US Army Corps
Of Engineers
Albuquerque District

SECTION 1135 PROGRAM

DRAFT

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT FOR

AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO

March 2008

Prepared by

U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109

In cooperation with

THE GREAT SEAL OF THE PUEBLO OF SANTA ANA
TAMAYA

AYRES ASSOCIATES

CONVERSION FACTORS

	From	Multiplier	To
Length	inches	25.4	millimeters
	feet	0.3048	meters
	miles	1.6093	kilometers
Area	acres	0.0407	hectares
	square miles	2.590	square kilometers
Volume	cubic yards	0.7646	cubic meters
	acre-feet	1,613.33	cubic yards
	acre-feet	1,233.5	cubic meters
	acre-feet	325,851	gallons
Flow	cubic feet/second (cfs)	0.0283	cubic meters/second
	cubic feet/second (cfs)	1.983	acre-feet/day
Mass (weight)	tons (short ton)	0.9072	metric tons
Velocity	feet/second (fps)	0.3048	meters/second
Salinity	µSiemens/cm or µmhos/cm	0.32379	parts/million NaCl or mg/liter NaCl
Temperature	° Fahrenheit (°F)	(°F-32)/1.8	° Celsius (°C)

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DRAFT
DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT FOR AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO

The public review period for this draft Detailed Project Report / Environmental Assessment consists of thirty (30) days, from **April 9 through May 8, 2008**.

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Albuquerque Public Library, Main Branch, 501 Copper Ave. NW, Albuquerque;
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Santa Fe Public Library, Main Branch, 145 Washington Ave., Santa Fe;
Pueblo of Santa Ana, Department of Natural Resources, 2 Dove Rd., Bernalillo;
and from the U.S. Army Corps of Engineers (see below to contact).

Please provide all comments by May 8, 2008, to:

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US Army Corps
Of Engineers
Albuquerque District

DRAFT
FINDING OF NO SIGNIFICANT IMPACT

AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO
(Section 1135 Ecosystem Restoration Program)

Over the past 50 years, the operation of Jemez Canyon and Cochiti dams has contributed to the degradation of aquatic, wetland, and riparian habitat along the Rio Grande through the Santa Ana Indian Reservation. The river channel has incised 5- to 10-feet, resulting in decreased inundation of 1,300 acres of floodplain and reducing the quality of fish and wildlife habitat. The proposed Section 1135 Ecosystem Restoration project entails the creation or improvement of 6.6 acres of shrub wetland; 5 acres of saltgrass meadow; 12.5 acres of riparian shrubs and woodland; 1.6 acres of bankline shrubs; and 62 acres of aquatic habitat improvements. The project was planned in conjunction with the Pueblo of Santa Ana who will provide 25 percent of the estimated $6.19 M total project cost. All construction and access areas are on tribal lands.

Alternatives considered during the feasibility study included a wide variety and acreages of wetland, riparian, and aquatic habitat types, and are discussed in detailed in the Detailed Project Report/ Environmental Assessment (DPR/EA). The recommended plan was selected based on consideration of restoration opportunities and constraints; cost-effectiveness; and completeness with regard to the Pueblo's overall restoration objectives for the Rio Grande corridor.

The planned action would result in only minor and temporary impacts on air quality, water quality, wildlife habitat, and aesthetic resources. The following elements have been analyzed and would not be significantly affected by the planned action: socioeconomic environment, air quality, water quality, noise levels, flood plains, riparian areas, wetlands, waters of the United States, biological resources, endangered and threatened species, prime and unique farmland, aesthetics, recreation, and cultural resources.

In accordance with the requirements of Executive Order 11988, Flood Plain Management, I have ensured to the maximum extent practicable that the risks of flood losses are minimized and the natural and beneficial values served by flood plains will be restored and preserved. Pursuant to Corps regulations, a Section 404(b)(1) evaluation and finding of compliance regarding effects to waters of the United States and wetlands is included in the DPR/EA.

The planned action has been fully coordinated with Federal, tribal, and local governments with jurisdiction over the ecological, cultural, and hydrologic resources of the project area. Based upon these factors and others discussed in detail in the DPR/EA, the planned action would not have a significant effect on the human environment. Therefore, an Environmental Impact Statement will not be prepared for the conduct of the subject Section 1135 ecosystem restoration project.

____________________ Date

____
B. A. Estok
Lieutenant Colonel, U.S. Army
District Commander

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT FOR AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO

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1. BACKGROUND, PURPOSE, AND NEED

1.01 STUDY AUTHORITY

This feasibility study was conducted under the authority of Section 1135(b) of the Water Resources Development Act of 1986 (Public Law 99-662), as amended[1]. The objective of this authority is to improve the quality of the environment through modification of the structure or operation of existing water resources projects constructed by the U.S. Army Corps of Engineers (Corps), providing such modifications are feasible and consistent with the original project purpose. Improvements in ecosystem structure or function in areas adversely affected by such projects are also included in this authority.

1.02 PROBLEM IDENTIFICATION

River systems and their attendant wetland and riparian woodland communities in the semi-arid western United States provide significant resources and benefits for both humans and wildlife (Brinson 1980, Crawford *et al.* 1993, Davis *et al.* 1996). Water resource management activities (diversions, dams, levees, drains, channelization, jetty-jacks) by Federal and other entities have altered the hydrologic, ecologic, and sediment transport characteristics of the Rio Grande within New Mexico. Jemez Canyon and Cochiti Dams, operated for flood and sediment control by the Corps, have contributed, in part, to the degradation of ecosystem functions and values of the Rio Grande in the study area.

Along the approximately 5 miles of the Rio Grande within the Santa Ana Indian Reservation, several hydrologic and ecologic problems have been identified:

- The historically broad channel has incised up to 10 feet during the past 30 years, resulting in a narrow, entrenched channel;
- The extent and quality of aquatic habitat for native fish have deteriorated due to increased water depth and velocity;
- Channel incision has resulted in lowering the local water table in certain locations;
- The lack of inundation, scouring, and sediment deposition within the "bosque" (riparian woodland) has curtailed native cottonwood and willow seedling recruitment;
- Widespread invasion of non-native saltcedar and Russian olive trees has decreased the value of wildlife habitat and increased the threat of damaging fire.

In response to these problems, the Pueblo of Santa Ana—a Federally-recognized Native American nation—initiated, in 1996, a restoration plan encompassing approximately 1300 acres of bosque in the historic floodplain and over 100 acres of bars, islands, and backwater wetlands within the active floodplain of the Rio Grande. To implement the restoration plan, the Pueblo has forged partnerships with Federal agencies and others, including the Corps, U.S. Bureau of Indian Affairs, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and the Middle Rio Grande Endangered Species Act Collaborative Program.

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[1] Amended by Section 304 of WRDA 1990 (P.L. 101-640), Section 202 of WRDA 1992 (P.L. 102-580), Section 204 of WRDA 1996 (P.L. 104-303), Section 506 of WRDA 1999 (P.L. 106-53), and Section 210c of WRDA 2000 (P.L. 106-541).

The Corps has closely coordinated with the Pueblo, Reclamation, and other agencies to implement necessary channel stabilization and restoration measures. In a previous ecosystem restoration project conducted under the Section 1135 program (USACE 2002), the Corps and the Pueblo constructed two grade control structures (also known as "Gradient Restoration Facilities" or "GRFs") within the Rio Grande to arrest the degradational trend of the channel. Construction was completed in March 2005.

During the initial planning phase of that study, restoration measures addressing a broad range of problems were formulated. In 2001, the current Section 1135 study was initiated to address additional ecosystem concerns, specifically, restoration of aquatic, saltgrass meadow, and shrub-dominated habitats. All measures proposed in the current study are physically and functionally separate in regards to hydrologic and ecologic benefits and effects from measures in the first Section 1135 project. The non-federal sponsor for the previous and the current Section 1135 projects is the Pueblo of Santa Ana.

1.03 STUDY PURPOSE AND SCOPE

The purpose of this Section 1135 Program feasibility study is to investigate and recommend cost-effective environmental quality improvements along the Rio Grande within the Santa Ana Indian Reservation. Restoration of ecosystem functions and values was evaluated within riverine, riparian, and wetland communities. This Detailed Project Report/Environmental Assessment (DPR/EA) addresses only those activities proposed for implementation by the Corps of Engineers.

1.04 REGULATORY COMPLIANCE

This document was prepared by the U.S. Army Corps of Engineers, Albuquerque District, in compliance with all applicable Federal statutes, regulations, and Executive Orders, including:

- National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.);
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq*.);
- U.S. Army Corps of Engineers' Procedures for Implementing NEPA (33 CFR 230);
- Clean Air Act, as amended (42 U.S.C. 7401 *et seq*.);
- Clean Water Act of 1977, as amended (33 U.S.C. 1251 *et seq*.);
- Endangered Species Act, as amended (16 U.S.C. 1531 *et seq*.);
- Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.);
- Floodplain Management (Executive Order 11988);
- Protection of Wetlands (Executive Order 11990).
- Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898);
- Archaeological Resources Protection Act, 16 U.S.C. 470aa *et seq*.
- National Historic Preservation Act, as amended (16 U.S.C. 470 *et seq*.);
- Protection of Historic and Cultural Properties (36 CFR 800 *et seq*.);
- Protection and Enhancement of the Cultural Environment (Executive Order 11593);
- American Indian Religious Freedom Act (42 U.S.C. 1996); and
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq*.).

2. EXISTING ENVIRONMENTAL SETTING

2.01 STUDY AREA LOCATION

The general study area entails a 5-mile-long reach of the Rio Grande within the Santa Ana Indian Reservation, from the Jemez River confluence south nearly to the US Highway 550 (formerly NM Hwy. 44) bridge. The study area also is within Sandoval County, New Mexico, and is immediately northwest of the town of Bernalillo. (See Plates 1 and 2.)

2.02 PERTINENT WATER RESOURCE DEVELOPMENT PROJECTS

Cochiti Dam

The Cochiti Dam and Lake Project is located on the mainstem of the Rio Grande, about 50 miles north of Albuquerque and 25 river-miles upstream from the Pueblo of Santa Ana, Sandoval County. The dam spans both the Rio Grande and the Santa Fe River near their confluence. The Flood Control Act of 1960 (P.L. 86-645) authorized the construction of Cochiti Dam for flood and sediment control. In 1964, P.L. 88-293 authorized the establishment of a permanent pool for the conservation and development of fish and wildlife resources and recreation purposes. The 1,200-acre (approx. 50,000 acre-feet) pool was created, and is maintained, by allocations from the San Juan-Chama Project (trans-mountain diversion). Construction of Cochiti Dam began in 1965 by the Corps and the project was put in operation in 1975.

The reservoir's initial storage allocations included 105,000 acre-feet for sediment control and approximately 500,000 acre-feet for flood control. Between 1975 and 2003, Cochiti Lake has retained approximately 30,760 acre-feet of sediment.

Cochiti Dam is operated by the Corps within the authority of the Flood Control Act of 1960 (P.L. 86-645). Reservoir releases are restricted to the maximum non-damaging capacity of the downstream channel as measured at Albuquerque, approximately 7,000 cfs (USACE 1996). When inflow would exceed the channel capacity of the Rio Grande downstream, flood control storage is initiated. Floodwaters are stored only for the duration required and are evacuated as rapidly as downstream conditions permit. Operation of Cochiti Dam for flood control is coordinated with Jemez Canyon and Galisteo Dams in order to regulate for the maximum safe flow at Albuquerque (7,000 cfs).

Flood storage is normally associated with snowmelt runoff during April through June. Summer flood storage is generally the result of short-term, high intensity thunderstorm events. The maximum water storage to date has been 396,167 acre-feet (water surface elevation 5,434.5 feet), which occurred in 1987. This volume included the permanent pool and flood control storage pools.

Jemez Canyon Dam

The Jemez Canyon Dam and Reservoir Project is located on the Jemez River 2.8 miles upstream from its confluence with the Rio Grande. It is situated in Sandoval County, about 5 miles northwest of Bernalillo, New Mexico, and about 22 miles north of Albuquerque. The Jemez River enters the Rio Grande about 25 miles downstream from Cochiti Dam.

Congressional authority for the construction of Jemez Canyon Dam is contained in the Flood Control Acts of 1948 (P.L. 80-858) and 1950 (P.L. 81-516). The facility regulates Jemez River flows for flood damage reduction and sediment control. Construction of the dam began in May 1950, and it was completed and placed into operation in October 1953. All lands associated with the Jemez Canyon Dam and Reservoir Project (about 6,711 acres) are held in trust by the United States for the benefit and use of the Pueblo of Santa Ana. The Department of the Army and the Pueblo signed a Memorandum of Understanding in 1952 (amended in 1978 by P.L. 95-498) which established a perpetual right and privilege for the construction, operation, and maintenance of the Jemez Canyon Dam and Reservoir Project. The Pueblo of Santa Ana reserved the right to use all associated lands for any purposes not inconsistent with those expressly granted to the Federal Government for the facility.

Jemez River flows passed through Jemez Canyon Dam are restricted to the maximum non-damaging capacity of the downstream channel of the Rio Grande, approximately 7,000 cfs at Albuquerque (USACE 1994). When the passage of inflow to the reservoir would exceed the safe channel capacity of the Rio Grande downstream, flood control storage is initiated. Flood waters are stored only for the duration needed to evacuate the water as rapidly as downstream conditions permit. Operation of Jemez Canyon Dam for flood control is coordinated with Cochiti and Galisteo Dams.

Flood storage is normally associated with snowmelt runoff during April through June. Summer flood storage is generally the result of short-term, high intensity thunderstorm events. The maximum storage to date has been 72,254 acre-feet (water surface elevation 5,220.3 feet), occurring in 1987.

At the time Jemez Canyon Dam was constructed, the Rio Grande downstream from the Jemez River confluence was an aggrading channel. By 1960, sufficient sediment had accumulated within the channel through Albuquerque to raise the river bed 6 to 8 feet above the typical valley floor elevation outside of the levee system (Lagasse 1980). In the spring of 1979, the New Mexico Interstate Stream Commission (NMISC) and the Corps established a sediment retention pool of about 2,000 acre-feet at Jemez Canyon Reservoir using water exchanged from the San Juan-Chama Project. This pool significantly improved the sediment retention. In January 1986 the sediment retention pool was expanded to include the entire unused capacity of the allocated sediment space (about 24,425 acre-feet) to further improve trap efficiency of the reservoir. The pool was created and maintained by capturing native water from the Jemez River in the reservoir and replacing that water to the Rio Grande by releasing San Juan-Chama Project water from upstream storage, usually during the spring runoff period. From closure in 1955 through 1998, Jemez Canyon Reservoir has retained approximately 19,800 acre-feet of sediment.

The Memorandum of Understanding (MOU) between the NMISC and the Corps concerning the establishment and maintenance of the sediment retention pool expired on December 31, 2000. The NMISC cited significantly increased demands on the available water in the region, its increasing cost, and the need for increased sediment loading to the Rio Grande as factors in deciding not to renew the term of the MOU. Approximately 12,000 acre-feet of the sediment retention pool was released in September through October, 2000 (USACE 2000), and the reservoir was completely evacuated in October 2001. Since the pool's evacuation, approximately 190 acre-feet of sand-sized material passes through the dam annually. The Corps currently is investigating structural and non-structural measures to maintain the passage of sediment through the dam.

2.03 PHYSIOGRAPHY AND GEOLOGY

The study area lies along the Rio Grande and is within the Mexican Highland Section of the Basin and Range physiographic province (Fenneman 1931). The study area lies at the northern end of the Albuquerque Basin with Santa Ana Mesa to the northwest and the Sandia Mountains to the southeast. The geology of the area includes a broad rift valley with extensive Quaternary gravel terraces and sand deposits. West of the river, the bedrock is composed of Santa Fe formation sandstone overlain by mesas formed from numerous faults and several intrusive volcanic basalt flows (Chronic 1987). The average riverbed elevation in the study area is about 5,050 feet.

2.04 SOILS

The substrate within the incised Rio Grande channel consists of sand and gravel alluvium with little soil profile development. Peralta loam and, less extensively, Trail loam and Sparham clay loam are the primary series throughout the abandoned floodplain in the study area.

The Peralta series consists of very deep, somewhat poorly drained, moderately permeable soils forming in mixed alluvium on floodplains. Slopes are zero to three percent. Peralta loam is classified as a coarse-loamy, mixed, calcareous, mesic Typic Ustifluvent (NRCS 1999). Peralta soils are not listed as hydric by the National Technical Committee for Hydric Soils (NTCHS 1991). The soil is moist in some or all portions of March through October, and the depth to water table typically is 24 to 36 inches during this period. Typically, the depth to redoximorphic features (mottles) is from 12 to 30 inches and indicates the depth to the fluctuating water table and seasonally saturated soils above the water table (NRCS 1999).

Trail loam consists of very deep, moderately well-drained soils forming in stratified alluvium, predominantly from sandstone. Trail soils are classified as sandy, mixed, mesic Typic Torrifluvents. This soil series occurs on the Rio Grande floodplain, low terraces, and alluvial fans and is neither saline nor sodic. The soil occurs in thin strata of sandy loam, fine sandy loam, very fine sandy loam, loam, and silt loam. Runoff is slow and the permeability is moderately rapid. In these soils, the water table typically is 40 to 60 inches below the surface during the growing season. Trail soils are intermittently moist during periods from July to September and from December to February; the driest period occurs during May and June. The soil moisture regime is classified as Typic aridic (non-hydric).

Sparham clay loam consists of somewhat poorly drained soils. Available water capacity is high within a depth of 60 inches and permeability is slow. Within the soil profile, salinity is slight and there are no sodic horizons. Depth to groundwater is relatively shallow; however, this series is not listed as hydric by the National Technical Committee for Hydric Soils (NTCHS 1991).

2.05 CLIMATE

Climate of the study area is characterized as arid continental—hot summers with a large diurnal range in temperature. Winters vary from moderate in the lower basin to severe in the adjacent mountainous area. The spring and fall transition seasons are usually short. During the summer, northern New Mexico has a higher frequency of thunderstorms than most areas in the United States. Thunderstorms are most active during July and August and usually reach peak activity in late afternoon. Thunderstorm activity ceases in autumn and clear weather prevails between winter frontal passages. The average growing season is about 165 days (NRCS 1999).

Since the installation of the weather station at Jemez Canyon Dam in 1954, the maximum annual precipitation was 13.88 inches in 1987 and the minimum was 2.40 inches in 1956. The maximum recorded 24-hour rainfall was 2.75 inches in October 1960. Mean annual precipitation at Bernalillo is 9.00 inches; mean monthly precipitation is given in Table 1. About one-third of the annual precipitation occurs during July and August as thunderstorms.

Table 1. Monthly temperature, precipitation, and evaporation at Bernalillo, New Mexico.

Month	Average daily minimum temp. (°F)[a]	Average daily maximum temp. (°F)[a]	Precipitation (inches) [a]	Evaporation (inches; Class A pan) [b]
January	19	49	0.45	2.98
February	22	55	0.46	4.50
March	28	63	0.57	7.67
April	35	72	0.51	9.73
May	43	81	0.64	12.67
June	51	91	0.49	14.48
July	59	94	1.40	13.74
August	57	91	1.54	11.68
September	49	84	0.99	9.50
October	37	73	0.94	6.88
November	25	59	0.49	4.12
December	19	50	0.51	2.97
Annual	37	72	9.00	100.92

[a] Data from NRCS (1999).
[b] Data from USACE (1994).

During the winter months, heavy snowfall occurs in the Jemez Mountains but snow is light in the study area. Snow remains in the mountainous areas above elevation 7,000 feet from December into April. Below 7,000 feet in elevation, snow seldom stays on the ground more than a few days. The average annual snowfall varies from 10 inches at Jemez Canyon Dam to over 100 inches in the mountains.

Surface winds, controlled by valley topography, are from the south in the summer and from the north in winter with annual wind velocity averaging about 10 miles per hour.

2.06 HYDROLOGY

Hydrology in the Middle Rio Grande Valley (*i.e.*, Cochiti Lake to Elephant Butte Lake) follows a pattern of high flows during spring snowmelt runoff and low flows during the fall and winter months. Additional, short duration, high flows result from thunderstorms that occur in late summer and fall. Middle Rio Grande hydrology has been altered due, in part, to the influence of flood control dams. Cochiti Dam primarily acts to decrease peak flows and has a much smaller impact on low flows; therefore, average annual flows have been less affected, while peak flows have been reduced. Average yearly hydrographs for pre- and post-Cochiti Dam periods through 1999 are shown in Figure 1. (Drought years were not included in the pre- and post-dam analysis.) The annual hydrographs illustrate that the closure of Cochiti Dam has reduced the peak flows and extended the duration of the high flow period. Average winter base flows are somewhat larger during the post-dam period.

Review of annual peak discharge data also exhibits the influence of flood control. Historical annual peak discharges recorded at the San Felipe gage (approximately 15 river-miles downstream from Cochiti Dam) illustrate the effects of regulation on the Rio Grande (Figure 2). From 1927 to 1945 flows in excess of 20,000 cfs were experienced approximately every five years. From 1945 to the construction of Cochiti Dam in 1973, floods in excess of 10,000 cfs were fairly common with the exception of drought years. Following construction of Cochiti Dam, regulation has prevented downstream flows from exceeding 10,000 cfs. This has reduced the average annual peak discharge from 9,800 cfs to 5,700 cfs for the pre- and post-dam periods, respectively. A study to determine the effects of regulation on Middle Rio Grande flood hydrology was performed by the U.S. Bureau of

Reclamation Flood Hydrology Group (Bullard and Lane 1993). This study estimated return period floods at ten gaging stations on the Middle Rio Grande. The study applied a procedure to develop discharge values for regulated (dam) and unregulated (no-dam) conditions. Table 2 summarizes the 2-, 5-, and 10-year discharges at the San Felipe and Albuquerque gaging stations as determined from this study.

