measures, including annual surveys and habitat assessments, that would be initiated to track and evaluate the long term status of threatened and endangered species and their habitats in the study area. We encourage the local non-Federal sponsor(s) to develop an SHA or HCP for future operation and maintenance activities that may affect listed species. Such an effort would greatly facilitate operation and maintenance of the project while providing conservation benefits to listed species. For instance, to avoid potential disturbance to listed species nesting in the study area, certain portions of the restored habitats could be inaccessible to recreationists. Also, we encourage the City of Phoenix to continue to work cooperatively with the Service and AGFD to utilize the Gila topminnow (*Poeciliopsis occidentalis occidentalis*) instead of mosquitofish for vector control.

Finally, conclusions that the proposed restoration project will have a net beneficial effect on the local environment is based on the premise that areas now dominated by salt cedar will be replaced with cottonwood and willow. This is expected to increase the overall vegetative structure and thus increase habitat available for native wildlife such as riparian obligate songbirds. The Service is continually concerned with the regional success of revegetation projects such as that proposed for Tres Rios. Our major concern is that conclusions drawn regarding net beneficial effects are heavily reliant on the assumption that revegetation, survival, and growth rates of native riparian plant species will be successful and sufficient to provide the types of habitat desired. We look forward to participating in the monitoring and adaptive management program to ensure that these goals are met.

RECOMMENDATIONS

1) Efforts to secure effluent as a source of water to support the biological resources within the study area should be pursued. The Corps and local sponsors should explore opportunities to discharge all available effluent into the river channel in perpetuity.

2) Assessments should be performed to ensure that site specific microhabitat conditions would be conducive to establishment and growth of cottonwood, willow, and mesquite. Consideration should be given to depth to groundwater, soil texture and salinity, and flooding. If the Corps

proceeds with revegetation, we recommend implementation of the specific suggestions presented in the DISCUSSION section above.

3) A greater emphasis should be placed on the creation of cottonwood and willow gallery forests over open water and marsh in the study area. Natural regeneration of native riparian vegetation should be encouraged in the study area.

4) Conservation measures developed during the informal section 7 consultation process and outlined in our March 22, 2000, letter to the Corps should be implemented. The Corps should encourage the local non-federal sponsor(s) to work with the Service in the development of a SHA or HCP.

We appreciate the opportunity to provide recommendations for the proposed project. If we can be of further assistance or you have questions, please contact Mike Martinez (x224).

Sincerely,

David L. Harlow
Field Supervisor

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