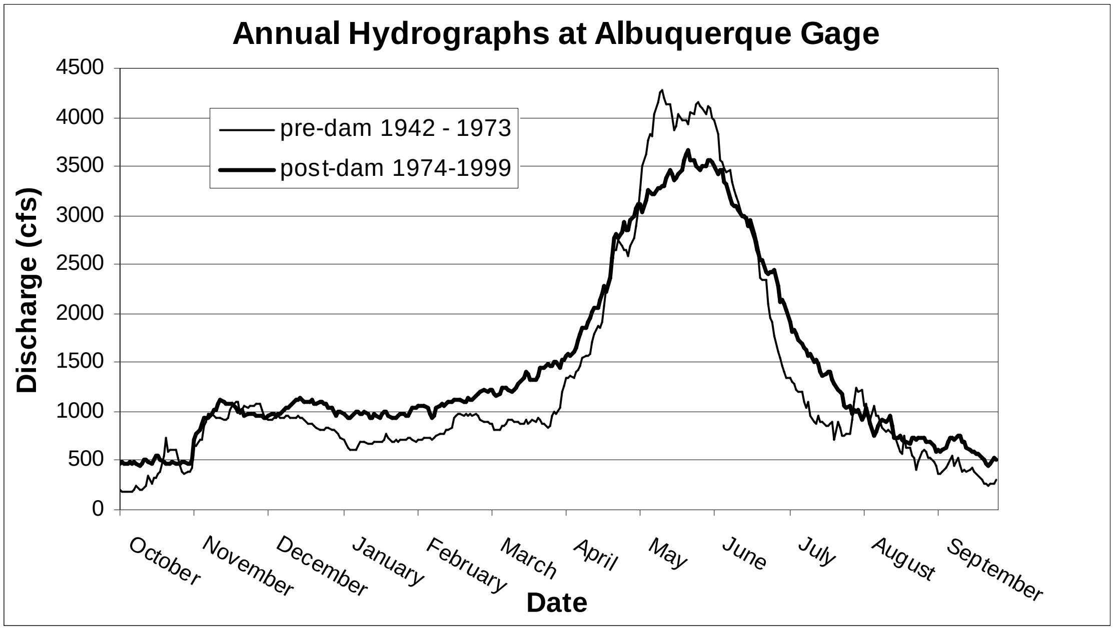

Figure 1. Average annual hydrograph at Albuquerque gaging station for pre- and post-Cochiti Dam periods. (U.S. Geological Survey data compiled by Ayres Associates.)

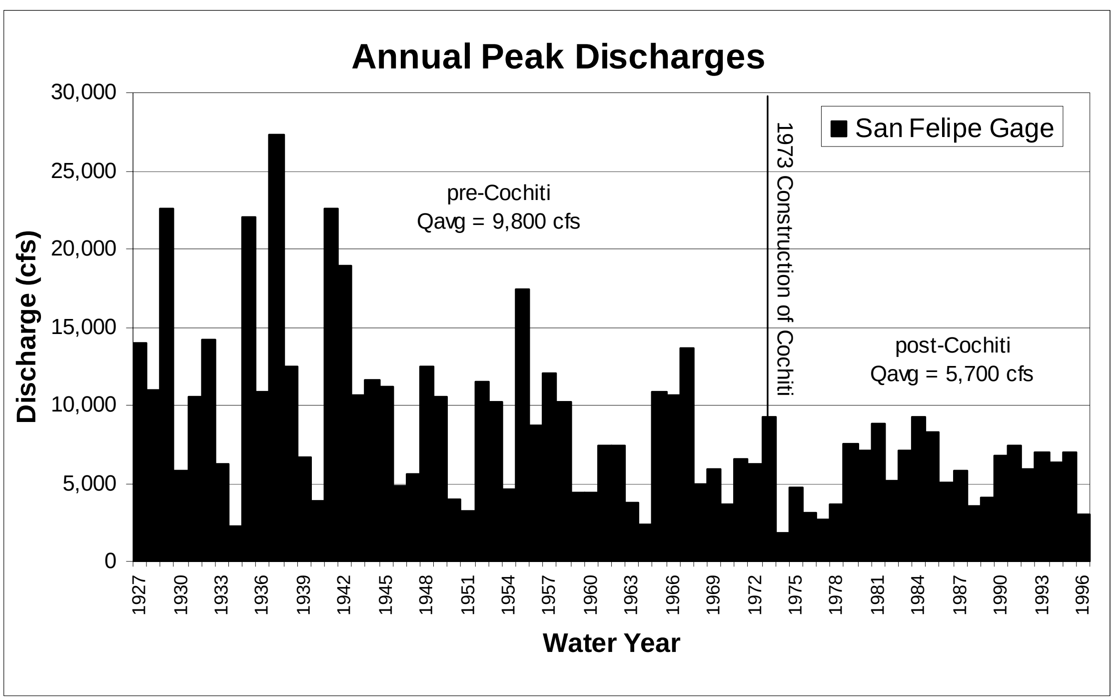

Figure 2. Annual peak discharges at the San Felipe gage. (U.S. Geological Survey data compiled by Ayres Associates.)

Table 2. U.S. Bureau of Reclamation flood flow discharges (cfs) for regulated and unregulated conditions.

Return Period	San Felipe gauge		Albuquerque gauge	
	Unregulated	Regulated	Unregulated	Regulated
2-year	11,166	5,650	10,647	4,820
5-year	16,965	9,330	15,114	7,450
10-year	20,762	10,000	17,899	9,090

Flood control dams have acted to reduce flood flows by approximately a factor of two (Table 2). This is significant with respect to geomorphology since channel-forming processes are assumed to be dominated by discharges within the range of the 2- to 10-year recurrence intervals. The Rio Grande study by Bullard and Lane (1993) included flood flow data up through 1988. An independent analysis including peak flows through 1996 verified that the data provided by Bullard and Lane is valid for the current conditions.

2.07 GEOMORPHOLOGY, HYDRAULICS AND SEDIMENT

Channel Geometry and Hydraulics

A river channel's geometry and its adjustment to changing conditions are dependent on many factors. Discharge is the dominant variable that affects channel morphology but sediment transport, channel bed and bank material, and other hydrologic factors also are important influences.

Channel geometry results from a range of discharges over time, but it is convenient to select a single value for the basis of analysis and design. An effective discharge calculation was completed for post-dam conditions in the Santa Ana reach to provide a basis for geomorphic comparisons and sediment transport calculations. Because this reach is incised, the term "bankfull" is problematic; therefore, the dominant/effective discharge was adopted for the analyses. The effective discharge calculated from the flow record at the San Felipe gage was approximately 6,000 cfs, and the value for the Albuquerque gage was 5,500 cfs. For the Santa Ana reach, the effective discharge was selected as 5,800 cfs, an average of the San Felipe and Albuquerque values. (This flow rate is slightly greater than the 2-year discharge of 5,400 cfs.)

Historically, the morphologic characteristics of the Middle Rio Grande channel were those of a wide and shallow river. The channel was described as a sand-bed stream (Nordin and Beverage 1965) with a braided pattern (Lane and Borland 1953) likely resulting from sediment overload (Woodson 1961). The river followed a pattern of scouring and filling during floods and was in an aggrading regime (*i.e.*, accumulating sediment). Flood hazards associated with the aggrading riverbed prompted the Middle Rio Grande Conservancy District to build levees along the floodway during the 1930s. However, the levee system confined the sediment and increased the rate of aggradation in the floodway. By 1960 the river channel near Albuquerque was 6 to 8 feet above the elevation of lands outside the levees (Lagasse 1980). Additional channel rectification works included Kellner jetty-jacks installed during the 1950s and 1960s for bank stabilization. Construction of mainstem and tributary dams at Jemez Canyon (1953), Abiquiu (1963), Galisteo Creek (1970), and Cochiti (1975) was expected to slow aggradation or reverse the trend and promote degradation in the Middle Rio Grande Valley. The flood damage reduction improvements have reduced the sediment load in the Middle Rio Grande and accomplished flood control objectives for much of the river valley.

The combined result of dams and other water resource development projects has been significant degradation of the Rio Grande channel in the 33-river-mile reach from Cochiti Dam downstream to Corrales (Mussetter Engineering, Inc. 2003). In the Santa Ana reach, degradation has resulted in channel bed lowering and the virtual elimination of inundation of the historic floodplain. Hydraulic modeling revealed that the west-side floodplain is approximately 4 feet above the current water surface elevation of the effective discharge of 5,800 cfs. Currently, inundation of the historic floodplain would begin at discharges of approximately 15,000 cfs.

From Angostura Diversion Dam downstream to Corrales—approximately 16 river-miles, and encompassing the study area—a flattening of the riverbed slope has been the general trend since 1971 indicating that reduced sediment supply is the primary factor of degradation. The slope reduction results in a lowering of the channel bed from upstream to downstream as water entrains sediment from the channel bed and banks. Under the reduced sediment conditions this process continues until the sediment transport capacity equals that supplied from upstream. Alternatively, the degradation could stop if the channel becomes armored or structural controls stabilize the channel slope: the Gradient Restoration Features recently installed have arrested degradation in the upper 5 miles of the reach.

A comparison of minimum channel elevation (thalweg) profiles in the Santa Ana reach is presented in Figure 3. The profiles indicate more than 10 feet of degradation at the upstream end of the reach and approximately 5 feet at the lower end since 1971. The profiles become flatter and slightly longer through time. The lengthening of the profiles results from meandering of the main channel. The channel lowering and decrease in channel slope are indicative of adjustment to the reduced sediment supply.

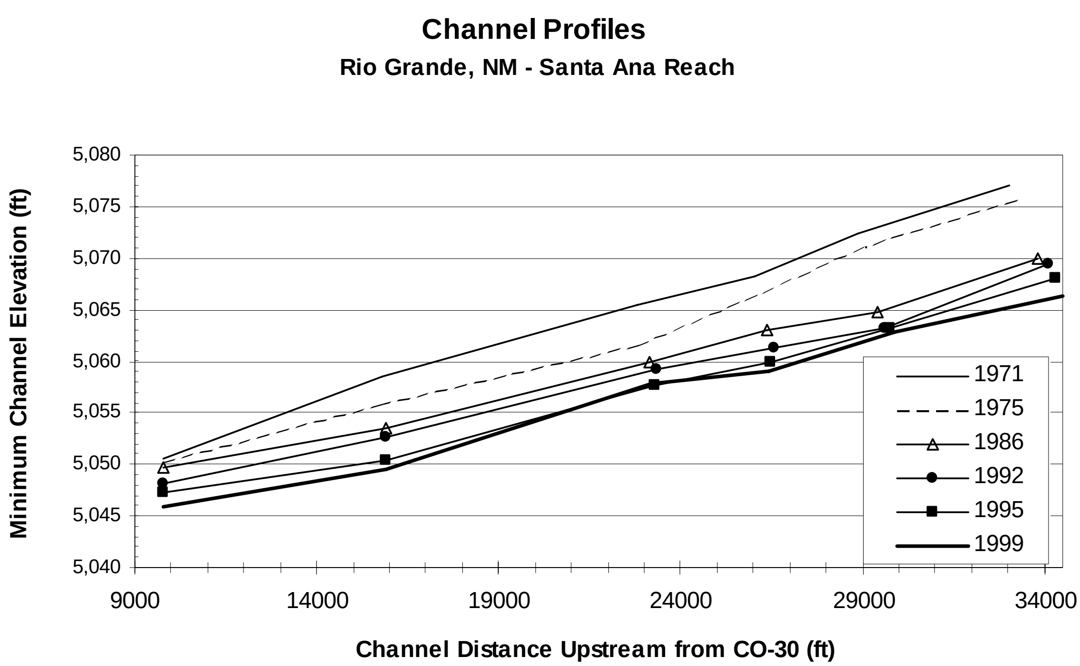

Figure 3. Historical channel profiles. (Elevation datum is NGVD).

In the study area, the channel slope has generally decreased from greater than 0.001 ft/ft to approximately 0.00085 ft/ft since construction of Cochiti Dam. A slight increase in the slope was observed from 1995 to 1999 which could be attributed to temporary adjustment to sediment inflows from tributaries and lower than average discharge in the Middle Rio Grande mainstem since 1995.

Comparison of channel cross sections also illustrates the magnitude of degradation in the Santa Ana reach. As an example, historical surveys of Cochiti Rangeline CO-24 are presented in Figure 4. The transition from a wide shallow channel to the existing entrenched condition is clearly evident in the comparative cross sections.

Hydraulic variables at the post-dam effective discharge were averaged over the nearly 5-mile-long Santa Ana reach from Cochiti Rangelines CO-24 to CO-29.[2] A comparison of reach-averaged main channel hydraulic variables is shown in Figure 5. The effects of incision on hydraulics and channel geometry include decreased channel width and increased depth and velocity. This is significant to aquatic habitat in that fewer shallow, low-velocity areas are available to fish. The effective channel width has decreased from approximately 600 feet to less than 300 feet. Simultaneously, the channel depth has increased by a factor of two. This translates into a significant decrease (by a factor of four) in the width-depth ratio, a parameter used to describe the level of entrenchment.

Sediment

Observation of historical suspended sediment data indicates significant reductions in sediment load following construction of flood control dams. Prior to construction of Cochiti Dam, the average annual suspended sediment load was on the order of 4 million tons per year. This has been reduced to an average of approximately 1 million tons per year.

Cross sections from 1975, 1986, 1992, 1995, and 1999 were compared to compute sediment losses in the study reach since construction of Cochiti Dam. Comparison of the cross sections indicates that the Santa Ana reach has been losing approximately 140,000 tons of sediment per year from 1975 to 1995. Somewhat less degradation was experienced from 1995 to 1999 due to lower than average discharge during this period.

[2] The Cochiti Dam aggradation/degradation rangelines referred to throughout this document are a series of cross-sections spanning the Rio Grande channel between Cochiti Dam and Elephant Butte Lake. The cross-sections are measured periodically to monitor changes in channel characteristics. Rangelines CO-24 through CO-30 are within or near the Santa Ana reach and the locations of several are shown on Plate 3. For reference, the approximate locations of rangelines and nearby structures are given below. (Proposed work in the channel would occur between rangelines CO-26 and CO-29.)

Approximate distance upstream from Cochiti rangeline CO-30.

Rangeline or feature	Distance (feet)	Distance (miles)
Angostura Diversion Dam	39,810	7.54
CO-24	34,530	6.54
Jemez River confluence	33,480	6.34
CO-26 (& GRF #1)	26,450	5.01
CO-27	23,220	4.40
CO-28	15,930	3.02
CO-29	9,830	1.86
US Highway 550 bridge	8,230	1.56
CO-30	0	0.00

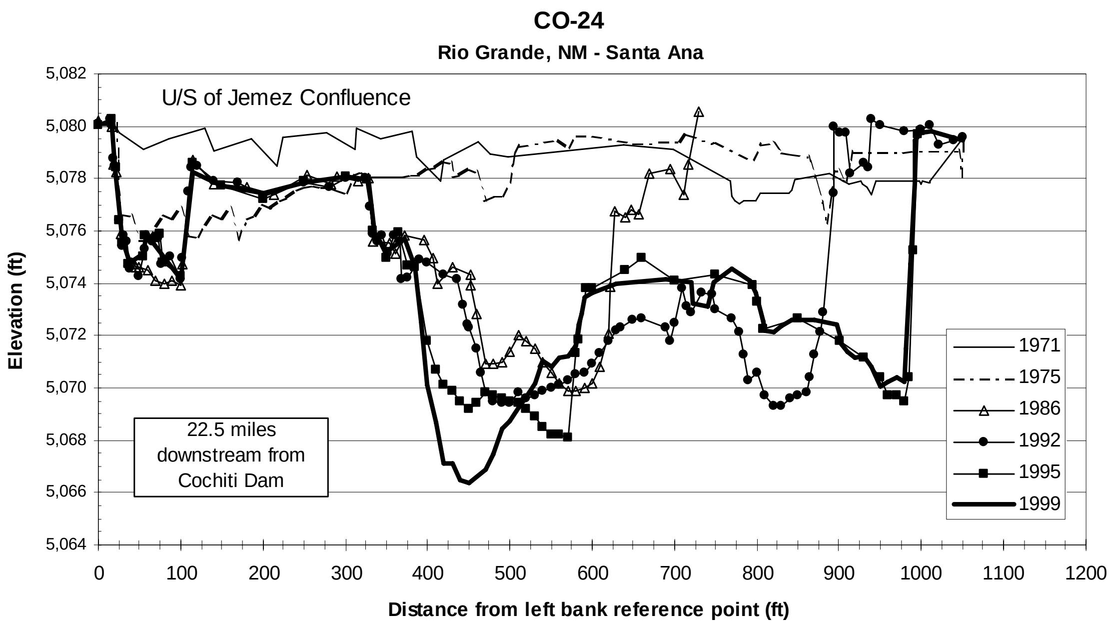

Figure 4. Historical cross sections at Cochiti Rangeline CO-24. (Elevation datum is NGVD).

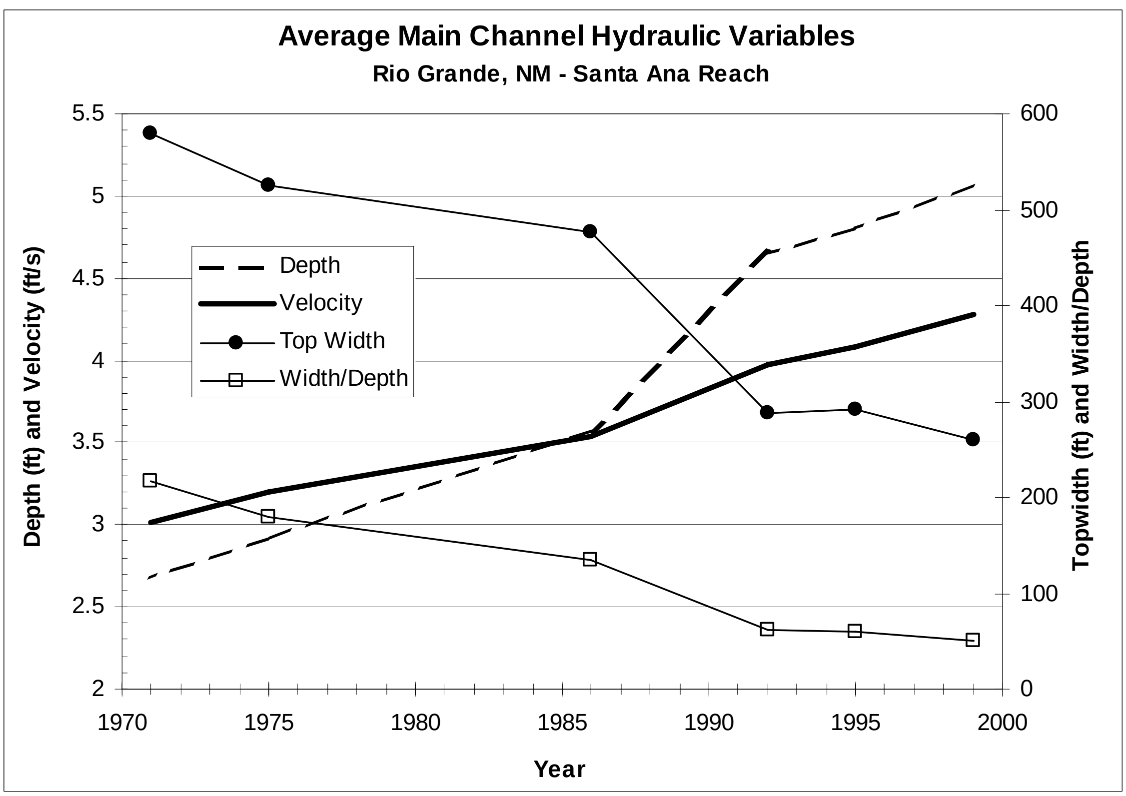

Figure 5. Reach-averaged channel hydraulic variables.

The riverbed material generally has become more coarse over time as fine sediments are trapped by dams upstream or removed from the channel bed downstream. Prior to dam construction the median bed material was on the order of 0.2 mm in size, which is indicative of fine sand. Recent bed material samples indicate a median size on the order of 7 to 20 mm which is in the gravel range.

Since the evacuation of the Jemez Canyon Reservoir sediment retention pool in October 2001, the dam has operated with open gates, passing all inflow. Between October 2001 and August 2005, approximately 600 acre-feet of previously trapped sediment has passed through the dam. An additional estimated 600 acre-feet of sand-sized, bed material has passed through the reservoir from the upstream reach in the same time period. Much of this material has accumulated in the Rio Jemez below the dam. It is expected that approximately 300 acre-feet of sand-sized material will continue to pass through the dam on an annual basis (Ayres Associates 2006). While this is a substantial increase in sediment input, no appreciable change in the bed elevation of the Rio Grande has yet been observed.

Recent Structural Improvements

In 1998, the U.S. Bureau of Reclamation (Reclamation) investigated routine bank stabilization measures where active bank erosion persistently threatened the riverside levee on the east side of the Rio Grande about 0.5 mile downstream of the Jemez River confluence. Rather than continue with traditional maintenance activities, a more permanent solution to the problem was sought in coordination with the Pueblo. Under their River Maintenance Program, Reclamation has improved riverine habitat in the 2-mile reach near the Jemez River confluence through the creation of a wider operational channel and floodplain, resulting in reduced water velocities, decreased flow depth, increased width-to-depth ratios, and increased sediment deposition. A Gradient Restoration Facility (GRF)—reinforced sheetpile across the channel with a riprap apron extending 500 feet downstream—was installed approximately 1.3 miles downstream from the Jemez River confluence.

In March 2005, the Corps and the Pueblo completed construction of two additional GRFs approximately 0.9 and 1.9 miles, respectively, downstream from the Bureau's structure. The Corps' structures consist of a perpendicular sheet pile wall extending approximately two feet above the channel bed and a gently sloped, downstream riprap apron approximately 400 feet long. The apron facilitates upstream passage of small native fish. Additionally, a 200-foot-long bed-sill composed of launchable gravel was installed downstream from the GRFs to provide a transition between the stabilized channel and the downstream reach which is expected to continue to degrade.

2.08 WATER QUALITY

Section 404 of the Clean Water Act provides for the protection of "waters of the United States" from impacts associated with irresponsible or unregulated discharges of dredged or fill material in aquatic habitats, including wetlands as defined under Section 404(b)(1).

Section 401 of the Clean Water Act requires that a Water Quality Certification Permit be obtained for anticipated discharges associated with construction activities or other disturbance within waterways. Clean Water Act enforcement within the Santa Ana Indian Reservation is the responsibility of the U.S. Environmental Protection Agency (EPA). When assessing water quality impacts of specific projects on tribal lands, the EPA commonly takes into consideration the standards set by neighboring governments.

From the southern boundary of the reservation (near the Highway 550 bridge) to the northern boundary of the Pueblo of Sandia about 1.2 miles downstream, the State of New Mexico is responsible for water quality certification permits and standards. The New Mexico Water Quality Control Commission describes the designated uses for the Rio Grande from Angostura Diversion downstream to the Alameda Bridge in Albuquerque as irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact (20 NMAC 6.1; February 23, 2000). State regulations contain a qualitative general standard for turbidity: "Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water" (20 NMAC 6.1, Section 1105K).

Within the Pueblo of Sandia, designated uses along the Rio Grande include warmwater fishery, primary contact ceremonial use, secondary contact recreational use, agricultural water supply, and industrial water supply (Pueblo of Sandia 1993).

Numeric standards that must be maintained in surface waters downstream from the project area are listed in Table 3. Standards for metal and organic constituent concentrations are described in appropriate regulations (20 NMAC 6.1, Section 3100; Pueblo of Sandia 1993).

Section 402(p) of the Clean Water Act specifies that storm water discharges from construction sites must be authorized under the National Pollution Discharge Elimination System. Construction sites are defined as areas of clearing, grading, and excavation activities that disturb one acre or more.

Table 3. Selected numeric water quality standards for physical and biological characteristics, and inorganic substances for the Rio Grande downstream from the project area.

Parameter	State of New Mexico [a]	Pueblo of Sandia [b]
Dissolved oxygen	> 5.0 mg/L	≥ 5.0 mg/L
PH	6.6 – 9.0	6.0 – 9.0
Temperature	< 90 °F	≤ 90 °F
Fecal coliform bacteria:		
Monthly geometric mean	< 200/100 mL	≤ 100/100 mL
Single sample	< 400/100 mL	≤ 200/100 mL
Total dissolved solids	< 1,500 mg/L [c]	–
Sulfate	< 500 mg/L [c]	–
Chloride	< 250 mg/L [c]	–
Total residual chlorine	–	≤ 0.011 mg/L
Turbidity	–	≤ 25 NTU

[a] 20 NMAC 6.1, Sections 2105.1 and 3100.
[b] Pueblo of Sandia (1993)
[c] Monthly average concentration at mean monthly flows above 100 cfs.

2.09 AIR QUALITY AND NOISE

Sandoval County is within the Environmental Protection Agency's Air Quality Control Region 152 (State of New Mexico Region 2) (NMED 1997). The County is in attainment status for National Ambient Air Quality Standards for priority pollutants (particulate matter, sulfur oxides, nitrogen dioxide, carbon monoxide, ozone, and lead), meaning that ambient air quality meets or exceeds State and Federal standards. Generally, the only air pollutant of concern in the area is particulate matter (blowing dust during periods of high winds). In the State's Prevention of Significant Deterioration program administered by the New Mexico Environment Department, the region is designated Class II, which allows for moderate development and its associated air emissions. The nearest Mandatory Class I area from the Pueblo of Santa Ana is the Bandelier Wilderness Area, approximately 28 miles to the north.

Existing noise levels in the project area are very low, as is typical of rural locations. The major source of ambient noise is automobile, train, and air traffic.

2.10 ECOLOGICAL SETTING

Plant Communities and Recent Restoration Activities

The study area lies within the Plains and Great Basin Grassland biotic community as defined by Brown and Lowe (1980). Vegetation typical of this community dominates the upland area west of the historic Rio Grande floodplain. Dominant species include black grama, New Mexico feathergrass, western wheatgrass, galleta, sand dropseed, ring muhly, four-wing saltbush, sand sagebrush, and sparsely distributed one-seed juniper (Dick-Peddie 1993). [Common and scientific names of plant and animal species are listed in the Fish and Wildlife Coordination Act Report contained in Appendix A.]

The Middle Rio Grande Valley has one of the highest value riparian ecosystems remaining in the Southwest (Crawford *et al.* 1993). Historically, riparian plant communities were dominated by a cottonwood overstory, with a coyote willow and saltgrass-dominated understory. Other common riparian shrub species included New Mexico olive, seep-willow, false indigo bush, and wolfberry. Wetlands were common, frequently vegetated with cattails, sedges, spikerush, rushes, and yerba mansa (Scurlock 1998).

The existing riparian community in the Middle Rio Grande Valley and in the project area is a result of alteration of the flow regime; drainage for agriculture and development; flood control; channelization and Kellner jetty-jack fields; livestock grazing; beaver activity; and the spread of non-native saltcedar and Russian olive. Natural wetlands no longer occur within the Santa Ana reach of the Rio Grande.

There are approximately 1,400 acres of riparian habitat bordering the river within the Santa Ana Indian Reservation. A mature cottonwood overstory is present throughout approximately one third of this area. Saltcedar and Russian olive are common understory plants, replacing native vegetation such as cottonwood and coyote willow in many areas. In accordance with their overall restoration plan, the Pueblo of Santa Ana has cleared non-native vegetation from nearly 720 acres, leaving large cottonwoods and native shrubs intact. The Pueblo has encouraged natural establishment or specifically revegetated cleared bosque areas with a suite of native vegetation such as cottonwood and Gooding's willow, coyote willow, seep-willow, and New Mexico olive.

The Pueblo and the Bureau of Reclamation have recently cooperated to lower a 45-acre overbank area to facilitate inundation by flows with a return period of 2 to 5 years and was vegetated with native riparian trees and shrubs. The overbank area also included approximately 10 acres of willow-dominated.

Over the past several years, the Pueblo also has accomplished the following restoration activities within the study area:

- Removal of 110 acres of dense saltcedar, remediation of saline and sodic soils, and replanting native, salt-tolerant grasses;
- Cessation of livestock grazing in the riparian area and management as a nature preserve;
- Removal of 1,600 obsolete Kellner jetty-jacks from the abandoned floodplain; and
- Compilation of baseline vegetation, soil, and hydrologic data.

East of the river and bosque is the Bernalillo Riverside Drain, and its attendant levee, maintained by the Middle Rio Grande Conservancy District. Agricultural fields and rural residences are present east of the levee.

The proposed waste spoil deposition area is located along the upland margin of Jemez Canyon Reservoir. Vegetation within the area consists of a monotypic stand of sparse to moderately dense saltcedar, approximately 4 to 8 feet in height.

Fish

Aquatic habitat in the Middle Rio Grande Valley has been altered by flood control dams, irrigation diversion dams, levees, jetty-jack fields, and drainage for agriculture and development (Crawford *et al.* 1993). In the project area, the altered sediment and flow regimes have resulted in the transformation from a wide, braided sand-bed system to a single, incised, gravel-bed channel with no appreciable active floodplain (USBR 1999). Wetlands and large slackwater areas are generally no longer available for aquatic organisms. From Cochiti Dam downstream nearly to Albuquerque, the cold, clear water released from the reservoir and the entrenched channel with a gravel bed have created an aquatic system that favors cool-water fishes and invertebrates, and limits warmwater fisheries. Consequently, the existing aquatic communities in the project area differ than those that occurred historically (Crawford *et al.* 1993).

The native ichthyofauna of the New Mexico portion of the Rio Grande is believed to have consisted of between 16 and 27 species (depending on location; Hatch 1985, Smith and Miller 1986, Propst *et al*. 1987), four of which were endemic to the basin. Of the latter, the Rio Grande shiner, phantom shiner, and Rio Grande bluntnose shiner no longer survive in the New Mexico portion of the river. The Rio Grande silvery minnow is the only surviving endemic Rio Grande fish and now occupies less than 5 percent of its total former range (Bestgen and Platania 1991). The loss of many native fish species in the Middle Rio Grande illustrates that the hydrological, morphological, and ecological changes in the channel have had a major impact on aquatic resources.

Fish surveys conducted within three river-miles upstream and downstream from the study area serve to characterize ichthyofauna in the study reach (Lang and Platania 1993, NMDGF 1997, Dudley *et al*. 2006b). The most abundant fish species included red shiner, flathead chub, and western mosquitofish, followed by white sucker, fathead minnow, and Rio Grande silvery minnow, gizzard shad, longnose dace, and channel catfish. This general composition of the existing fish community has been confirmed by recent surveys performed by the Pueblo (pers. comm., Brian Bader, Pueblo of Santa Ana Dept. of Natural Resources).

In 1998 through 2000, the U.S. Fish and Wildlife Service's Fishery Resources Office completed three surveys of fishes in the lower Rio Jemez in cooperation with the Pueblo of Santa Ana. Common carp was the most abundant fish, followed by white sucker, fathead minnows, and Rio Grande silvery minnow (USFWS 2000).

Wildlife

Hink and Ohmart (1984) performed systematic faunal surveys throughout the Middle Rio Grande Valley, including portions of the Santa Ana Indian Reservation. That report and additional observations by biologists from the Corps and the Pueblo of Santa Ana form the basis of the following descriptions.

Large mammals from higher elevations in the Jemez Mountains that occasionally are observed along the Rio Grande include elk, mule deer and black bear. Other mammals such as coyote, raccoon, beaver, muskrat, long-tailed weasel, badger, bobcat, and striped skunk could be found in the project vicinity. Nuttall's and desert cottontails, black-tailed jackrabbit, rock squirrel, pocket gopher, deer mouse, western harvest mouse, white-throated woodrat, kangaroo rat and American porcupine are also likely to occur in the project area.

Hink and Ohmart (1984) found that riparian areas are used extensively by most bird species in New Mexico. Cottonwood-dominated community types are preferred habitat for a large proportion of bird species, especially during the breeding season. Generally, the abundance of breeding birds increases with the complexity and density of vegetation structure, which is thought to be related to the increased food, cover, or nest substrate it provides. Along the Rio Grande, the highest breeding densities typically have been found in marshes, cottonwood stands with a well developed shrub understory, and in tall shrub stands (Hink and Ohmart 1984, Hoffman 1990, Thompson *et al*, 1994, Stahlecker and Cox 1996, HAI 2006). Saltcedar and woodland stands with a sparse understory generally support fewer breeding birds. Species known to be breeding in or near the riparian zone of the study area include Black-crowned Night-Heron, Black-chinned Hummingbird, Northern Flicker, Downy Woodpecker, Northern Rough-winged Swallow, Bewick's Wren, Black-billed Magpie, Common Raven, White-breasted Nuthatch, American Robin, Spotted Towhee, Summer Tanager, Yellow-breasted Chat, Blue Grosbeak, and Black-headed Grosbeak. Game species in the area include Mourning Dove and Scaled Quail. Raptors typical of northern New Mexico that may occur seasonally in the project area include the Bald Eagle, Turkey Vulture, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, Swainson's Hawk, American Kestrel, Western Screech-Owl, and Great Horned Owl.

Marshes, drains, and areas of open water contribute to the diversity of the riparian ecosystem as a whole because of their strong attraction to waterbirds. The Rio Grande in and near the project area provides habitat, on a seasonal basis, for Double-crested Cormorant, Canada Goose, Mallard, Gadwall, Green-winged Teal, and Northern Shoveler, and Sandhill Crane. Spotted Sandpiper and Killdeer breed along the Rio Grande channel.

The Rio Grande is a major migratory corridor for songbirds (Yong and Finch 2002), waterfowl, and shorebirds. At various times of the year, riparian areas support the highest bird densities and species numbers in the Middle Rio Grande basin. Both the river channel and the drains adjacent to the bosque provide habitat for species such as Mallards, Wood Ducks, Great Blue Herons, Snowy Egrets, Green Herons, Belted Kingfishers and Black Phoebes. Agricultural fields and grasslands with little woody vegetation are important food sources for sparrows and other songbirds during migration and winter.

Most amphibians depend on aquatic habitat for at least a portion of their life cycle. Amphibians associated with wetter riparian areas, wet meadows, and marshes include chorus frogs, leopard frogs, and bullfrogs (Crawford *et al.* 1993). The presence of these species is limited in the project area by a lack of wet meadows or marshes. Amphibians likely common to the habitat types in the general project area (riparian and adjacent upland) include tiger salamander, New Mexico spadefoot, Great Plains toad, Woodhouse's toad, bullfrog, and northern leopard frog (Degenhardt *et al.* 1996).

Reptiles which may occur in the habitat types within and adjacent to the project area include the snapping turtle, spiny softshell, collared lizard, lesser earless lizard, shorthorned lizard, roundtail horned lizard, prairie lizard, little striped whiptail, New Mexico whiptail, Great Plains skink, ringneck snake, coachwhip, striped whipsnake, bullsnake, common garter snake, blackneck garter snake, smooth green snake, western diamondback rattlesnake, and prairie rattlesnake (Degenhardt *et al.* 1996).

2.11 ENDANGERED AND PROTECTED SPECIES

As the quality and quantity of the fish and wildlife habitat within the Middle Rio Grande Valley has decreased over time, so has its ability to sustain native flora and fauna. Several species endemic to the valley have been placed on the Federal threatened and endangered species list under the Endangered Species Act. Listed species that could potentially occur within the project area include the Rio Grande silvery minnow and Southwestern Willow Flycatcher. No Federally-listed plant species are likely to occur within project area, and none have been detected by Corps of Engineers and Pueblo of Santa Ana biologists.

Rio Grande Silvery Minnow

The Rio Grande silvery minnow (*Hybognathus amarus*) was formerly one of the most widespread and abundant species in the Rio Grande basin of New Mexico, Texas, and Mexico (Bestgen and Platania 1991). At the time of its listing as endangered, the silvery minnow was restricted to the Middle Rio Grande in New Mexico, occurring only from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir—only 5 percent of its historic range (Platania 1991). The Rio Grande silvery minnow was listed as federally endangered under the Endangered Species Act in July 1994 (USFWS 1994). The species is listed by the State of New Mexico as an endangered species, Group II. The U.S. Fish and Wildlife Service (Service) documented that de-watering of portions of the Rio Grande below Cochiti Dam through water regulation activities, the construction of main stream dams, the introduction of non-native competitor/predator species, and the degradation of water quality as possible causes for declines in Rio Grande silvery minnow abundance (USFWS 1993a). A recovery plan for the silvery minnow has been completed (USFWS 1999) and a draft revised recovery plan (USFWS 2007) was released by the Service in January 2007.

Critical habitat for this species was designated in the Middle Rio Grande Valley in July 1999 (USFWS 1999a) and included the reach encompassing the study area. As a result of litigation, this designation was rescinded, and the U.S. Fish and Wildlife Service re-designated critical habitat in February 2003 (USFWS 2003). Currently, the critical habitat extends from Cochiti Dam downstream for 157 miles; however, the Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta are excluded. Constituent elements of critical habitat required to sustain the Rio Grande silvery minnow include stream morphology that supplies sufficient flowing water to provide food and cover needs for all life stages of the species; water quality to prevent water stagnation (elevated temperatures, decreased oxygen, etc.); and water quantity to prevent formation of isolated pools that restrict fish movement, foster increased predation by birds and aquatic predators, and congregate disease-causing pathogens.

The Rio Grande silvery minnow is a moderately sized, stout minnow, reaching 3.5 inches in total length, which spawns in the late spring and early summer, coinciding with high spring snowmelt flows (Sublette *et al.* 1990). Spawning also may be triggered by other high flow events such as spring and summer thunderstorms. This species is a pelagic spawner, producing neutrally buoyant eggs that drift downstream with the current (Platania 1995). As development occurs during the drift—which may last as long as a week depending on temperature and flow conditions— the larvae seek quiet waters off-channel; however, considerable distance can be traversed by the drifting, developing eggs (Sublette *et al.* 1990, Bestgen and Platania 1991, USFWS 1993a, Platania 1995). Maturity for this species is reached toward the end of the first year. Most individuals live one year, with only a very small percentage reaching age two (Sublette *et al.* 1990, Bestgen and Platania 1991, USFWS 1993a).

Natural habitat for the Rio Grande silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are lower than in the main channel. Areas with detritus and algal-covered substrates are preferred. The lee sides of islands and debris piles often serve as good habitat. Stream reaches dominated by straight, narrow, incised channels with rapid flows would not typically be occupied by the Rio Grande silvery minnow (Sublette *et al.* 1990; Bestgen and Platania 1991).

In the proposed project area, past actions have reduced the total habitat from historic conditions and altered habitat conditions for the Rio Grande silvery minnow. Narrowing and deepening of the channel, lack of side channels and off-channel pools, and changes in natural flow regimes have all adversely affected the Rio Grande silvery minnow and its habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (USFWS 1993a). In addition, Angostura Diversion Dam directly upstream of the project area blocks upstream migration and restricts species redistribution. Cochiti Dam, approximately 25 miles upstream of the project area, also acts as a barrier. The coarser substrate, deeper channel, and higher velocities that occur in the incised channel downstream of dams do not provide the conditions where large numbers of Rio Grande silvery minnows are known to occur.

Within the Santa Ana Indian Reservation, the minnow is known to occupy the Rio Grande, and the Jemez River downstream from Jemez Canyon Dam. Surveys in 2006 (Dudley *et al*. 2006b) detected silvery minnows in the Rio Grande both upstream and downstream from the study area. The fish appears to be regularly present in relatively low numbers compared to downstream reaches. Silvery minnows are likely present in the lower Jemez River (USFWS 2000) opportunistically during relatively low-flow periods; higher discharges may move the fish downstream to the Rio Grande.

<u>Southwestern Willow Flycatcher</u>

The Service listed the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) as endangered in February 1995 (USFWS 1995a). The flycatcher also is classified as endangered by the State of New Mexico (NMDGF 1987). The current range of the flycatcher includes Arizona, New Mexico, southern California, western Texas, southwestern Colorado, and southern portions of Nevada and Utah (Unitt 1987; Browning 1993). In New Mexico, flycatchers are known to breed in the Rio Grande, Zuni, San Francisco, and Gila river drainages. Available habitat and overall numbers have declined statewide (USFWS 1997). A recovery plan for the flycatcher (USFWS 2002) has been completed.

Loss and modification of nesting habitat is the primary threat to this species (Phillips *et al.* 1964; Unitt 1987; and USFWS 1993b). Loss of habitat used during migration also threatens the flycatcher's survival. Large-scale losses of southwestern wetland and cottonwood-willow riparian habitats used by the flycatcher have occurred (Phillips *et al.* 1964; Carothers 1977; Rea 1983; Johnson and Haight 1984; Howe and Knopf 1991).

The flycatcher is an obligate riparian species and nests in thickets associated with streams and wetlands where dense growth of willow, buttonbush, boxelder, Russian olive, saltcedar, or other shrubs are present. Nests are frequently associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now rare, widely separated, and occur in small and/or linear patches. Flycatchers nest in stands with a densely vegetated understory approximately 10 to 23 feet or more in height. Surface water or saturated soil is usually present within or adjacent to occupied thickets (Phillips *et al.* 1964; Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the breeding season with only damp soil present by late June or early July (Muiznieks *et al.* 1994; Sferra *et al.* 1995). Habitats not selected for nesting include narrow (less than 30 feet wide) riparian strips, small willow patches, and stands with low stem density.

Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not utilized for nesting may still be used during migration.

Southwestern Willow Flycatchers arrive in New Mexico in late May and early June. Breeding activity begins immediately and young may fledge as soon as late June. Late nests and re-nesting attempts may not fledge young until late summer (Sogge and Tibbitts 1992; Sogge *et al.* 1993).

Occupied and potential flycatcher nesting habitat occurs within the Middle Rio Grande Valley in the 230-mile reach between Velarde and San Marcial: approximately 44 breeding pairs or territorial males were identified in 2004 surveys, approximately 30 were found in 2005 (USBR and USACE 2006) and more than 37 were know to be present in 2006 (USBR 2006). The largest breeding concentration of flycatchers along the Rio Grande occurs at the headwaters of Elephant Butte Lake (downstream from San Marcial) where 130, 107, and 142 pairs or territorial males were present in 2004 through 2006, respectively (USBR 2006). Occupied and potential habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's willow and peachleaf willow, Rio Grande cottonwood, coyote willow, and saltcedar. The nearest known breeding flycatchers from the study area occur along the Rio Grande near San Juan Pueblo and Isleta Pueblo, 50 miles upstream and 35 miles downstream, respectively.

Much of the riparian habitat along the Rio Grande within the study area consists of mature cottonwood stands that lack understory structure and density to be suitable breeding habitat for the flycatcher (Ahlers and White 1996, USBR 1999, BIA 2001), although flycatchers are known to occur in the study area during migration. No breeding flycatchers were observed in the project area during formal surveys in 1999 (USBR 1999) and 2001 (BIA 2001), nor during subsequent wildlife surveys performed by the Pueblo.

Critical habitat for the flycatcher was designated throughout its range in July 1997 (USFWS 1997); however, that rule was vacated in 2001 as a result of litigation. The Service re-designated critical habitat in October 2005 (USFWS 2005); however it does not include the current study area.

2.12 CULTURAL RESOURCES

Culture History

Culture history for Santa Ana Pueblo and generally for the middle Rio Grande area has been documented in numerous references such as White (1942), Cordell (1979, 1984, 1997), Ortiz (1979), Strong (1979), and Bayer (1994). The project area is located on Santa Ana Indian Reservation land, in an agricultural area along the Rio Grande known as Ranchiit'u (El Ranchito, Ranchitos). The Ranchiit'u is within the Northern Rio Grande Region as archaeologically defined by Wendorf and Reed (1955) (Rodgers 1979, Cordell 1997, Penner *et al*. 2001). The culture history of the Southwest and the project area has been chronologically generalized into several classification schemes that utilize noticeable changes in the cultural record, as seen in temporal and spatial similarities and differences, to assist in the explanation and interpretation of the cultural record. The primary Periods and their approximate dates are as follows:

PaleoIndian: ca. 11,500 B.P.- 7,500 B.P.
Archaic: ca. 7,500 B.P.- 2,000 B.P.
Anasazi: ca. 1 - 1540
Historic: 1540 - present

The PaleoIndian and Archaic Periods are typically identified in the archaeological record by the presence of morphologically diagnostic projectile points. The end of the Archaic Period is difficult to define chronologically because the mobile hunting and gathering lifestyle continued in many areas into the Historic Period.

Generally in the Rio Grande Valley, the prehistoric era is characterized by increasing population sizes, movement of people across the landscape, more sedentism and aggregation of peoples into larger villages, an increasing dependence on agriculture, and a more intense and efficient use of the environment. Small pithouse villages, larger above-ground roomblocks, and huge adobe pueblos with scattered fieldhouses are common. There is an increasing use of water control methods and local and long distance trade is important.

In the Ranchiit'u area, the chronological Puebloan cultural sequence includes the Rio Grande Developmental (ca. 660-1200), the Coalition period (ca. 1200-1325), the Rio Grande Classic (ca. 1325-1600), and the Historic period dating from about 1600 to present (Rodgers 1979, Cordell 1997). The Pueblo of Santa Ana people, who call themselves "Tamayame" and their Pueblo "Tamaya," are one of several Keresan speaking groups that live in the middle Rio Grande area. Archaeological evidence supports their ancestral creation and migration stories (Strong 1979, Bayer 1994).

The Historic Period in the Southwest is initiated with the 1540 *entrada* of the Spanish. In 1598 Oñate arrived in the Rio Grande Valley, claiming the region for the King of Spain and began his colonization and subjugation efforts (Strong 1979, Bayer 1994). After years of oppression, exploitation, desecration, spiritual persecution, disease, in addition to drought and resulting famine, the Tamayame actively joined with other Rio Grande Pueblos to expel the Spaniards in what has been called the Pueblo Revolt of 1680 (Strong 1979, Simmons 1988, Bayer 1994). In the aftermath, and as a result of the effects of the Revolt and several subsequent Spanish forays in which numerous Puebloan pueblos, including those of the Santa Anan people, were attacked and burned, the Tamayame affiliated themselves with the Spaniards after de Vargas' Reconquest (Strong 1979, Bayer 1994). The Tamayame resettled in an area of traditional use, building homes and a Spanish church at Tamaya (Harrington 1916, Bayer 1994).

At the end of the Seventeenth Century, the Puebloans received grants from the Spaniards for the land around their Pueblos. However, these areas did not include all of the areas the Puebloans had traditionally used and, located in such an arid and marginal environment as that of the Southwest, were generally not large enough to sufficiently support the Pueblo. The Tamayame soon recognized that land and water would increasingly become scarce with the influx and rapid population growth of the colonizers. In order to reestablish their claims to the Ranchiit'u and other nearby areas, the Tamayame, in 1709, started purchasing the land back (White 1942, Strong 1979, Bayer 1994). Eventually, the majority of the Tamayame moved to—and today continue to live in—the Ranchiit'u area (Harrington 1916, Strong 1979, Bayer 1994). Encroachment, trespass, fraudulent claims, and schemes continually pressed the Tamayame for their land (Bayer 1994).

In 1821 Mexico won its independence from Spain and in 1846 the United States invaded and took the Southwest. Through most of the Historic Period, the Tamayame and their neighbors farmed along the streams and rivers, grazed livestock in the upland areas, and utilized regional timber resources and a few did some mining. It was not until 1869 that Congress confirmed the land claims of the Pueblo; the patent was not issued until 1883 (White 1942, USGAO 2001). However, it was not until the *Sandoval* case was settled in 1913 that most of the land problems were abated; but not ended (White 1942, Bayer 1994).

In the 1880s, the arrival of Atchison, Topeka, and Santa Fe (AT&SF) Railroad brought a huge and rapid influx of new residents to New Mexico (Bayer 1994). The AT&SF Railroad's main line tracks were laid through Pueblo of Santa Ana's Ranchiit'u in 1880 as the line was pushed southward to Albuquerque and Belen (Bayer 1994). The construction of branch lines soon followed. The Santa Fe Northwestern Railway (SFNW) was one such branch line that, in order to reach timber resources in the Cañon de San Diego Grant and the Jemez Mountains, crossed not only the Ranchiit'u, but also the Spanish Pueblo Grant at Tamaya, and Pueblo of Santa Ana's traditional lands in the Ojo de Espiritu Santo Grant as well as the Spanish Pueblo Grants at Zia and Jemez (Glover 1990, Bayer 1994). Initial surveys for the SFNW route to the Jemez Mountains were conducted in 1921, a construction contract was awarded on October 16, 1922, and work in the roadbed in Bernalillo began on November 8, 1922 (Glover 1990). Work on the massive, wooden Rio Grande trestle was completed early in 1923 (Glover 1990). The right-of-way agreement with the Pueblos of Santa Ana, Zia, and Jemez was signed in March, 1926, was legally questioned, and was then reapproved on July 10, 1928 (Glover 1990, Bayer 1994). The SFNW ceased operations and the railroad was abandoned in 1941; today, all that remains in the Ranchiit'u area are portions of the old railroad grade bed and cut-off pieces of the old Rio Grande trestle pilings (Glover 1990).

Formation of the Middle Rio Grande Conservancy District (MRGCD) was approved in 1924 and operations began the next year to provide facilities for the efficient delivery of irrigation, domestic use and stock water, to prevent flood hazards and to provide flood protection measures, to regulate the Rio Grande channel and stream flows, and to provide drains to reclaim land that had become saturated and saline from high groundwater levels (Ackerly *et al*. 1997). The development and rehabilitation work conducted by the MRGCD had impacts to the Ranchiit'u area in the form of rights-of-way for flood control structures, ditches and drains; however, these structures have also provided flood control and made irrigation of the Ranchiit'u land easier for the Tamayame (Bayer 1994). To assist in the prevention of flood hazards and providing for flood protection measures, the Corps has also constructed flood protection structures on Santa Ana Indian Reservation lands such as the Jemez Canyon Dam (Rodgers 1979).

<u>Cultural Resources</u>

A search of the New Mexico Historic Preservation Division's (NMHPD) Archeological Records Management Section database was conducted to identify cultural resources sites reported within the vicinity of the project area. The database search found that no archaeological sites have been reported within the river's 100-year floodplain in the project area; and therefore, no sites are reported to occur in the vicinity of the proposed construction areas along the Rio Grande channel.

Inspection of aerial photography of the project location for the years 1935, 1952, 1963, and 1997 indicates that all of the 100-year floodplain in this area (except for a small area that will not be disturbed by the current project) has at one time or another since the 1930s been part of the river's active channel. On-site inspection and aerial photography of the project area also indicates that significant aggradation, some of which was induced by the installation of Kellner jetty-jacks, has also occurred historically in this river reach. Therefore, if cultural resources sites were within the 100-year floodplain, they would have been either washed away by the river and/or buried by significant sediment deposition.

A database search of the State Register of Cultural Properties, maintained by the NMHPD, and of the National Register of Historic Places found that numerous State and National Register properties occur within the historic community of Bernalillo as well as several that are located in the general vicinity of the project area. Of these, Coronado State Monument Museum (State Register No. 1515) and Kuaua Ruin (State Register No. 225) are located downstream of the project area. They are, however, located on gravel terraces well above the river channel.

At the southern portion of the project area are piling remnants of the Rio Grande trestle once used by the Santa Fe Northwestern Railway (SFNW). These piling remnants are only visible during low river flows. The SFNW was in operation from 1922 to 1941 and the Rio Grande trestle was constructed in early 1923 (Glover 1990, Myrick 1990). A portion of the railroad's grade bed is also visible on the west side of the river on Pueblo of Santa Ana and Coronado State Monument lands.

A levee and drain system operated by the MRGCD traverses the eastern edge of the project area. Many of the levees, drains, irrigation ditches, and associated structures and features along the middle Rio Grande were constructed in the 1930s (Ackerly *et al*. 1997, Berry and Lewis 1997) and, therefore, are considered historic. The levee and associated service road surfaces were not surveyed for cultural resources because they are built-up roads and their surfaces have been disturbed numerous times since their construction in the 1930s.

On the west side of the river, existing paved and improved gravel roads that cross upland areas of the reservation would be utilized to access proposed construction areas. On May 17, 2001, two Corps archaeologists conducted an intensive cultural resources inventory of portions of the two west side access roads. The pedestrian survey was conducted by walking 10-meter wide linear transects along either side of the roads; a total of approximately 29.2 acres was covered. The survey found no artifacts or cultural resource manifestations.

In recent years, the Pueblo of Santa Ana has been actively working to develop and protect its natural and cultural resources and has sponsored numerous archaeological surveys on Pueblo lands in anticipation of construction and rehabilitation projects and habitat restoration efforts related to Pueblo development. Other access and staging areas anticipated for use in this proposed Section 1135 restoration project have been previously surveyed for cultural resources and received use clearance or have been previously disturbed and utilized for similar purposes.

2.13 SOCIO-ECONOMIC ENVIRONMENT

The Santa Ana Indian Reservation covers approximately 79,000 acres spanning the Rio Grande and lower Jemez River. The majority of the approximately 767 residents live along the east side of the Rio Grande.

Principal employment sectors at the Pueblo and throughout Sandoval County include agriculture and service. Over the past 25 years, the Pueblo of Santa Ana has developed a successful agricultural enterprise centered on the production and processing of organic blue corn products. Other natural resource enterprises include sand and gravel mining and a native plant nursery. Extensive recreational and entertainment attractions include the Santa Ana Star Casino, the Prairie Star Restaurant, a 27-hole golf course, and a 22-field soccer complex.

The 350-room, Pueblo-owned, Tamaya Hyatt Resort is located outside of the 100-year floodplain immediately to the west of the proposed project area. The resort opened in January 2001 and includes an 18-hole golf course on the terraces to the west.

2.14 LAND USE, AESTHETIC RESOURCES, AND RECREATION

The Rio Grande corridor in the project area has been declared a natural preserve by the Pueblo of Santa Ana Tribal Council. Ecosystem restoration activities are a primary objective of the preserve plan. Recreational opportunities along the Rio Grande within the study reach which are available to tribal members, resort guests, and invited guests of the Pueblo include hiking, horse riding, and nature observation.

Aesthetic resources include landforms, vegetation and human-created structures in the environment which generate one or more sensory reactions and evaluations by the observer, particularly in regard to pleasurable response. These sensory reactions entail sight, sound and smell; however, because the visual sense is so predominant in the observer's reaction and evaluation, aesthetic resources, for the purpose of this section, will be referred to as visual resources.

The Rio Grande is likely the most important visual resource in the study area. Water bodies traditionally are considered to have a high aesthetic quality. Riparian vegetation is another natural aesthetic resource. The nearby Hyatt Tamaya Resort maintains walking paths throughout the riparian woodland immediately adjacent to portions of the proposed restoration features. Areas of the bosque recently cleared of non-native vegetation in the northern half of the study area generally appear more stark than other portions, but should increase in aesthetic quality as new understory growth and organic litter accumulates.

Coronado State Monument is immediately south of the Santa Ana Indian Reservation boundary. Located on the west bank of the Rio Grande, the park includes a visitor center, partially excavated pueblo ruins, and picnic area. It is managed by New Mexico State Monuments (Museum of New Mexico, Office of Cultural Affairs, State of New Mexico) and receives about 30,000 visitors annually.

2.15 HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE

No sources of hazardous, toxic, or radiological waste (HTRW) are known to occur in the project area. Pertinent portions of the project area and potential access road alignments were examined by the Corps in May 2001. Minimal residential debris was noted. No areas with potential HTRW impacts were identified during the project area walk-through. Pueblo of Santa Ana Department of Natural Resources personnel have not identified any areas of concern.

3. FUTURE CONDITIONS WITHOUT PROJECT

Future conditions without project implementation were projected to characterize the "no action" alternative and its effects, and to form a basis for comparison of restoration benefits. The following summarizes future conditions for pertinent (*i.e.*, hydrologic, geomorphic, and ecologic) resources.

Throughout the Middle Rio Grande Valley, the river, floodplain, and the associated fish and wildlife populations are expected to continue to experience adverse effects from new and ongoing Federal, State, and private water resource development projects. Additionally, increasing urbanization and development within the historic floodplain downstream from the study area would continue to eliminate remnant riparian areas located outside the levees, putting increased pressure on the habitat and wildlife in the riparian zone within the floodway.

Gradient Restoration Facilities (GRFs) installed by the Corps and the Bureau of Reclamation have arrested long-term degradation and stabilized the channel bed elevation within the study reach. Therefore, hydraulic modeling results of post-GRF conditions serve to characterize the future without-project condition for the current study. Several specific geomorphic and hydraulic parameters are included in other sections of this report (*e.g.*, Figure 5 and Table 13) for comparison with the proposed with-project condition.

Except in stabilized reaches, the Rio Grande channel downstream from Cochiti Dam would continue to become narrower and deeper, negatively affecting warmwater fishes and reducing native aquatic habitat. The trend toward extirpation of native fish species would continue, further altering the aquatic community. The quality of river and ground water would be increasingly affected by urban discharges and agricultural runoff. The lack of flooding in the riparian zone and a lowered water table would continue to restrict opportunities for wetland formation and maintenance, causing the remaining cottonwoods to die off, and growth of non-native vegetation such as saltcedar and Russian olive to increase. The native cottonwood/willow vegetative complex gradually would be replaced with non-native species. The overall quality and quantity of fish and wildlife habitat would continue to degrade, and species that do not adapt to the changes would be stressed and eventually disappear from the system (Crawford *et al.* 1993).

In the Santa Ana reach, aquatic habitat extent and quality would remain limited. There would continue to be a lack of wetland and shallow water aquatic habitat in the project area. Native vegetation would continue to be replaced by non-native vegetation, as the remaining native vegetation becomes decadent and dies. Fish and wildlife in the project area would continue to follow the same decline in the project area as throughout the Middle Rio Grande Valley. The Pueblo of Santa Ana would continue to improve riparian habitat in the study area through the removal of non-native vegetation and planting of native species, within the allowance of their limited budget.

In downstream reaches where degradation is expected to continue, the wetted channel would continue to decrease in width and increase in depth, a situation that is detrimental to the Rio Grande silvery minnow. Suitable flycatcher habitat would continue to be absent in the project area. Mature cottonwood stands would die naturally of senescence, and lack recruitment of native riparian habitat.

4. PLAN FORMULATION AND SELECTION

4.01 RESTORATION OBJECTIVES

Beginning in 1998, the Pueblo facilitated several planning sessions with the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, Ayres Associates, David Evans and Associates, Inc., and the Corps, to identify problems (see Section 1.02) and discuss the objectives of the Pueblo's overall restoration plan along the Rio Grande. Through these sessions and ensuing coordination, degraded ecosystem functions and values were identified and potential solutions were suggested. During the plan formulation process for this Section 1135 study, restoration opportunities and constraints were identified, project objectives were established, and alternative solutions were evaluated for their benefits and cost-effectiveness.

After reviewing baseline conditions, ecosystem problems, and planning opportunities, the following objectives were established to guide the development and evaluation of restoration measures:

1. Improve aquatic habitat and channel geomorphic characteristics (toward the recent historic condition).
2. Restore wetland habitat (emergent marsh or shrub).
3. Increase extent and improve habitat quality of native riparian communities.
4. Replace non-native shrub species with native species.
5. Reduce the extent or severity of bank sloughing.

Constraints to developing alternatives to achieve these objectives also were identified:

- The degree of channel incision precludes the cost-effective reintroduction of surface-water inundation of the abandoned floodplain.
- Depth to groundwater is variable throughout the study area.
- Avoid creation of a potential nuisance or liability for the Pueblo, and its citizens and guests.

4.02 AQUATIC HABITAT RESTORATION

The recently installed grade control structures in the Rio Grande channel in the study area have arrested downcutting; however, aquatic habitat and geomorphic conditions differ significantly from the recent historic condition. Because existing, regulated discharge conditions differ significantly from historic flows, restoration goals were not established to attain the exact channel width and depth parameters exhibited in the past. Rather, the restoration goal was a wider and shallower channel cross-section—trending toward the historic condition—that would be relatively stable within the existing (and foreseeable future) discharge condition.

"Overbank Lowering" entails the partial excavation (scraping) of active sandbars within the incised floodway (not within the abandoned, vegetated floodplain). The overbank modification would be accomplished by lowering the surface elevation of the existing overbank, including side channels, by designated amounts. Six bars, totaling 62.2 acres, were identified for Overbank Lowering within the project reach (Plate 3).

Increasing the availability of shallow, low velocity aquatic habitat would benefit the majority of native fish species in the study area (i.e., red shiner, western mosquitofish, fathead minnow, Rio Grande silvery minnow, and longnose dace). Restoration design was based on habitat use of the endangered Rio Grande silvery minnow. Aquatic habitat characteristics were based on the descriptions of highly utilized areas in the *Rio Grande Silvery Minnow Recovery Plan* (USFWS 1999).

The "preferred habitat" used in subsequent analysis includes those areas with depths less than 2 feet (60 cm) and velocity less than 1 ft/sec (30 cm/sec). These parameters are also supported by data in the current draft revised recovery plan (USFWS 2007).

Hydraulic modeling was performed to support problem identification and the evaluation of alternatives. One-dimensional hydraulic modeling was performed using the HEC-RAS River Analysis System (HEC 1998) and 2-dimensional modeling was completed with the finite element model RMA-2V (WES 1998). Detailed 1-dimensional hydraulic modeling included approximately 60 cross sections throughout the Santa Ana reach and was used to evaluate existing conditions and sediment transport. The 2-dimensional modeling was used to determine restoration benefits and refine the hydraulic design.

To quantify potential restoration benefits, the two-dimensional model was used to determine the extent of preferred habitat both with and without the implementation of Overbank Lowering. Because grade control structures have stabilized the channel elevation in the study reach, future geomorphic conditions were considered to be essentially similar to the existing condition.

The extent of preferred habitat for the existing condition increases with discharge (see Figure 6), indicating that a wide range of topographic relief is present throughout the floodway (channel plus overbank areas). Therefore, excavation was devised to lower existing bars uniformly and preserve the general contours and topographic diversity of the existing surface. An excavation depth of 1 to 2 feet was initially selected for each of six bars that would result in inundation of the majority of the bar at 5,400 cfs; this was termed alternative "A". To provide a range of alternatives for cost efficiency analysis, excavation depths 0.5 feet shallower (alternative "B") and 0.5 feet deeper (alternative "C") also were evaluated. *Therefore, excavation depth increases in 0.5-foot increments from plan "B" to "A" to "C"*. The area over which excavation would be performed is the same for all three alternatives, namely 62.2 acres.

The hydraulic model determined the extent of preferred habitat area for the without-project and three excavation-depth alternatives over a range of discharges (Table 4 and Figure 6). For the without-project condition, acreage of preferred habitat increased over the range of flows analyzed. For all three with-project alternatives, acreage increased up to 5,400 cfs, then decreased in extent through 7,000 cfs. This reduction in preferred habitat area at higher flows was not considered an issue in light of their relatively infrequent occurrence.

Table 4. Extent of preferred Rio Grande silvery minnow habitat[a] (acres) within the study reach at various discharges.

Discharge (cfs)	Without project	B	A	C
500	13.39	17.17	19.82	23.22
1000	11.27	18.00	20.30	22.81
2000	14.19	19.06	22.09	25.69
3000	17.23	24.10	27.28	27.82
4000	19.74	26.02	29.51	31.66
5400	22.05	28.09	27.72	24.17
7000	26.50	18.82	13.17	9.46

[a] Depth = 2 feet or less and velocity = 1 foot/sec or less.

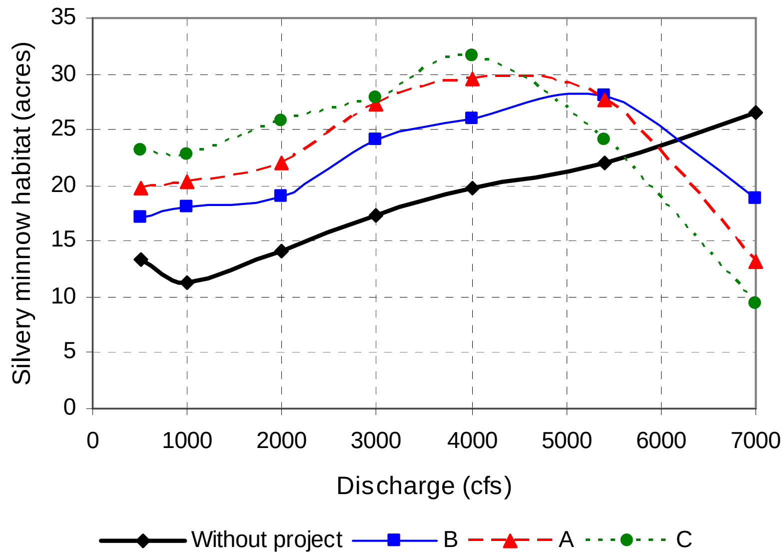

Figure 6. Acres of Rio Grande silvery minnow habitat at various discharges.

Habitat suitability is a function of both physical and temporal availability. The temporal availability of preferred habitat is dependent on the frequency distribution of discharge. Therefore, the probability distribution of the mean daily discharge at streamflow gages upstream (San Felipe) and downstream (Albuquerque) from the Pueblo of Santa Ana were averaged to characterize the study reach. These frequencies were aggregated in discharge classes of approximately 1,000-cfs increments (Table 5). The resultant frequency distribution was equated to time by multiplying by 365 (Table 5) and expressed as "days per year" (that is, the relative distribution of flows over a "statistical" year). This temporal parameter was multiplied by the acreage of preferred habitat at a similar discharge and the resultant index was expressed in "acre-days per year" (Table 6 and Figure 7).

Table 5. Probability of discharge classes in the study area.

Discharge class)			
Range (cfs)	Mid-point (cfs)	Probability	Probability x 365 ("days per year")
250-750	500	9.51	34.7
751-1250	1000	27.10	98.9
1501-2500	2000	27.48	100.3
2501-3500	3000	16.20	59.1
3501-4500	4000	6.54	23.9
4501-6300	5400	6.33	23.1
6301-7700	7000	3.84	14.0
Totals		97.0[a]	354.0[a]

[a] Totals are less than 100% and 365 days due to discharges less than 250 cfs and greater than 7,700 cfs.

Table 6. Frequency-dependent availability of preferred Rio Grande silvery minnow habitat (acre-days/year).

Discharge class mid-point (cfs)	Without project	B	A	C
500	465	596	688	806
1000	1115	1781	2008	2256
2000	1423	1912	2215	2576
3000	1018	1425	1613	1644
4000	471	621	704	756
5400	509	649	640	558
7000	372	264	185	133
Total [a]	5373	7246	8053	8730
Diff. from Without Project condition (and % increase)		+1897 (+35%)	+2680 (+50%)	+3357 (+62%)

[a] Total acre-days per year is the index to be used in incremental cost analysis.

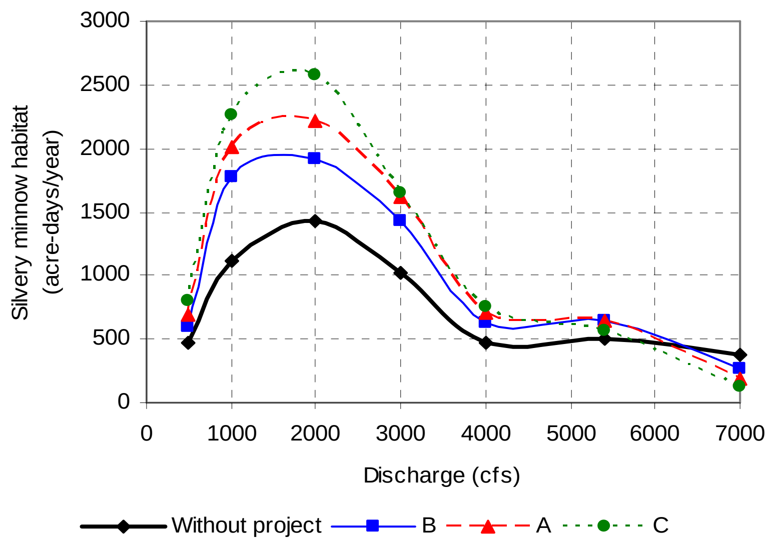

Figure 7. Frequency-dependent availability of Rio Grande silvery minnow habitat.

All three excavation-depth alternatives resulted in positive increases in the frequency-dependent availability of preferred habitat. For the entire range of discharge up to 7,000 cfs, Overbank Lowering would provide between 1,900 to 3,360 additional acre-days per year of preferred habitat, depending on excavation depth alternative. The selection of the recommended plan is discussed in Section 4.04.

4.03 RIPARIAN AND WETLAND RESTORATION

As stated previously, the Pueblo of Santa Ana has independently accomplished removal of non-native woody vegetation throughout 720 acres in the project area. In the current study, riparian and wetland habitat restoration features were formulated to provide wildlife habitat components that complement the Pueblo's overall restoration plan. Emphasis was placed on wetland, meadow, and native shrub communities—all of which have significantly decreased in abundance over the past 50 years (Crawford *et al*. 1993, Roelle and Hagenbuck 1995). These habitat types were identified as crucial components contributing to overall wildlife diversity and habitat quality in the study area.

Saltgrass Meadow

A relict saltgrass meadow area occurs near the southern end of the riparian zone in the study area (Plate 5). Meadow vegetation had begun to be displaced by saltcedar more than 50 years ago. The Pueblo killed saltcedar in this area by aerial spraying in 1998; however, the area currently harbors a moderately dense stand of live (re-sprouted) and dead saltcedar, along with herbaceous vegetation (largely noxious weed species). The soil type in this somewhat poorly drained area is Sparham clay loam. Groundwater in the 5-acre stand is sufficiently close to the ground surface to support vegetation typical of existing meadows in the middle Rio Grande valley during the growing season. This site is unique in terms of soil type and moisture within the floodplain of the study area and, therefore, was considered the only suitable area for meadow restoration. Removal of saltcedar, root-plowing (to eliminate re-sprouting) and reseeding with native grass species were determined to be the most practical restoration activities.

Riparian Shrub Habitat

Generally, the abundance of both small mammals and birds increases with the complexity and density of vegetation structure, which is thought to be related to the increased food, cover, or nest substrate provided. Along the Rio Grande, the highest densities of both animal groups consistently have been found in cottonwood stands with a well developed shrub understory and in tall shrub stands, regardless of whether the shrubs are native or exotic (Hink and Ohmart 1984, Hoffman 1990, Thompson *et al*. 1994, Stahlecker and Cox 1997, Campbell *et al*. 1997, HAI 2006). Cottonwood stands with a sparse understory generally support fewer small mammals and breeding birds. The understory clearing performed to date on the Pueblo has had temporary effects on wildlife populations. Although regeneration of native understory species has been encouraged, this is a slow process in the arid Southwest, and the Pueblo and the Corps have recognized the need for additional riparian shrub stands to maintain diverse wildlife habitat.

A 5-acre shrub stand dominated by Russian olive and saltcedar adjacent to the relict saltgrass meadow discussed above also was evaluated for its restoration potential (Plate 5). Originally, replacement of this vegetation with an additional 5 acres of saltgrass meadow was considered; however, clarification of soil type and groundwater depth indicated that this area was, in fact, better suited to woody vegetation types. Areas of relatively shallow groundwater are limited in the abandoned floodplain of the study area, and this site was determined to be the most practical location for riparian shrub restoration. Existing aboveground vegetation would be removed with a brush mower. The area would be root-plowing to eliminate re-sprouting and replanted with native shrub species, primarily New Mexico olive and silver buffaloberry.

Wetland Shrub Swale and Surrounding Riparian Woodland

As evidenced by remembrances of Pueblo elders and recent historical (1918 and 1935) vegetation maps, emergent and shrub wetlands occurred throughout this reach of the Rio Grande. The last vestiges of wetland habitat in the project area occupied a high-flow channel in 1982 (Hink and Ohmart 1984), which has since dried due to channel incision and subsequent lowering of the water table in the area.

Because channel degradation at the project site has precluded the use of surface water in the creation of new wetland areas, excavation to the water table within the abandoned floodplain was considered the most viable approach to creating suitable hydrologic conditions. An initial evaluation of the creation of different wetland types was performed by David Evans and Associates, Inc., in 2000 (see Technical Appendix E). Open water/emergent wetland was contrasted with a shrub-dominated wetland, and both 5- and 10-acre areas were considered for each type. Water depths would be 1 to 4 feet for the open water/emergent wetland. The water table would be at or below the surface in the shrub wetland. The open water/emergent wetland entailed a higher cost per acre due to greater planting costs and the deeper excavation requirements. While recognizing that these two wetland types provide very different habitats for wildlife, the shrub-dominated wetland was the preferred alternative. A shrub wetland also would not create mosquito problems nor be a potentially attractive nuisance to visitors at the nearby resort. The proposed wetland is referred to as the "Shrub Swale" feature in the remainder of this report.

Swales with a minimum size of approximately 5 acres were considered in the current evaluation. The swale would be excavated to an appropriate depth—such that the water table would be at or below the surface—and waste spoil would be removed to an upland disposal site. Coyote willow and Gooding's willow would be the primary planted species.

The selected location is approximately 15 acres in size and has been previously cleared of woody vegetation (Plate 4). The area surrounding the Shrub Swale also is planned to be replanted in the current project with riparian trees and shrubs that would tolerate the relatively deeper water table in the abandoned floodplain. (This area is referred to as the "Riparian Plantings" feature.) In the subsequent incremental cost analysis, the costs and ecological benefits of four alternatives (scales) were considered for the entire 15-acre site (see Table 8):

- No action.
- 15 acres of Riparian Plantings;
- 5-acre Shrub Swale with 10 acres of surrounding Riparian Plantings; and
- 10-acre Shrub Swale with 5 acres of surrounding Riparian Plantings.

Bankline Plantings

Along the west side of Rio Grande, approximately 1,410 linear feet of actively eroding bankline were identified (Plate 4). While the recently installed grade controls will serve to prevent widespread erosion, this bank will continue to slough during higher flows. Hydraulic Engineers also have recommended bankline stabilization as additional protection for proposed features (Shrub Swale and Riparian Plantings) adjacent to this bankline. The bank would be most simply stabilized by planting coyote willows whips along the toe.

4.04 INCREMENTAL COST ANALYSIS AND PLAN SELECTION

Corps of Engineer regulations require that ecosystem restoration projects be analyzed for cost-effectiveness and incremental benefits expected from contemplated restoration alternatives. Analysis of cost-effectiveness, in general, compares the relative costs and benefits of alternative plans. The least expensive plan which meets the restoration objective is usually selected. "Incremental cost analysis" is the technique used by the Corps to develop cost-effective restoration projects (Orth 1994, Robinson *et al*. 1995). This method is particularly well suited for the analysis of a series of features, each entailing successively greater benefits and costs. Incremental analysis calculates the *cost per unit of output* gained by each successive feature, allowing the planning team to determine the point of diminishing returns. The final selection of a recommended alternative also may be influenced by noneconomic considerations such as, specific output targets, budget constraints, impacts to other environmental resources, and opportunity costs.

To compare the cost effectiveness of various restoration alternatives, an environmental output unit is required. An output unit is the quantification of expected improvement in target functions or values, such as increased productivity or habitat suitability. To compare disparate habitat features, a common output unit is necessary. The current study includes riparian woodland, riparian shrub, wetland shrub, saltgrass meadow, and aquatic habitats. It is widely recognized that these habitat types each have different values to various groups of wildlife and aquatic organisms. Although research has documented many of these values relative to individual habitat types, a common indicator, or output unit, has not been developed for Rio Grande riparian, wetland, and aquatic ecosystems. Therefore, a direct comparison of benefits among the all features cannot be made. However, the activities proposed in this study can be analyzed in two separate incremental analyses—for aquatic and vegetated habitats—and cost-effective solutions from each can be combined as the selected plan.

IWR-Plan software was used to evaluate cost effectiveness. Costs were estimated with Corps of Engineers' M-CASES (version 2.2) software and include site preparation, excavation, haul, disposal site management, construction contract supervision and administration, and a 25% contingency.

Aquatic Habitat Restoration

Three excavation depths for Overbank Lowering were compared. The index of ecological benefits used as "habitat units" in the analysis of aquatic habitat is the total acre-days-per-year of preferred silvery minnow habitat for each alternative (Table 6). Excavation quantities for alternatives B, A, and C—each successively deeper—were approximately 120,000 cubic yards (CY), 171,000 CY, and 221,000 CY, respectively. All three action alternatives are non-combinable and independent of each other. Table 7 summarizes the result of the analysis.

Table 7. Incremental cost analysis for aquatic habitat restoration.

Alternative measures	Habitat units (acre-days per year)	Cost	Average cost per habitat unit	Incremental habitat units	Incremental cost	Incremental cost per habitat unit
Without project	5373	$ 0	$ 0	5373	$ 0	$ 0
B	7246	$ 2,516,700	$ 347	1873	$ 2,516,700	$ 1,344
A	8053	$ 3,299,900	$ 422	807	$ 883,200	$ 1,095
C	8730	$ 4,267,900	$ 489	677	$ 868,000	$ 1,283

Cost, habitat units (acre-days per year), and average cost per habitat unit all increase with succeeding excavation depths. The incremental cost per habitat unit was highest for the initial excavation, decreased nearly 19% for excavation 0.5-foot deeper (alt. A), and then increased by 17% for the deepest excavation (alt. C). Alternative A was considered the "best buy" solution.

Wetland and Riparian Habitat Restoration

Revegetation methodologies have been the subject of much research and experimentation within Rio Grande ecosystems (Dreesen *et al*. 2002, Caplan *et al*. 2005, NRCS 2005). The revegetation methods included in this project's formulated alternatives—pole, whip, and tall-pot plantings—have been determined to be successful and cost effective techniques through the efforts, and iterative refinements, of numerous Federal, Tribal and local entities.

The index of ecological benefits used as "habitat units" for wetland and riparian habitats is the average summer-and-winter avian abundance within each measure's respective footprint (acres). Avian abundance was derived from densities determined from surveys in similar habitat types (Hink and Ohmart 1984, HAI 2006; see Technical Appendix F). Restoration measures are combinable and independent of each other. The "Shrub Swale" measure included four scales of activity and all other measures included two scales. Table 8 summarizes components of the incremental cost analysis model. Results are presented in Table 9 and Figure 8.

All measures and scales were determined to be cost-effective, least-cost solutions. The "best buy" solution included Shrub Swale scale A3 (10-acre Shrub Swale and 5 acres of surrounding Riparian Plantings) because of its relatively low incremental cost per unit. Results including different scales of the Shrub Swale measure also are presented in Table 9 and Figure 8 for comparison purposes.

Table 8. Summary of components used in incremental cost analysis (ICA) for wetland and riparian restoration measures.

Restoration measures	Code in ICA model	Acres	Vegetation type	Avian abundance	Cost
Bankline Planting	B0	1.6	Riverbank (without project)	0.9	$0
	B1	1.6	Coyote willow	2.5	$18,750
Riparian Shrubs	S0	5	Russian olive (w/o project)	36.1	$0
	S1	5	NM olive/silver buffaloberry	41.9	$48,115
Saltgrass Meadow	M0	5	Dense saltcedar (w/o project)	7.4	$0
	M1	5	Saltgrass meadow	68.0	$32,161
Shrub Swale and surrounding Riparian Planting	A0	15	Sparse saltcedar (w/o project)	15.9	$0
	A1	15	Riparian woodland	22.5	$196,600
		5	Willow shrub	45.8	$799.975
		10	Riparian woodland	15.0	$131,067
	A2	15		60.8	$931.041
		10	Willow shrub	91.6	$1,265,179
		5	Riparian woodland	7.5	$65,533
	A3	15		99.1	$1,330,732

Table 9. Incremental cost analysis of wetland and riparian restoration measures.

Measures	Identifying label in Figure 8	Included measures	Cumulative cost	Output (avian abundance)	Average cost	Incre-mental cost	Incre-mental output	Incremental cost per unit output
Without project (No action)	Without project	M0 S0 B0 A0	$0	60.3	$0	$0	0.0	$0
Saltgrass Meadow	M1	M1 S0 B0 A0	$32,161	120.9	$266	$32,161	60.6	$531
Riparian Shrubs	S1	M1 S1 B0 A0	$80,276	126.7	$634	$48,115	5.8	$8,296
Bankline Plantings	B1	M1 S1 B1 A0	$99,026	128.3	$772	$18,750	1.6	$11,719
Shrub Swale & Rip'n. Plantings	A3	M1 S1 B1 A3	$1,429,758	211.5	$6,760	$1,330,732	83.2	$15,994
Alternate: A1 replaces A3 ...								
Shrub Swale & Rip'n. Plantings	A1	M1 S1 B1 A1	$295,626	134.9	$2,191	$196,600	6.6	$29,788
Alternate: A2 replaces A3 ..								
Shrub Swale & Rip'n. Plantings	A2	M1 S1 B1 A2	$1,030,067	173.2	$5,947	$931,041	44.9	$20,736

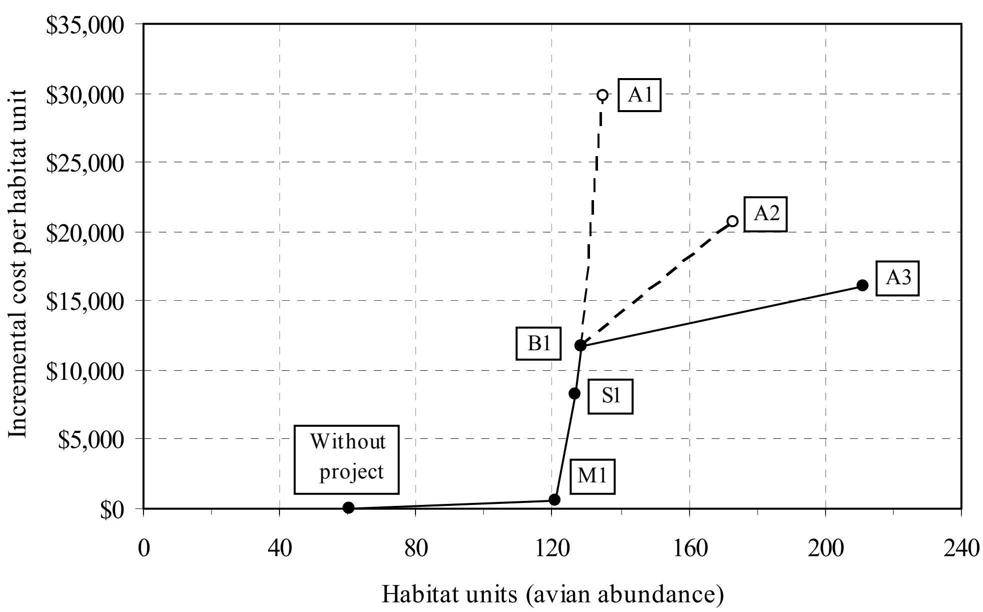

Figure 8. Incremental cost analysis results for vegetative restoration features. The solid line indicates the "best buy" solution, and dashed lines depict alternative scales of the Shrub Swale measure. (See Table 9 for explanation of codes.)

Plan Selection

After considering economy, overall benefits, and the cost limitation of the Section 1135 program, Overbank Lowering alternative A and the vegetative restoration solution including Shrub Swale scale A2 (5-acre Shrub Swale and 10 acres of surrounding Riparian Plantings) were selected for inclusion in the recommended plan. Table 10 displays how the selected restoration measures fulfill the project restoration objectives.

Table 10. Restoration measures and objectives.

	Restoration measures					
Restoration objectives	Overbank Lowering	Saltgrass Meadow	Riparian Shrubs	Shrub Swale	Riparian Plantings	Bankline Plantings
1. Improve aquatic habitat.	X					
2. Restore wetland habitat.				X		
3. Increase habitat quality of native riparian communities.		X	X	X	X	X
4. Replace non-native shrub species with native species.		X	X	X	X	
5. Reduce bank sloughing.						X

5. DESCRIPTION OF THE PROPOSED PLAN

5.01 RESTORATION FEATURES

Overbank Lowering

Six sandbars (encompassing approximately 62 acres) were identified to be lowered in surface elevation to increase their inundated area (Plate 3). Soil material would be removed from a uniform depth at each bar to preserve the existing variation in topography. The excavation depth varies among the bars from 1.0 to 2.2 feet. Additional features such as submerged berms, small channels, and embayments would be incorporated into the design to enhance slackwater areas over a range of discharges. All sandbars proposed for modification are upstream of the gravel bed-sill recently installed because channel degradation is still expected to occur downstream from the bed-sill. Material would be removed by excavators, scrapers, or bulldozers as determined by the construction contractor. All excess excavated material would be removed from the site; scraped material could be stockpiled on site for a short period (e.g., 24 hours). The excavation quantity is estimated to be 170,588 cubic yards (106 acre-feet).

Shrub Swale

Within a 14-acre area already cleared of vegetation, construction of a 6.6-acre Shrub Swale is proposed (Plate 4). The depth to groundwater in this area is influenced by Rio Grande flow. The water table ranges from 5 to 6 feet below the surface during the growing season in years with average river flow, to as much as 10-feet deep during years of below-average flow. To sustain riparian shrub growth within this portion of the abandoned floodplain, excavation to a depth of 5 feet is proposed. Thus, the water table during the growing season would be well within the range to support willow species.

Within the bottom of the excavated swale (4.3 acres), a mix of native willows would be planted: 12.5% tree willow (Gooding's or peachleaf willow) and 87.5% coyote willow. Tree willow often attains a height of 25 feet or more at maturity, while coyote willow ranges in height from 3 to 12 feet. Willows would be planted by placing dormant stems in narrow trenches cut within the swale bottom and backfilling. Planting densities would be 1,400 per acre for coyote willow whips (approximately 1 per linear foot of trench) and 200 stems per acre for tree willow. Cottonwood poles—not to exceed 20 per acre—would be scattered throughout the swale bottom.

Swale excavation would maintain a buffer of at least 100 feet from the active bank of the Rio Grande. Excavation quantity is estimated to be 40,500 cubic yards (25.1 acre-feet). To avoid a steep slope along the inner margin of the swale, a 10-foot-wide bench would be incorporated (Plate 4). The bench elevation would be 3 feet below the ground surface and 2 feet above the swale bottom. The area of the bench would be approximately 1.7 acres. Plantings on the bench and side slopes would consist of New Mexico olive, seep-willow, and false indigo bush. Containerized shrub seedlings propagated within narrow, cylindrical pots ("tall pots") would be best suited for this area. Cottonwood poles also would be planted on the bench and side slopes at an approximate density of 25 per acre.

Within the center of the swale, a small (0.6 acre) island would be created at the same elevation as the bench. In addition to increasing the length of structural edge, the island would provide a visual screen within the swale. Plantings on the tree island would be similar to that on the bench, with a slightly higher cottonwood pole density (that is, 50 per acre).

All plantings (including those discussed below) would be irrigated for two growing seasons to become established. Spray irrigation from a water truck would be used in most areas. Containerized shrubs may require manual irrigation of individual plants.

Guarantees would be included in all vegetation planting contracts to assure the successful establishment of plant materials. For pole and whip plantings, a survival rate of at least 80% after two growing seasons is normally required. Plant materials required for all re-vegetation features are summarized in Table 11.

Table 11. Proposed quantities of plant materials for all restoration features.

Feature	Number	Species (and type)
Shrub Swale		
Swale bottom	860	Tree willow whips
	6,020	Coyote willow whips
	86	Cottonwood poles
Bench & slope	340	New Mexico olive, seep-willow, false indigo bush (tall pots)
	43	Cottonwood poles
Island	120	New Mexico olive, seep-willow, false indigo bush (tall pots)
	30	Cottonwood poles
Riparian Plantings (surrounding the Shrub Swale)	1,500	New Mexico olive, silver buffaloberry, skunkbush sumac, wolfberry (tall pots)
	375	Cottonwood poles
Riparian Shrub Habitat	1,000	New Mexico olive, silver buffaloberry, skunkbush sumac, false indigobush, golden-currant (tall pots)
Bankline Plantings	1,410	Coyote willow whips

Riparian Plantings

Immediately surrounding the location of the Shrub Swale described above, non-native shrubs were removed by the Pueblo several years ago. Riparian vegetation in this 7.5-acre area is proposed to be re-established in this Section 1135 project (see Plate 4), and the same revegetation prescription would also be applied to the one-acre staging area following completion of construction. Rio Grande cottonwood would be established with pole plantings at an approximate density of 50 per acre. Shrub species suitable for planting in this somewhat drier substrate include silver buffaloberry, New Mexico olive, skunkbush sumac, and wolfberry. These shrubs also would be planted as containerized tall pots at an overall density of approximately 200 per acre. The entire area would be seeded (hand-broadcast) with a mixture of suitable grasses and forbs after shrubs have been planted.

Saltgrass Meadow

A relict saltgrass meadow area occurs near the southern end of the riparian zone on the Pueblo of Santa Ana (Plate 5). The meadow vegetation has been displaced by saltcedar more over the past 50 years. The area currently harbors moderately dense saltcedar and a variety of herbaceous vegetation (largely weed species). The soil type in this somewhat poorly drained area is Sparham clay loam. Groundwater in the 5-acre stand ranges from 2 to 4 feet below the surface during the growing period.

Due to the density of existing vegetation and its propensity to re-sprout after cutting, saltcedar will be removed with a brush mower and the area will be root-plowed. Following scarification with a harrow, the area will be reseeded with a rangeland drill or imprinter. The seed mix proposed entails primarily saltgrass. Other suitable plant species include alkali sacaton, scratchgrass muhly, and yerba mansa. Following seeding, a mulch of crimped hay would be installed. Periodic spray irrigation from a water truck would be required to establish vegetation.

Riparian Shrub Habitat

While the Pueblo is actively encouraging native shrub regeneration throughout areas cleared of non-native shrubs, those stands occur under an existing cottonwood canopy. Adjacent to the saltgrass meadow area described above is a 5-acre stand of tall shrubs dominated by Russian olive (Plate 5). Restoration of this stand as a shrub-dominated habitat (that is, no overstory trees) is proposed.

Existing Russian olive and saltcedar would be cleared with a brush mower. Root-plowing would eliminate the occurrence of re-sprouting and the need for subsequent herbicidal treatment. Containerized (tall pot) plantings of New Mexico olive, silver buffaloberry, skunkbush sumac, false indigobush and golden-currant would be installed at an overall density of 200 plants per acre.

Bankline Plantings

Along the west side of the Rio Grande, approximately 1,410 linear feet of eroding riverbank were identified and is expected to continue to slough during higher flows (Plate 4). The bank would be most simply stabilized by installing a row of coyote willows whips in a trench along the toe and backfilling. These plantings would provide cover for animals foraging along the bank or within the adjacent channel as well as providing additional protection for the proposed Shrub Swale and Riparian Plantings.

5.02 EXCAVATION AND SPOIL WASTE DISPOSAL

Estimates of earthwork quantities for Overbank Lowering were calculated from two-dimensional hydraulic modeling based on bathymetric data from August 2005. After allowing for expansion (12%) of excavated soil material, implementation of Overbank Lowering would result in approximately 191,059 cubic yards (118.4 acre-feet) of excess ("spoil waste") material. Excavation for the Shrub Swale would generate an additional 45,360 cubic yards (28.1 acre-feet) of spoil waste material. Prior to construction, samples of soil material to be excavated would be analyzed for concentrations of metals and potential contaminants to verify that that the material is safe and suitable for disposal.

The deposition area for all spoil waste material would be along the upland margin of Jemez Canyon Reservoir, approximately 3 miles from the project area. The site already contains material excavated from previous restoration work performed by the Pueblo of Santa Ana. Given that material would be deposited approximately 20-feet deep or more, a disposal area of approximately 7 to 10 acres would accommodate the grubbed material and excavated soil generated by the proposed project.

If suitable disposal sites closer to the work area should be identified by the Pueblo prior to construction, these alternative sites would be used only if they are devoid of significant ecological and cultural resources.

5.03 SCHEDULING OF CONSTRUCTION

Construction activities relative to Overbank Lowering would occur within the period November 2008 through March 2009 when flows are lowest (approximately 200 - 1,400 cfs) in the Rio Grande. Excavation of the Shrub Swale area could occur at any time during the year because of the dearth of vegetation within the footprint.

Removal of live vegetation in the Saltgrass Meadow and Riparian Shrub sites would occur during the September through March period to avoid the breeding season of migratory bird species. Implementation of planting activities is dependent of seasonal conditions. Cottonwood poles and willow whips must be installed during the dormant season and are usually planted in the February through March period. Containerized plants are usually installed from October through April. Grass seeding of unvegetated and disturbed areas could occur between March and August.

During construction, work may be temporarily suspended for Pueblo ceremonies or special functions. Temporary work suspensions would be coordinated through all appropriate project points-of-contact.

5.04 ACCESS AND STAGING

Access, staging, and spoil waste disposal areas were determined through coordination with the Pueblo of Santa Ana to facilitate construction activities yet minimize traffic congestion and disturbance to residents and visitors. Access to restoration areas would be required from both the east and west banks of the Rio Grande (see Plate 2).

Access to the Saltgrass Meadow and Riparian Shrub Habitat sites would be on a paved road from Jemez Dam Road and then along an existing dirt road to the site. If needed, the dirt access road would be graded and widened to a maximum of 30 feet.

Access to the Shrub Swale, Riparian Planting, and Bars #1, #2, and #4 would be from Jemez Dam Road along the existing gravel road of a utility corridor (at the northern end of the project area). At approximately 2.6 miles from Jemez Dam Road, access to the south would be along an existing dirt road paralleling, but outside of, the west edge of the bosque. These roads have previously been improved for recent construction and restoration activities and are approximately 30 feet wide.

A temporary, one-acre staging area for construction equipment and vehicles would be located in the riparian zone just north of the Shrub Swale and previously cleared of vegetation. The staging area would be enclosed by a temporary chain-link fence. Following completion of construction, the soil surface of the staging area would be scarified and planted with native grasses, forbs, and trees.

On the east side of the Rio Grande, construction traffic would gain access to Bars #3, #5 and #6 from Highway 550 by way of the existing Middle Rio Grande Conservancy District easement along the Bernalillo Riverside Drain and levee, and by existing dirt roads through the bosque to the riverbank. These routes would be scraped and minor fill may be added as necessary.

5.05 MONITORING

Post-project monitoring is crucial in the evaluation of project success and the performance of project features. Additionally, monitoring may generate new insights on ecosystem response and provide a basis for "lessons learned" that may be applied to subsequent planning and design efforts. Success should be based on a comparison of post-project conditions to the restoration project objective(s). Corps policy limits monitoring costs to 1% of the construction contract amount.

Monitoring of project performance and success would be conducted annually for up to four years following construction or vegetative planting. Monitoring would include measuring the surface elevation of lowered sandbars at selected channel cross-sections.

5.06 REAL ESTATE REQUIREMENTS

The Pueblo of Santa Ana would provide all appropriate lands, easements, rights-of-way, relocations, and spoil waste material disposal areas (LERRD) necessary for the project's construction, operation, and maintenance. All lands considered for LERRD credit were purchased in fee by the Pueblo of Santa Ana in 1753 (Bayer 1994, pages 78 and 218), and do not include any areas that received LERRD credit in an earlier Section 1135 project (USACE 2001). Permanent easements total 34.1 acres and include the footprints of the proposed Saltgrass Meadow, Riparian Shrub habitat, Shrub Swale, Riparian Plantings, and disposal site areas. The LERRD value for permanent easements is approximately $1,808,500. Temporary easements would be required for the footprints of the Overbank Lowering (approximately 62.2 acres) and Bankline Plantings (1.6 acres) features, and for the access road (2.4 acres) to the Saltgrass Meadow and Riparian Shrub sites. Temporary easements account for an additional $80,600 of LERRD value. No relocation of utilities or public facilities would be required for project implementation, operation, or maintenance.

5.07 PROJECT COSTS

The feasibility-level cost estimate summary is included in Appendix C and is summarized in Table 12. This feasibility study was accomplished with Federal funding. The Total Project Cost includes the feasibility, plans-and-specifications, and implementation phases and is subject to cost-sharing as specified in Section 5.08.

Table 12. Project costs itemized by phase and implementation activity.

Phase or activity	Implementation activity	Phase
Feasibility Study		200,000
Plans and Specifications (9%)		220,700
Implementation[a]		
Construction contract	3,823,700	
Supervision and administration (9.75%)	362,800	
Monitoring	38,200	
Total implementation costs		4,224,700
Federal share (total of above)		4,645,400
Local share (and LERRD credit)		1,548,500
Total Project Cost		6,193,900

[a] Implementation costs are based on 2006 dollars and include a contingency of 25%.

5.08 COST SHARING REQUIREMENTS

Section 1135 projects require that a local Sponsor cost-share 25% of the total project cost and are limited to no more than $5 million in Federal costs. The Pueblo of Santa Ana requested the current study and would serve as the local cost-sharing Sponsor for the project. The cost-sharing requirements and provisions would be formalized with the signing of a Project Cooperation Agreement (PCA) between the Pueblo and the Department of the Army following approval of this Detailed Project Report / Environmental Assessment. In the PCA, the Sponsor would agree to be responsible for 25% of the total project cost which includes the feasibility study, plans and specifications phase, and implementation (construction). A draft PCA will be submitted with this Detailed Project Report for Corps Division review and eventual approval by the Federal Government and the Pueblo.

The basic criterion for non-Federal cost-sharing responsibilities for Section 1135 projects is to provide 25 percent of total project costs, as further specified below:

> Unless assumed by the Federal Government, provide all lands, easements, and rights-of-way, including those necessary for borrow and dredged or excavated material disposal, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation and maintenance of the Project.
>
> Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.
>
> Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project to the extent and in such detail as will properly reflect total project costs and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 33 CFR 33.20.
>
> Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

The expected cost share requirement for the project is $1,548,500. The LERRD value for lands required for the project is approximately $1,889,100. Because the LERRD value exceeds the local cost share requirement, the local sponsor would waive reimbursement of the difference in accordance with current Corps policy, or request approval for reimbursement of the difference ($340,600).

5.09 FINANCIAL ANALYSIS

The Pueblo of Santa Ana has funds available for implementation of the project and has transmited a Letter of Intent to cost share the total project cost prior to approval of this Detailed Project Report (see Appendix B).

5.10 PROJECT IMPLEMENTATION PROCEDURES AND SCHEDULE

Remaining actions necessary for the approval and implementation of this project are summarized below.

The final Detailed Project Report and the draft PCA will be transmitted to the Division Engineer, South Pacific Division, Corps of Engineers, for approval.

The PCA will be signed by the Pueblo of Santa Ana and the Federal Government.

The Corps of Engineers and the Pueblo of Santa Ana will complete the final project design and the construction contract specifications.

The Corps of Engineers and the Pueblo of Santa Ana will conduct pre-award activities. These activities will include issuing plans and specifications to interested contractors, soliciting construction bids, review of submitted bids, obtaining required Clean Water Act permits and certification, and so on.

A contract will be awarded to build the project.

PCA execution and the initiation of the Plans and Specification phase is anticipated to begin in May 2008. The first construction contract is expected to be awarded in September 2008

5.11 CONSISTENCY WITH PROJECT PURPOSE

The construction and operation of the proposed Section 1135 project would be consistent with the authorized purposes and current operation of Jemez Canyon and Cochiti dams. Additionally, the proposed project would not alter the extent or frequency of damaging discharges within or downstream from the project reach. The deposition of approximately 147 acre-feet of spoil waste material within the reservoir's remaining 23,000-acre-feet of sediment space would not impinge on the flood control capacity of the reservoir.

5.12 OPERATION AND MAINTENANCE CONSIDERATIONS

Currently, the annual costs for operation, maintenance, repair, replacement and rehabilitation (OMRR&R) are estimated to be $4,000. This value includes project inspection on an annual basis, periodic hydraulic cross-sections, and monitoring of vegetation development. Upon completion of construction, the Corps of Engineers will complete an Operations and Maintenance manual for the project that will summarize all OMRR&R requirements.

6. FORESEEABLE EFFECTS OF THE PROPOSED PLAN

6.01 GEOMORPHOLOGY, HYDROLOGY, AND AQUATIC HABITAT

With respect to historic river geomorphology and aquatic habitat in the Middle Rio Grande, slower velocities and shallower depths are more desirable conditions for most native fish species in the study reach. The objective of Overbank Lowering is to improve current geomorphic and aquatic habitat characteristics to the degree possible given the existing, regulated flow regime. Table 13 shows the improved conditions in the overbank area which would result from the proposed project at the effective discharge. An appreciably wider and shallower channel with lower mean velocities would result over the range of discharges up to 7,000 cfs. (Additional discussion of aquatic habitat improvement is contained in Section 6.06.)

Table 13. Hydraulic variables (and percent change) comparing the with- and without-project conditions at 5,400 cfs (approx. two-year return interval).

	Channel characteristics				Overbank characteristics			
	Topwidth (ft)	Velocity (fps)	Depth (ft)	Width/ depth ratio	Percent discharge	Cross-section area (ft^2)	Topwidth (ft)	Depth (ft)
Future without project	241	4.0	5.3	45.6	5.5	174	143	1.2
Overbank lowering	243 (+0.8%)	4.0 (0%)	5.1 (-3.8%)	47.8 (+4.8%)	8.9 (+61.8%)	314 (+80.5%)	281 (+96.5%)	1.1 (-8.3%)

The New Mexico Interstate Stream Commission supports habitat restoration activities in the Rio Grande corridor but is concerned about water depletions resulting from such activities. The proposed work would occur on bars that are temporary in nature and located within the 600-foot-wide river channel, where the river water-level elevation and river surface water open area fluctuate significantly. Therefore, the proposed work would not increase depletions to any measurable or calculable degree.

6.02 DISPOSAL OF SPOIL WASTE MATERIAL

Approximately 236,419 cubic yards (146.5 acre-feet) of excess soil ("spoil waste") would be generated from excavation for the Overbank Lowering and Shrub Swale features in the recommended plan. All excavated material would be hauled offsite and deposited along the upland margin of Jemez Canyon Reservoir. The area required for disposal would be approximately 7 to 10 acres. The spoil waste disposal site is devoid of cultural resources, endangered and threatened species, and significant ecological resources.

The disposal site within Jemez Canyon Reservoir is near the upper topographic limit of the flood control space. The site's elevation (approximately 5,220 feet above MSL [NGVD]) is such that the chance of inundation is less than 4% (USACE 1994). The unfilled portion of the reservoir's sediment space is approximately 23,000 acre-feet. The 146.5 acre-feet of spoil waste proposed to be deposited within the reservoir would be allocated to this unfilled sediment space and would not impinge upon the flood control capacity of the reservoir.

It is possible that relatively small upland disposal areas that are closer to the project may be identified during the subsequent design phase. These sites may be utilized if they are devoid of any significant ecological or cultural resources.

There are no known locations of contaminants in sediments of the Rio Grande and the adjacent floodplain within the study area. To verify that spoil waste material is safe and suitable for disposal, soils would be analyzed for concentrations of metals and potential contaminants prior to construction.

6.03 WATER QUALITY AND WATERS OF THE U.S.

The majority of the area proposed for Overbank Lowering is below the ordinary high water mark (here defined as the elevation of the 2-year discharge of 5,400 cfs) and, therefore, would occur within "waters of the United States" as defined in Section 404 of the Clean Water Act. Section 404 strictly regulates the deposition of fill material while the proposed Overbank Lowering activity entails the removal of material. The applicability of the Section 404 regulation would, therefore, depend on the specific methods and equipment employed during implementation. The use of excavators or scrapers that directly lift and remove material from the surface of the sandbars (with only *de minimus* fill due to spillage) would not be subject to Section 404 regulation. However, the use of bulldozers to lower the surface of sandbars would be subject to Section 404 because the scraped material would be considered temporary fill. In the interest of minimizing construction costs, the specific equipment to be employed in Overbank Lowering would be left to the discretion of the construction contractor. The appended Section 404(b)(1) evaluation (Appendix D) analyzes the effects of the proposed action relative to the Clean Water Act and is summarized below.

All proposed construction activities would occur when overbanks are exposed during the annual period of low flow in the Rio Grande. Bed material within the channel is primarily coarse sand and gravel with only a small percentage of suspendable fine particles. Based on previous work within the channel in this reach by the Corps and the Bureau of Reclamation, the increase in turbidity due to the proposed activities would be negligible. The initial reflooding of lowered sandbars would only slightly increase turbidity downstream due to the presence of fines in the disturbed area. This temporarily elevated turbidity would be similar to, or less than, levels occurring annually in the Rio Grande during the spring runoff period and would not pose a threat to aquatic life.

Prior to the start of construction, Section 401 Water Quality Certification would be obtained from Region 6 of the U.S. Environmental Protection Agency (USEPA). Additionally, a Notice of Intent would be filed with USEPA Region 6, and a Section 402 Storm Water Pollution Prevention Plan will be prepared by the Corps. The plan would include the best management practices to be employed to minimize erosion and stormwater runoff from areas disturbed during construction.

Following completion of construction, the Shrub Swale would be considered a wetland subject to Section 404 regulation. Groundwater levels under the swale are hydrologically linked to surface water stage in the adjacent Rio Grande channel. In most years, river stage increase during the snowmelt runoff period raises the groundwater level, allowing the establishment and continued growth of hydrophytic vegetation in the swale.

6.04 AIR QUALITY AND NOISE

The planned action would not result in any permanent or significant short-term degradation of air quality, although some highly-localized and ephemeral increases in concentrations of dust and combustion emissions would be expected during the operation of construction vehicles and equipment. Measures to minimize dust, such as surface watering and mulching, would be employed during construction.

During excavation activities, only a slight, localized increase in ambient noise levels would be expected from the operation of equipment.

6.05 ECOLOGICAL RESOURCES

Approximately 15.6 acres of vegetation on bars immediately adjacent the channel would be removed (grubbed) to facilitate Overbank Lowering. Vegetation in these areas consists of very sparse saltcedar, with occasional Russian olive or coyote willow shrubs. The remaining 46.6 acres proposed for Overbank Lowering are unvegetated or consist of sparse grasses and forbs. A high-water side-channel on Bar #1 that supports coyote willows along its banks would be avoided during Overbank Lowering activities.

Sparse saltcedar also occupies the 14.1-acre footprint of the proposed Shrub Swale and Riparian Plantings. All woody vegetation in this area was removed in 2000 during previous restoration clearing, and saltcedar re-sprouts were treated with a manual herbicide application approximately two years later. Currently, only sparse saltcedar re-sprouts remain, and would be mechanically removed prior to the proposed restoration activities.

The 5-acre footprint of the proposed Saltgrass Meadow is occupied by moderately dense saltcedar that has re-sprouted following aerial herbicide treatment in 1998. Saltcedar would be removed and the area would be root-plowed to prevent its future regrowth.

Saltcedar has been shown to be a low-quality wildlife habitat (Hink and Ohmart 1984, Thompson *et al*. 1994, Campbell *et al*. 1977, HAI 2006). The habitats proposed for restoration have a quantifiably higher value for avian (see Table 8) and small mammal species.

The 5-acre Riparian Shrub Habitat footprint is currently occupied by dense Russian olive. In the current project, it is proposed to convert this area to a similarly structured native shrub stand, consistent with the Pueblo of Santa Ana Restoration Plan. The proposed shrub habitat type—consisting primarily of New Mexico olive and silver buffaloberry—has been documented to support higher avian species richness and abundance than dense Russian olive stands (HAI 2006). Additionally, the location of this shrub stand between the existing cottonwood forest and the proposed saltgrass meadow would increase overall wildlife habitat value due to the juxtaposition and diversity of vegetation structure.

The mean avian density for the summer and winter seasons was the basis for wetland and riparian restoration benefits in this study's incremental cost analysis (see Section 4.04). Based on the index values in Table 8, avian abundance within the approximately 26 acres of vegetative restoration would increase 186% between the existing (60.3) and with-project (173.2) conditions.

Except for some planting activities, project construction would occur between September and March to avoid disturbance during the breeding season. Wildlife occurring within the project work areas would be temporarily displaced during construction activities. Wildlife value and use also would be temporarily reduced until plantings mature.

The increase in shallow, low-velocity aquatic habitat would benefit most native fish species, especially red shiner, western mosquitofish, fathead minnow, Rio Grande silvery minnow, and longnose dace. (Quantification of these benefits is discussed in the following section.) Overbank Lowering activities would only occur on exposed sandbars outside of the wetted channel; therefore, disturbance to fish species during construction would be negligible.

6.06 ENDANGERED AND PROTECTED SPECIES

Southwestern Willow Flycatcher

Temporary construction impacts: No breeding Willow Flycatchers have been known to occur within the proposed study area in, at least, the past 18 years. No suitable breeding habitat occurs within the project area. Potentially suitable breeding habitat (requiring additional growth to become suitable) occurs neat the confluence of the Jemez River and Rio Grande, approximately one mile upstream from the implementation area. It is highly unlikely that the flycatcher or its habitat would be harmed by the proposed habitat restoration activities. It is possible that individual, migrating flycatchers could be displaced a short distance up- or downstream by construction activity during the month of September.

General long-term impacts: The restoration of native riparian and wetland vegetation throughout approximately 26 acres would benefit migrating flycatchers. Once established and mature, vegetation within the 6.6-acre Shrub Swale would be potentially suitable habitat for breeding flycatchers.

Rio Grande Silvery Minnow

Temporary construction impacts: The Rio Grande silvery minnow is known to occur within the proposed project reach. Overbank Lowering construction would take place on exposed sandbars and, therefore, would not have a direct effect on any individuals present in the channel. While minor, indirect disturbance may be anticipated from proposed activities immediately adjacent to the channel, the Rio Grande silvery minnow, as well as other fish, have the ability to move to safer and less stressful areas of the channel. Overbank Lowering activities would not occur within the spawning period of the silvery minnow.

Long-term impacts: The availability of shallow (less than 2-feet deep), low-velocity (less than 1 ft/sec) areas was used as the index for aquatic habitat improvements and is discussed in detail in Section 4. The following summarizes expected benefits of the proposed plan.

The extent of preferred habitat would increase by approximately 50% or more for discharges less than 5,400 cfs as a result of proposed Overbank Lowering (Table 14 and Figure 9A). The hydraulic model indicated that the acreage of preferred habitat would decrease for discharges greater than 6,000 cfs. However, habitat suitability is a function of both physical and temporal availability. The temporal availability of preferred minnow habitat was based on discharge frequency and expressed as "days per year". When combined with the acreage available at the appropriate discharge, the resultant index—acre-days per year—indicates both the spatial and temporal availability of preferred habitat (Table 14 and Figure 9B). For the entire range of discharge up to 7,000 cfs, Overbank Lowering was estimated to provide 8,053 acre-days/year of preferred habitat, a 50% increase from the 5,373 acre-days/year available for the without-project condition.

The loss of preferred habitat acreage at discharges greater than 6,000 cfs is not a cause for concern when the relatively low frequency of these flows and other factors are considered.

Immediately upstream from the study reach, the Pueblo and Bureau of Reclamation recently have completed restoration activities that increased (by 45 acres) floodway inundation at flows higher than 5,400 cfs. Also, the Jemez River—the confluence of which is approximately one mile upstream from the study reach—usually experiences peak spring runoff flow about 3 to 4 weeks prior to the Rio Grande; therefore, silvery minnow can utilize the slackwater areas along the Jemez River during high flows on the mainstem. Lastly, flows greater than 5,800 cfs begin to inundate extensive areas of the riparian zone approximately 36 miles downstream from the project area. Because silvery minnow spawning intensity increases with higher discharge (Dudley *et al*. 2006a), the population as a whole benefits under these conditions. In the subsequent final design for the project, the 2-dimensional hydraulic model would be utilized to identify and avoid the highest overbank elevations in order to minimize the projected decrease in extent of preferred habitat.

Table 14. Spatial and temporal availability of preferred Rio Grande silvery minnow habitat[a] for the with- and without-project conditions.

Discharge class midpoint (cfs)	Preferred habitat (acres)				Preferred habitat (acres-days per year)	
	Without project	With project	Discharge probability[b]	Probability as "days per year"	Without project	With project
500	13.39	19.82	9.51	34.7	465	688
1000	11.27	20.30	27.10	98.9	1,115	2,008
2000	14.19	22.09	27.48	100.3	1,423	2,215
3000	17.23	27.28	16.20	59.1	1,018	1,613
4000	19.74	29.51	6.54	23.9	471	704
5400	22.05	27.72	6.33	23.1	509	640
7000	26.50	13.17	3.84	14.0	372	185
Total			97.0[c]	354.0[c]	5,373	8,053

[a] Depth 2 feet or less; velocity 1 ft/sec or less.
[b] Average of Albuquerque and San Felipe streamflow gauges.
[c] Totals are less than 100 and 365 because discharges less than 250 cfs and greater than 7,700 cfs are not included.

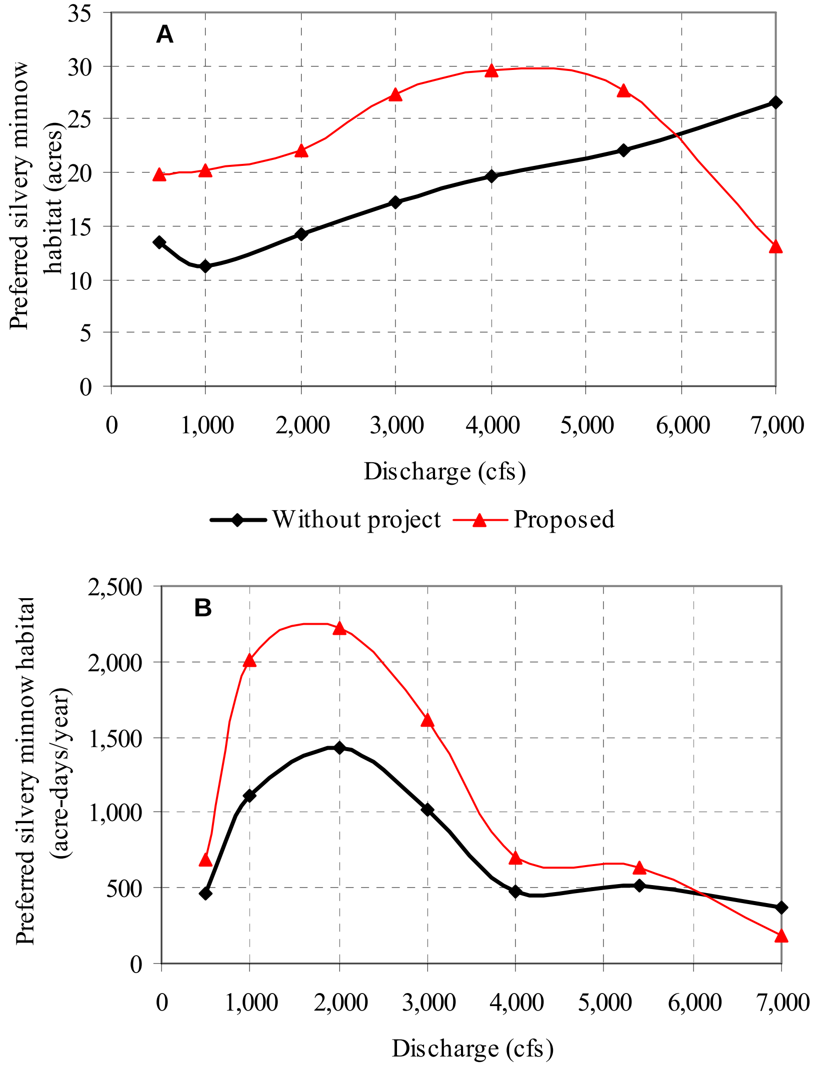

Figure 9. Availability of preferred Rio Grande silvery minnow habitat for the with- and without- project conditions: A) acres; B) acre-days per year.

<u>Endangered Species Act Compliance Summary</u>

Based on the analyses and information described above, the Corps has determined that the conduct of the proposed restoration project may affect, but would not likely adversely affect the Southwestern Willow Flycatcher and Rio Grande silvery minnow. During informal consultation under the Endangered Species Act, the Corps will request concurrence from the U.S. Fish and Wildlife Service regarding this determination.

In July 2004, the Service and the Pueblo of Santa Ana finalized a Safe Harbor Agreement regarding the Southwestern Willow Flycatcher and Rio Grande silvery minnow. That agreement does not pertain to activities with Federal involvement.

6.07 CULTURAL RESOURCES

The New Mexico Historic Preservation Division's Archeological Records Management Section database was searched to identify cultural resources sites reported within the vicinity of the project area. The database search found that no archaeological sites have been reported within the river's 100-year floodplain in the project area. If cultural resources sites were within the 100-year floodplain, they would have been either washed away by the river and/or buried by significant sediment deposition. A recent archaeological survey and assessment that considered the potential for cultural resources to occur within the 100-year floodplain came to the same conclusion: "Based on aerial photo analysis, preliminary geomorphic studies, and field inspection, it became clear that the low terraces within the bosque represent relatively recent historic period alluvial deposits with little or no potential to contain cultural materials of significant antiquity or archaeological integrity." (Penner *et al*. 2001). All restoration activities in the proposed project would occur within the 100-year floodplain of the Rio Grande; therefore, no cultural resources would be affected by the proposed restoration project.

No State or National Register properties which could be affected by the restoration project occur within the construction area or along access routes.

All access and staging areas—including overnight equipment and vehicle parking, and spoil disposal areas—have been previously surveyed for cultural resources and received use clearance, have been previously disturbed and utilized for similar purposes, or are located within the 100-year floodplain. In considering the above information and previous survey work, there would be no effect on prehistoric or historic archaeological sites or cultural resources on Santa Ana Indian Reservation lands or in the general project area.

During project planning, long-time Tribal Administrator, Mr. Roy Montoya, in consultation with tribal members, indicated that no Traditional Cultural Properties would be affected by this restoration project. No other prehistoric or historic properties or archaeological sites are reported or known to occur near the proposed construction areas and no artifacts or cultural resource manifestations were observed during the site visit to the riverside construction areas.

Therefore, the Corps is of the opinion that there would be "No Historic Properties Affected" by the proposed restoration project or on the historic and cultural resources of the region. A concurrence of no effect to cultural resources was obtained from the New Mexico State Historic Preservation Officer in July 2001. Consultation with the Pueblo of Santa Ana and the New Mexico State Historic Preservation Officer is documented in Appendix B.

Pursuant to 36 CFR 800.11, should any previously unrecorded and/or previously undetected cultural material be discovered during construction activities, all work will cease in the immediate area of the exposed resource until the significance and disposition of the archaeological remains have been evaluated, and a determination of significance made in consultation with the Pueblo of Santa Ana and the New Mexico State Historic Preservation Officer.

6.08 LAND, AESTHETIC RESOURCES, AND RECREATION

Land use within the project area would not be altered by the proposed project. The area would remain a designated natural preserve.

Existing vegetation screens most of the proposed work areas from the nearby Hyatt Tamaya Resort. If necessary, screening material/fencing would be installed to further conceal the staging area.

The aesthetic quality of the Rio Grande would not be adversely affected by the proposed action, and may increase slightly due a wider channel following completion of restoration. The Shrub Swale and Riparian Planting areas currently area vegetated by scattered, scrubby saltcedar, and the aesthetic quality of the area would improve following restoration planting.

Minor secondary benefits to recreational activities in the project area would result from improved ecological functions, values and esthetics associated with the proposed plan. During construction, public access would be restricted from the staging and construction areas. Visitors to the area would still be afforded access to the adjacent bosque and river channel.

6.09 SOCIO-ECONOMIC AND ENVIRONMENTAL JUSTICE CONSIDERATIONS

The proposed restoration project would not affect economic enterprises of the Pueblo of Santa Ana or in Sandoval County.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires ". . . to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report of the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations . . ." The proposed action has been reviewed for compliance with this order and would not adversely affect the health or environment of minority or low-income populations.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* Federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children under the age of 18. These risks are defined as "risks to health or to safety that are attributable to products or substances that the child is likely to come into contact with or ingest." The conduct proposed action would not entail any risk to the health and safety of children under the age of 18, nor to adults.

6.10 CUMULATIVE EFFECTS

The National Environmental Policy Act defines cumulative effects as "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

As stated earlier, the Pueblo of Santa Ana improved the ecological condition of approximately 720 of the 1,400 acres of riparian habitat within the Rio Grande corridor on the reservation. The restoration activities proposed in this Section 1135 project entails an additional 26 acres of riparian and wetland improvements. Similarly, the Pueblo, Bureau of Reclamation, and Corps have cooperated on restoring aquatic habitat (see Section 2.7), and the proposed Section 1135 project would improve an additional 62 acres within the Rio Grande. In summary, the proposed project would have a beneficial cumulative effect on the riverine and riparian ecosystems

7. RECOMMENDATION

As District Engineer, Albuquerque District, U.S. Army Corps of Engineers, I have weighed the ecosystem benefits to be gained from implementing the recommended habitat restoration plan at the Santa Ana Indian Reservation against the cost, and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the proposed project is a justified expenditure of Federal funds. The proposed project is fully consistent with the authorized purposes of Jemez Canyon and Cochiti Dams and would not have any effect on their operation or maintenance. I recommend that the Secretary of the Army approve the Aquatic Habitat Restoration at Santa Ana Pueblo, New Mexico, project.

Total first-cost estimate of the project is $6,193,900. The project sponsor, the Pueblo of Santa Ana, would provide one-quarter — that is $1,548,500 — of the total project cost, thus meeting the requirement of 25% non-Federal money for Section 1135(b) program (Public Law 99-662) projects. All future operation and maintenance responsibilities for the features implemented in the recommended plan would be borne by the Pueblo of Santa Ana. These and other pertinent details have been included in the draft Project Cooperation Agreement negotiated with the sponsor.

I further recommend that funds in the amount of $3,840,000 be allocated in fiscal year 2008 to complete plans and specifications and initiate construction.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of restoration projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted as proposals for implementation funding. However, prior to transmittal, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

B. A. Estok
Lieutenant Colonel, U.S. Army
District Commander

8. PREPARATION, COORDINATION AND CONSULTATION

8.01 PREPARATION

This Detailed Project Report / Environmental Assessment was prepared by the U.S. Army Corps of Engineers, Albuquerque District. The Product Delivery Team (PDT) and principal preparers included:

Kelly Alcon and Louis Gurule – Real Estate
Alan CdeBaca – Cost Estimator
William DeRagon – Biologist and PDT leader
Darrell Eidson, P.E. – Hydraulic Engineer
Gregory Everhart – Archaeologist
Brian Jordan – Chemist
Ronald Kneebone, Ph.D. – Project Manager
Art Maestas – Geotechnical Engineer
Will Trujillo, P.E. – Civil Engineer

Ayres Associates (Fort Collins, CO) conducted geomorphic, hydrologic, and hydraulic analyses which formed the basis of all findings, and performed the hydraulic design:

Peter Lagasse, P.E., Ph.D – Senior Vice President
Lyle Zevenbergen, P.E., Ph.D – Senior Hydraulic Engineer
Morgan Byars, P.E. – Hydraulic Engineer
Scott Hogan, P.E., CFM – Hydraulic Engineer
Dustin Robinson, P.E. – Civil Engineer

David Evans Associates, Inc., conducted wetland creation analysis.

The current and former staff members of the Pueblo of Santa Ana Department of Natural Resources were, of course, instrumental in the planning, coordination, and technical activities associated with this study:

Brian Bader and Todd Caplan – former Restoration Program Managers
Deborah Goss – Director
John Cote – former Director
Alan Hatch – GIS/IT Division Manager
Glenn Tenorio – Water Resources Technician, Governor's Representative
Ron Montoya – Governor's Representative
Roy Montoya – former Tribal Administrator
Les Ramirez – former Legal Counsel/Policy Analyst

The Albuquerque District Independent Technical Review Team consisted of:

Rob Browning – Economics and planning
Lynette Giesen – Planning
Champe Green, CWB – Ecology and compliance
Ryan Gronewold – Hydrology and Hydraulics
Cecelia Horner, P.E. – HTRW
John Schelberg, Ph.D – Cultural Resources
Terry Weeks – General Engineering

8.02 COORDINATION AND CONSULTATION

Agencies and other entities contacted formally or informally in preparation of this Environmental Assessment included:

New Mexico Environment Department
Pueblo of Sandia
U.S. Army Corps of Engineers, Regulatory Branch
U.S. Bureau of Reclamation, Albuquerque Area Office
U.S. Environmental Protection Agency, Region 6
U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office
Middle Rio Grande Endangered Species Act Collaborative Program

The planned action has been fully coordinated with the U.S. Fish and Wildlife Service (Service) in compliance with the Fish and Wildlife Coordination Act of 1958. The final Fish and Wildlife Coordination Act Report prepared by the Service is included in Appendix A.

Coordination under Section 106 of the National Historic Preservation Act has been conducted with the New Mexico State Historic Preservation Officer. A letter of concurrence with the Corps' determination of no effect to cultural resources is included in Appendix B.

8.03 PUBLIC REVIEW

[To be completed after public review.]

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PLATES

[Plates are contained in a separate electronic file.]

APPENDIX A

FISH AND WILDLIFE COORDINATION ACT REPORT

Note: Fish and Wildlife Coordination Act Reports provide early input to Corps water resource development projects. This report discusses both grade restoration and vegetative features.

New Mexico Highway 44 mentioned in the text has since been renamed Highway 550.

The Bald Eagle was removed from the Federal Endangered species list in 2007.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

January 9, 2001

Cons. #2-22-00-I-149

Lt. Colonel Raymond G. Midkiff, District Engineer
Attn: Environmental Section
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109

Re: Final Fish and Wildlife Coordination Act Report for the Riparian and Wetland Restoration Project, Pueblo of Santa Ana Reservation, New Mexico.

Dear Lt. Colonel Midkiff:

Enclosed is the Final Fish and Wildlife Coordination Act Report for the referenced project in Sandoval County, New Mexico, proposed by the U.S. Army Corps of Engineers, Albuquerque District. The proposed project on the Rio Grande addresses restoration of riverine, riparian, and wetland habitats.

This report has been prepared by the U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e).

Sincerely,

Joy E. Nicholopoulos

Joy E. Nicholopoulos
Field Supervisor

Enclosure

cc: (w/enc)
Governor, Pueblo of Santa Ana
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Chief, New Mexico Environment Department, Surface Water Quality Bureau,
Santa Fe, New Mexico

Final Fish and Wildlife Coordination Act Report for the Riparian and Wetland Restoration Project, Pueblo of Santa Ana Reservation, Sandoval County, New Mexico

Submitted to
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, N.E.
Albuquerque, New Mexico 87109
January 2001

Prepared by
Denise Smith
U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113

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INTRODUCTION

This is the Final Fish and Wildlife Coordination Act Report (CAR) for the Riparian and Wetland Restoration Project, Pueblo of Santa Ana Reservation, New Mexico, prepared by the U.S. Fish and Wildlife Service (Service) under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661-667e). This report has been prepared with the cooperation of the Pueblo of Santa Ana and the U.S. Army Corps of Engineers (Corps). Comments from both agencies have been incorporated into this report. Should project plans change or a considerable amount of time elapse before this project begins to be constructed, impacts on fish and wildlife should be re-examined.

The Pueblo of Santa Ana and the Corps are planning a restoration project within a 6.4-kilometer (km) (4-mile (mi)) reach of the Rio Grande, approximately 40 km (25 mi) downstream of Cochiti Dam, beginning downstream from the Jemez River confluence with the Rio Grande and Angostura Diversion Dam, and continuing downstream nearly to the New Mexico Highway 44 bridge at Bernalillo, Sandoval County, New Mexico (Figure 1). The proposed project involves restoration of riverine, riparian, and wetland habitats.

This CAR addresses the restoration plan proposed by the Corps under the authority provided by Section 1135(b) of the Water Resources Development Act of 1986 (P.L. 99-662), as amended, for improvement of the environment where Corps projects have contributed to environmental degradation. This report provides information concerning fish and wildlife resources existing without the project, potential project impacts to fish and wildlife resources, a discussion of the potential benefits and concerns related to fish and wildlife resources, and recommendations to decrease adverse effects and maximize benefits to fish and wildlife resources. Components of the larger restoration plan are described in this introduction for background information.

The restoration plan addressed in this CAR is part of a larger, multi-agency project (the Pueblo of Santa Ana Reservation Restoration Plan), which involves planning and funding by the Pueblo of Santa Ana, and several Federal agencies: the U.S. Bureau of Reclamation (Reclamation), the Corps, the Bureau of Indian Affairs, the Environmental Protection Agency, and the Service.

The Pueblo of Santa Ana Reservation includes a 9.6-km (6-mi) reach of the Rio Grande, with approximately 484.8 hectare (ha) (1,200 acres (ac)) of riparian habitat on the east and west sides of the river. Chronic bank erosion and channel degradation, as well as replacement of native riparian vegetation with non-native vegetation is occurring within the reservation reach. The Pueblo of Santa Ana has organized the expertise and programs available through several Federal agencies to restore riparian, wetland, and riverine habitats within the reservation's ecosystem. Contributions of each of the agencies toward the overall restoration plan are described below.

The Pueblo of Santa Ana

The Pueblo of Santa Ana discontinued livestock grazing in the riparian area, and manages the area as a nature preserve. The Pueblo of Santa Ana developed a riparian forest restoration plan describing the existing vegetation and treatment plans. Soil data, including salinity and texture, and ground water table data have been collected. Baseline monitoring of insect, small mammal, amphibian, reptile, bird, and bat species is being conducted. The Pueblo of Santa Ana has cleared 127.3 ha (315 ac) of non-native vegetation, and plans to clear an additional 16.2 ha (40 ac) in the year 2000. Non-native vegetation has been cleared using heavy equipment, and re-sprouts are being individually treated with herbicide. Revegetation of cleared areas is occurring with native riparian tree and shrub species. Twelve ha (30 ac) have been planted, and more would be planted in conjunction with Reclamation and Corps projects. In addition, the Pueblo of Santa Ana has removed 486 m (1,600 ft) of Kellner jack lines on the west side of the river that are no longer needed for bank protection. Soil remediation on 40.4 ha (100 ac) has been completed in an hyper-saline area where saltcedar was removed to facilitate successful planting of native vegetation. Monitoring is being conducted to document the response of wildlife species to the various riparian restoration activities.

Bureau of Indian Affairs and U.S. Environmental Protection Agency

The Bureau of Indian Affairs and the U.S. Environmental Protection Agency provided financial assistance to the Pueblo of Santa Ana for clearing non-native vegetation on 127.3 ha (315 ac) for the purpose of fire suppression.

U.S. Fish and Wildlife Service

The Service provided funds to conduct soil, wildlife, and vegetation surveys, herbicide application on the stumps of cut non-native vegetation, and native riparian vegetation planting.

U.S. Bureau of Reclamation

Reclamation's involvement in the plan evolved as an alternative to routine emergency bank stabilization measures conducted by Reclamation on the east side of the river, about 0.80 km (0.5 mi) downstream of the Jemez River confluence, where active bank erosion persistently threatens adjacent structures. Rather than continue long-term maintenance, a more permanent solution to the problem was sought. Reclamation plans to provide restoration of riverine habitat through the creation of a wider operational channel and floodplain, resulting in reduced water velocities, decreased flow depth, increased width-to-depth ratios, and increased sediment deposition in a 3.2- km (2-mi) reach of the Rio Grande immediately downstream of the confluence with the Jemez River. The project consists of three phases to be constructed over a three-to-five year time frame. In phase 1, the river channel would be realigned to move flows away from the presently deteriorating east side levee bank. This phase includes the installation of a gradient restoration facility (GRF) approximately 6.4 km (4 mi) upstream of New Mexico Highway 44 bridge, and accompanying fish passage apron; excavation of a 7.5-meter (m) wide (25-feet (ft)) pilot channel and adjacent floodplain area; installation of river dikes to block off the existing river channel, creating two backwater areas; installation of bio-engineered bank stabilization along the new channel alignment where necessary; and planting of native vegetation along the restored reach.

Phase 2 would begin after the pilot channel has widened into the new river channel. This phase would consist of excavating and planting the remaining floodplain areas, and installation of bendway weirs along the east side of the new channel alignment to protect the levee and irrigation structures. Bendway weirs are low-level, upstream-angled stone sills, keyed into the outer bank of a bend for erosion control and improvement of instream habitat. The bendway weirs may be constructed in Phase 3 if the channel is continuing to adjust to the new alignment during Phase 2.

Phase 3 would consist of revegetation of 18.2 ha (45 ac) on bank lines, backwater areas, and floodplain zones in a 1.6-km (1-mi) reach. Monitoring of the hydrologic and geomorphic conditions that result from the river restoration activities would help determine the timing, location, and extent of planting. Both backwater areas would be densely planted with willows, and black willow and cottonwood poles for overstory canopy.

U.S. ARMY CORPS OF ENGINEERS PROJECT DESCRIPTION

The proposed Corps project includes restoration of riverine, riparian, and wetland habitats. The project includes improved channel stability along 6.4 km (4 mi) of the Rio Grande within the Pueblo of Santa Ana Reservation with construction of three GRFs downstream of and extending the benefits of Reclamation's GRF (described in previous section), and a downstream sill; lowering and regrading bars within the channel (described as overbank lowering); creation of a saltgrass meadow; creation of a shrub wetland; creation of a backwater; Kellner jack modification; removal of exotic vegetation; and native vegetation plantings.

Three GRFs with 152.5-m-long (500-ft) downstream aprons would be constructed to stabilize the bed elevation while providing slopes flat enough (0.004) to be negotiated by small native fishes (Figure 2). The downstream sill would provide a control point for the structures upstream, with self-launching riprap that would fill in directly below the sill where the channel is expected to scour and continue the current down-cutting trend. Placement of the GRFs in the channel would result in only slightly increased surface water elevations in the Rio Grande, and therefore would not likely result in an increase in groundwater elevations in the project area. Overbank flooding of the riparian areas within the project site is also not expected, since hydraulic studies show that over 424.5 cms (15,000 cfs) flow is required before overbank flooding would begin to occur (approximately the 50-year flood).

Overbank lowering would be conducted on six sand bars within the project area (Figure 2), totaling 39.5 ha (98 ac), to create additional riverine habitat by providing more frequent off-channel inundation. The overbank areas would be lowered to initiate flooding at the 2-year discharge of 152.8 cms (5,400 cfs).

Dense, non-native saltcedar and Russian olive growth within approximately 20.2 to81 ha (50 to 200 ac) of the riparian forest along the Rio Grande would be removed through brush cutting and root plowing, combined with local herbicide application to stumps to minimize re-sprouting. Existing patches of native woody species (cottonwood, willow, New Mexico olive, and seepwillow) would be retained wherever possible. Native tree species (cottonwood and black willow) would be re-established within the cleared areas at an approximate density of 20 poles per ha (50 poles per ac). Understory shrubs would be established in selected areas. Coyote willow would be established through whip planting in appropriately moist areas. Other areas disturbed from construction activities throughout the project area would be re-seeded with native grasses, forbs, and shrubs. A 2.6-ha (6.4-ac) salt grass meadow would be established in an area with a historically high water table once the saltcedar currently dominating the area is removed.

A wetland would be created in the riparian zone on the west side of the Rio Grande with 4.6 ha (11.5 ac) of shrub vegetation, surrounded by 2.2 ha (5.5 ac) of riparian woodland vegetation. The area has been prepared by clearing the existing Russian olive vegetation, and would be excavated and contoured to create the desired wetland habitat features to provide a variety of functions and values. Basin grading would be to a maximum depth of 0.304 m (1 ft) above the growing season high groundwater table, and would be irregular in shape. Shrub vegetation (coyote willow and seepwillow) would be planted at the lowest elevations, with black willow, New Mexico olive, wolfberry, and skunkbush sumac 0.61 to 0.92 m (2 to 3 ft) higher in elevation, and with riparian vegetation such as Fremont cottonwood, black willow and wolfberry planted slightly higher. Pole cuttings would be used for cottonwood, black willow, and coyote willow, while seepwillow, skunk-bush sumac, New Mexico olive, and wolfberry would be planted as seedlings or containerized shrubs. While cottonwood cuttings would be widely spaced, shrub species would be planted in clumps to mimic the dense thickets often formed by the species. Supplemental irrigation for two growing seasons would likely be required to establish new plantings until root growth is sufficient to penetrate to the capillary fringe.

A 0.3-ha (0.7-ac) backwater habitat would be cut into the bank of the Rio Grande to provide low-velocity water when flows exceed the 2-year discharge. The backwater channel would be constructed to slope gradually from the top-of-bank to the river bed to avoid trapping aquatic species in isolated pools when the water elevation decreases.

The Corps is investigating modification of an existing Kellner jack field on the east side of the river that has a double row of bank-line jacks protecting the narrow and eroding bank. The bank-line jacks need to remain in place for continued bank protection; however, the lateral lines may be replaced with more aesthetically pleasing options.

One staging area would be located on the east side and one on the west side of approximately 0.4 ha (1 ac) each. Each area would be located in previously disturbed locations and would be outside of the 100-year floodplain. The waste material amount and disposal area have not been determined. All channel work and construction of the shrub wetland would occur during times of low water in the Rio Grande. Clearing within the riparian zone would occur while the trees are dormant and the deciduous trees leafless.

The proposed project includes monitoring by the Corps for a period of 5 years to determine if the restoration is successful and to provide performance data that may be useful to the development of future restoration activities in the Middle Rio Grande. Plant species composition, structure, and abundance would be determined in plots within or transects through restored riparian and wetland areas. Hydraulic cross-sections would be measured within the Rio Grande channel and floodplain, including the backwater area.

EVALUATION METHODOLOGY

Since project planning began in 1998, the Service has attended many meetings, held by Reclamation, the Corps, and the Pueblo of Santa Ana, to discuss project features, design, and construction methods. Field trips to the project area have taken place in conjunction with the restoration activities.

The recent flora and fauna surveys conducted by the Pueblo of Santa Ana are not available to the public outside the Pueblo of Santa Ana, and therefore are not used in this report. Surveys for Rio Grande silvery minnow were conducted in the project area in 1992, 1996, 1998, 1999, and 2000. Southwestern willow flycatcher surveys were conducted in 1996 by Reclamation. Annual surveys for bald eagles were conducted by the Corps between 1988 and 1996.

Additional biological data and background information were derived through review of relevant literature and personal communications. The Corps is providing technical and background information.

FISH AND WILDLIFE RESOURCES

Hydrology and Geomorphology

The Rio Grande flows from its headwaters in southern Colorado, through New Mexico, depositing into the Gulf of Mexico as it forms the border between Texas and Mexico. The Middle Rio Grande (Figure 1) is known as the area between Cochiti and Elephant Butte Reservoirs in New Mexico. The proposed project area, the Pueblo of Santa Ana Reservation reach, is approximately 40 km (25 mi) downstream of Cochiti Reservoir. The watershed feeding into this reach is 51,541 km 2 (19,900 mi2), including the contributing waters diverted from the closed basin of 7,511 km2 (2,900 mi2) in San Luis Valley, Colorado, into the Chama River, known as San Juan-Chama water (Corps 2000).

A significant portion of the upstream watershed discharge is regulated by flood control reservoirs. Upstream of the proposed project reach, there are six reservoirs - El Vado, Heron, Abiquiu, Galisteo, Cochiti, and Jemez Canyon Reservoirs. The reservoirs reduce sediment transport and peak discharges, with Cochiti Reservoir having the greatest significance for the Pueblo of Santa Ana Reservation project area. Angostura Diversion Dam, immediately upstream of the proposed project area, also contributes to sediment deprivation (Corps 2000).

The regulated flows in the Middle Rio Grande follow a pattern of high flows during spring runoff and low flows during the fall and winter months, with additional high flows from later summer thunderstorms. An average annual hydrograph (post-dam era of 1974-1999) for the river at the San Felipe gage upstream of the project area indicates that the seasonal peak discharge usually occurs in late-May to early-June from snowmelt originating in Colorado. Average maximum daily discharges range from approximately 99 to 113 cms (3,500 to 4,000 cfs). The average base flow of approximately 28.3 cms (1,000 cfs) usually persists from November to March and the lowest average flows of 14 cms (500 cfs) have been observed in October. The 2-year return period is calculated at 152.8 cms (5,400 cfs), the 50-year at 435.8 cms (15,400 cfs), and the 100-year at 631 cms (22,300 cfs) (Corps 2000).

Reservoir operations upstream of the project area have changed the hydrology and sediment supply, causing chronic erosion of the banks of the river and degradation of the channel bed. The historical river prior to dam construction was a wide, multi-threaded, shallow, sand-bed channel with a wide floodplain. The upstream dams were built in part to slow the aggradation occurring in the channel and to reverse the trend to degradation. Kellner jacks were placed along the channel to encourage a straighter and deeper channel and to stabilize the banks. The resulting degradation and channelization has created a narrow and deep single-thread channel, with no functional floodplain from Cochiti Dam to downstream of Bernalillo, New Mexico. Continued degradation in this reach is expected unless restoration alternatives are implemented (Corps 2000).

The incised channel and dam operations prevent overbank flows and periodic scouring of floodplain areas. This changed hydrology precludes natural regeneration of native cottonwoods and willows and promotes the growth of non-native vegetation such as saltcedar and Russian olive, which are replacing the native cottonwood/willow vegetative complex. As a result of all of these changes, the quality and quantity of fish and wildlife habitat have steadily decreased.

Aquatic Resources

The aquatic habitat in the Rio Grande has been altered from dams and reservoirs that store sediment and control releases for agricultural use, flood control, and recreation; and levees constructed for flood control and protection of development within the floodplain. Jetty jack fields have straightened and channelized the river for more effective water transport. Reservoir operations reduce peaks in flows and discharge lower flows for a longer duration (Crawford *et al*. 1993). In the project area, the altered sediment and flow regimes have resulted in the transformation from a wide, braided sand bed system to a single, incised, gravel-bed channel with no floodplain (Reclamation 1999). Wetlands and slack water areas are generally no longer available for aquatic organisms (Crawford *et al.* 1993).

The aquatic resources in the Rio Grande evolved to live in a system that is very different than what currently exists. The cold, clear water releases from Cochiti Dam and the entrenched channel armored with a gravel bed have created an aquatic system that favors cool-water fishes and invertebrates, and limits warm water fisheries below the dam and downstream to Albuquerque. Consequently, the existing aquatic communities in the project area differ than those that occurred historically (Crawford *et al.* 1993).

The loss of many native fish species in the Middle Rio Grande illustrates that the hydrologic and morphological changes in the channel have had a major impact on aquatic resources. The native ichthyofauna of the New Mexico portion of the Rio Grande is believed to have consisted of between 16 and 27 species (Hatch 1985; Smith and Miller 1986; and Propst *et al.* 1987), 4 of which were endemic to the basin. Of the latter, the Rio Grande shiner, phantom shiner, and Rio Grande bluntnose shiner no longer survive in the New Mexico portion of the Rio Grande. The Rio Grande silvery minnow is the only endemic Rio Grande fish surviving in New Mexico and occurs in less than 5 percent of its total former range (Bestgen and Platania 1991).

Fish surveys are conducted regularly in or near the project area by Reclamation, the Service's Fishery Resources Office, the New Mexico Department of Game and Fish (NMDGF), and the University of New Mexico's (UNM) Biology Department. These surveys target the Rio Grande silvery minnow but provide information on other species as well. In September, 1992, eight fish species were sampled at the New Mexico Highway 44 bridge and reported by UNM - western mosquitofish, white sucker, flathead chub, flathead minnow, red shiner, and Rio Grande silvery minnow, gizzard shad, and longnose dace. Western mosquitofish were the most abundant fish captured, followed by flathead chub, while longnose dace were the least abundant (Lang and Platania 1993). Six fish species were sampled in the Rio Grande immediately downstream of the project area (New Mexico Highway 44 bridge crossing) in February 1996, by NMDGF and UNM, including western mosquitofish, white sucker, flathead chub, flathead minnow, red shiner, and Rio Grande silvery minnow. Flathead chub were the most abundant, followed by Rio Grande silvery minnow, and flathead minnow. Red shiner and western mosquitofish were the least abundant (New Mexico Department of Game and Fish 1997). In July 1998, April 1999, and March-April 2000, the Service's Fishery Resources Office completed three surveys of fishes in the lower Rio Jemez and in Jemez Canyon reservoir in cooperation with the Pueblo of Santa Ana. One of the collection efforts yielded 21 Rio Grande silvery minnow, 1.3 percent of the fishes collected in the 3 surveys. Common carp was the most abundant fish, followed by white sucker and fathead minnows (Service 2000). A list of common and scientific names of fish that may occur in the Rio Grande in the project area and vicinity is provided in Appendix D.

Main stream dams on the Rio Grande in the Middle Rio Grande are barriers to fish movement, blocking upstream movement and restricting species redistribution (Platania and Altenbach 1998). Cochiti Dam and Angostura Diversion Dam are directly upstream of the project area, and downstream dams are Isleta and San Acacia Diversion Dams, and Elephant Butte Dam. The proposed project is designed to avoid further restriction of aquatic movement upstream. The GRFs have riprap aprons 152.5 m-long (500 ft) that extend downstream at a slope similar to existing, pre-construction slopes in the project area. The downstream sill is designed to provide continuity in the slope in the inevitable event of continued channel degradation downstream of the project area.

Terrestrial Resources

<u>Vegetation</u>

The Middle Rio Grande has one of the highest value riparian ecosystems remaining in the Southwest. The variety of vegetation types support a relatively high diversity and number of animals. Historical vegetative communities were dominated by a cottonwood overstory, with a willow and saltgrass-dominated understory, with other riparian species such as New Mexico olive, baccharis, false indigo bush, and wolfberry. Wetlands were common, vegetated with cattails, sedges, spikerush, rushes, yerba mansa, and other wetland plants (Scurlock 1998).
The existing vegetation community in the valley and in the project area is a result of alteration of the flow regime; drainage for agriculture and development; levees; channelization and straight armored bank formation from Kellner jack construction; livestock grazing; and beaver activity. Overbank flooding and in-channel scouring rarely occurs, reducing the opportunity for natural recruitment of native vegetation, i.e. cottonwood regeneration. The introduction and subsequent

establishment of saltcedar, Russian olive, and other exotics that thrive in the altered hydrologic regime has significantly degraded the riparian plant community (Crawford *et al.* 1993). In addition, these conditions limit the formation and maintenance of wetlands, a vegetation and habitat type that is no longer represented on the Pueblo of Santa Ana Reservation reach of the Rio Grande. Changes to the river channel and the floodplain that affect how base flow and flood currents move downstream and across the floodplain (dams, levees, channelization, etc.) would continue to have effects on patterns of erosion, aggradation, and maintenance or regeneration of riparian vegetation.

There is approximately 484.8 ha (1,200 ac) of riparian habitat on the east and west sides of the river within the Pueblo of Santa Ana Reservation. Saltcedar is a common understory plant, as well as Russian olive, replacing native vegetation such as cottonwood and willow in many areas. As part of the Pueblo of Santa Ana Reservation Restoration Plan, clearing of non-native vegetation has been conducted on more than 127.3 ha (315 ac), leaving the cottonwood overstory wherever it currently exists. All cleared areas would be revegetated with a suite of native vegetation such as cottonwood and willow for overstory; coyote willow, seepwillow, and New Mexico olive for understory; and salt grass as ground cover in some areas. Banks along the Rio Grande in the Pueblo of Santa Ana Reservation reach are made up of non-cohesive materials and are easily eroded. The channel is incised with steep banks, especially on the outside bends, which are vertical or steeply graded, 1.83-6.1 m (6-20 ft) high in some places. Where there is vegetation along the bank, it is usually lined with saltcedar and/or Russian olive. For example, just below the Jemez River confluence is a 6.1-m (20-ft) high bank heavily lined with mature Russian olive and saltcedar (Reclamation 1999). A list of common and scientific names of plants that may occur in the Rio Grande floodplain in the area and nearby is provided in Appendix F.

<u>Mammals</u>

Existing mammal populations are also a result of the existing water operations and land uses in the Middle Rio Grande. Hink and Ohmart (1984) performed systematic floral and faunal surveys throughout the Middle Rio Grande, so general information concerning the project area can be extracted from their report. Residential development, agricultural conversion and subsequent irrigation systems, and construction of bridges and roads resulted in permanent loss of all habitats in the developed area, disruption of animal movement and dispersal, and creation of a continual disturbance that affects animal communities in the adjacent, fragmented portions of the bosque (Crawford *et al.* 1993). The largest mammal likely to occur in the area is the mule deer. Other mammals such as coyote, raccoon, beaver, muskrat, long-tailed weasel, bobcat, swift fox, and striped skunk could be found in the project vicinity. Nuttall's and desert cottontails, black-tailed jackrabbit, rock squirrel, pocket gopher, deer mouse, western harvest mouse, white-throated woodrat, and American porcupine are also likely to occur in the project area. A list of common and scientific names of mammals that may occur in the Rio Grande floodplain in the project area and nearby is provided in Appendix A.

<u>Birds</u>

Hink and Ohmart (1984), found that riparian areas are used heavily by most bird species in New Mexico. Cottonwood-dominated community types are used by large numbers of bird species, and are preferred habitat for a large proportion of the species, especially during breeding season. Bird density appears to be strongly related to density of foliage, regardless of species composition of the plant community. In the Hink and Ohmart study, bird densities were higher in stands of non-native trees and shrubs. Marshes, drains, and areas of open water contribute to the diversity of the riparian ecosystem as a whole because of their strong attraction for water-loving birds. At various times of the year, these areas support the highest bird densities and species numbers in the Middle Rio Grande.

Since there are no wetlands in the project area, reservoirs and the river and tributaries in and near the project area provide habitat, on a seasonal basis, for a variety of waterfowl including Canada goose, mallard, gadwall, green-winged teal, American wigeon, northern pintail, northern shoveler, ruddy duck, and common merganser. Shorebirds such as the spotted sandpiper and killdeer may occur in the project area. Raptors typical of northern New Mexico mountains that may occur in the project area include the bald eagle, turkey vulture, golden eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, American kestrel, common barn-owl, and great horned owl. Birds from a variety of habitats that may be in the project area at any given time include the common nighthawk, belted kingfisher, great blue heron, northern flicker, downy woodpecker, hairy woodpecker, violet-green swallow, northern rough-winged swallow, cliff swallow, barn swallow, western scrub jay, pinyon jay, black-billed magpie, common raven, plain titmouse, white-breasted nuthatch, canyon wren, western bluebird, mountain bluebird, American robin, northern mockingbird, American pipit, European starling, yellow warbler, spotted towhee, white-crowned sparrow, red-winged blackbird, Brewer's blackbird, northern oriole, and evening grosbeak (Udvardy 1977, Scott 1987). Game species could include the mourning dove, Merriam's turkey, and scaled quail. A list of common and scientific names of birds that may occur in the Rio Grande floodplain is provided in Appendix C.

Amphibians and Reptiles

Hink and Ohmart (1984) documented 3 turtle species, 17 lizard species, and 18 snake species in the Rio Grande Valley. Many of these are upland species that do not occur regularly in the riparian habitats. Riparian and upland habitats in the project area likely support a diverse assemblage of reptiles and amphibians.

Most amphibians depend on the aquatic habitat of riparian areas for at least a portion of their life cycle, which are generally lacking in the project area. Amphibians associated with wetter riparian areas with wet meadows and marshes are chorus frogs, leopard frogs, and bullfrogs (Crawford *et al.* 1993). Their presence is limited in the project area by a lack of wet meadows and marshes. Amphibians common to all the habitat types (wetland, riparian, and upland) include the barred tiger salamander, Woodhouse's toad, red-spotted toad, and northern leopard frog. A list of common and scientific names of amphibians and reptiles that may occur in the Rio Grande floodplain in the project area and nearby is provided in Appendix B.

Reptiles typically found in the habitat types within the project area include the western collared lizard, mountain short-horned lizard, southern prairie lizard, variable skink, regal ringneck snake, desert striped whipsnake, smooth green snake, western diamondback rattlesnake, prairie rattlesnake, western blackneck garter snake, and wandering garter snake.

Threatened and Endangered Species

As the quality and quantity of the fish and wildlife habitat within the Middle Rio Grande has decreased over time, so has its ability to sustain native flora and fauna. Several species endemic to the valley have been listed on the Federal threatened and endangered species list under the Endangered Species Act. Information is provided in this CAR concerning those listed species that could be potentially affected by the proposed project; Rio Grande silvery minnow, Southwestern willow flycatcher, and bald eagle.

Rio Grande Silvery Minnow

The Rio Grande silvery minnow was formerly one of the most widespread and abundant species in the Rio Grande basin of New Mexico, Texas, and Mexico (Bestgen and Platania 1991). Currently, the Rio Grande silvery minnow is restricted to the Middle Rio Grande in New Mexico, occurring only from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir (approximately 274 km (170 mi), only 5 percent of its historic range (Platania 1991). The Rio Grande silvery minnow as federally endangered under the Endangered Species Act in July 1994 (Service 1994). The species is listed by the State of New Mexico as an endangered species, Group II. The Service (1993a) documented the de-watering of portions of the Rio Grande below Cochiti Dam through water regulation activities, the construction of main stream dams, the introduction of non-native competitor/predator species, and the degradation of water quality as possible causes for declines in Rio Grande silvery minnow abundance.

Critical habitat for this species was designated July 6, 1999 (Service 1999a), and is defined as the Rio Grande from the New Mexico Highway 22 Bridge, immediately downstream of Cochiti Dam, to the Railroad Bridge near San Marcial, New Mexico. The proposed project area is within Rio Grande silvery minnow critical habitat. Constituent elements of critical habitat required to sustain the Rio Grande silvery minnow include stream morphology that supplies sufficient flowing water to provide food and cover needs for all life stages of the species; water quality to prevent water stagnation (elevated temperatures, decreased oxygen, etc.); and water quantity to prevent formation of isolated pools that restrict fish movement, foster increased predation by birds and aquatic predators, and congregate disease-causing pathogens (Service 1999).

On November 21, 2000, the U.S. District Court for the District of New Mexico issued an opinion that declared critical habitat for the Rio Grande silvery minnow was invalid (Middle Rio Grande Conservancy District, ex rel the State of New Mexico, the State Engineer, New Mexico Interstate Stream Commission, the New Mexico Attorney General, and Forest Guardians versus Bruce Babbitt *et al.*, No. CIV 99-870, 99-872, and 99-1445M/RLP). The final rule for critical habitat is to remain operational for 120 days, and an Environmental Impact Statement and the new rule should be completed within 120 days of the order.

The Rio Grande silvery minnow is a moderately sized, stout minnow, reaching 90 millimeters (3.5 inches) total length, which spawns in the late spring and early summer, coinciding with high spring flows (Sublette *et al.* 1990). Spawning may also be triggered by other high flow events such as spring and summer thunderstorms. This species is a pelagic spawner, producing neutrally buoyant eggs that drift downstream with the current (Platania 1995). As development occurs during the drift, which may last as long as a week depending on temperature and flow conditions, the larvae seek quiet waters off-channel. Platania (1995) found that eggs developed in 24 to 48 hours in a laboratory experiment. Taking into account the possible length of the drift, considerable distance could be traversed by the drifting, developing eggs (Sublette *et al.* 1990; Bestgen and Platania 1991; Service 1993a; and Platania 1995). Maturity for this species is reached toward the end of the first year. Most individuals of this species live one year, with only a very small percentage reaching age two. It appears that the adults die after spawning (Sublette *et al.* 1990; Bestgen and Platania 1991; Service 1993a).

This reproductive strategy, where the progeny end up downstream, may partially explain the greater abundance of the species in the San Acacia reach (San Acacia Diversion Dam to Elephant Butte Reservoir), as revealed by numerous fish collections (Bestgen and Platania 1991; Platania 1993). During recent surveys in 1999, over 95 percent of the Rio Grande silvery minnows captured occurred downstream of San Acacia Dam (Platania and Dudley 1999; Smith and Jackson 2000). In the past, the young drifted downstream, developed to maturity, and proceeded back upstream to occupy available habitat. The upstream migration is now blocked by main stream dams, thus restricting the species' redistribution. Concurrently, a portion of the reproductive effort upstream of each dam is distributed downstream by the drift. Rio Grande silvery minnows that move into the San Acacia reach (the majority of the population) are believed to be transported by high velocities in the narrow and deep channel into Elephant Butte Reservoir, where none survive (Reclamation 1999).

Natural habitat for the Rio Grande silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Areas with detritus and algal-covered substrates are preferred. The lee sides of islands and debris piles often serve as good habitat. Stream reaches dominated by straight, narrow, incised channels with rapid flows would not typically be occupied by the Rio Grande silvery minnow (Sublette *et al.* 1990; Bestgen and Platania 1991).

In the project area, past actions have reduced the total habitat from historic conditions and severely altered habitat conditions for the Rio Grande silvery minnow. Narrowing and deepening of the channel, lack of side channels and off-channel pools, and changes in natural flow regimes have all adversely affected the Rio Grande silvery minnow and its habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (Service 1993a). In addition, Angostura Diversion Dam directly upstream of the project area blocks upstream migration and restricts species redistribution. Cochiti Dam, approximately 40 km (25 mi) upstream of the project area, also acts as a barrier. Recent fish collections and habitat surveys have demonstrated that habitat through the Pueblo of Santa Ana Reservation is poor for the Rio Grande silvery minnow. The river is dominated by large size substrate with very little sand. In addition, the deeper channel and higher velocities that occur in the incised channel downstream of the dams do not provide the conditions where greater numbers of Rio Grande silvery minnows are known to occur.

Southwestern Willow Flycatcher

The Service listed the Southwestern willow flycatcher (flycatcher) as endangered on February 27, 1995 (Service 1995a). The flycatcher is also classified as endangered (Group I) by the State of New Mexico (New Mexico Department of Game and Fish 1987). The current range of the flycatcher includes southern California, southern portions of Nevada and Utah, Arizona, New Mexico, western Texas, and southwestern Colorado (Unitt 1987; Browning 1993). Critical habitat for the flycatcher was designated July 22, 1997; however, the proposed project area is not within designated critical habitat. In New Mexico, the species has been observed in the Rio Grande, Rio Chama, Zuni, San Francisco, and Gila River drainages. Available habitat and overall numbers have declined statewide (Service 1997). A draft recovery plan for the flycatcher is under review.

Loss and modification of nesting habitat is the primary threat to this species (Phillips *et al.* 1964; Unitt 1987; and Service 1993b). Loss of habitat used during migration also threatens the flycatcher's survival. Large scale losses of southwestern wetlands have occurred, particularly the cottonwood-willow riparian habitats used by the flycatcher (Phillips *et al.* 1964; Carothers 1977; Rea 1983; Johnson and Haight 1984; Howe and Knopf 1991).

The flycatcher is a riparian obligate and nests in riparian thickets associated with streams and other wetlands where dense growth of willow, buttonbush, boxelder, Russian olive, saltcedar, or other plants are present. Nests are often associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now rare, widely separated by vast expanses of arid lands, small and/or linear patches. Flycatchers nest in thickets of trees and shrubs approximately 2 to 7 m (6.6 to 22.9 ft) in height or taller, with a densely vegetated understory from ground or water surface level to 4 m (13.1 ft) or more in height. Surface water or saturated soil is usually present beneath or next to occupied thickets (Phillips *et al.* 1964; Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the breeding season with only damp soil present by late June or early July (Muiznieks *et al.* 1994; Sferra *et al.* 1995). Habitats not selected for either nesting or singing are narrower riparian zones, with greater distances between willow patches and individual willow plants. Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not selected for nesting or singing may still be used during migration.

Flycatchers begin arriving in New Mexico in late April and May. Breeding begins in late spring, and young begin to fledge in early summer. Late nests and re-nests may not fledge young until late summer (Sogge and Tibbitts 1992; Sogge *et al.* 1993).

Occupied and potential flycatcher nesting habitat exists along the Rio Grande; however, only 30 breeding pairs were identified in the Rio Grande drainage in 1999 surveys. Occupied and potential habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's willow and peachleaf willow, Rio Grande cottonwood, coyote willow, and saltcedar. The habitat within the Pueblo of Santa Ana Reservation Restoration Project area is not currently considered potential nesting habitat for the flycatcher (Reclamation 1999), although flycatchers may use the area during migration. Habitat in the area has mature cottonwoods, often bordered or mixed with saltcedar and Russian olive, with small patches of willows along the high flow channels. Ahlers and White (1996) reported that most of the mature riparian vegetation lacked understory structure and density and is unsuitable habitat for the flycatcher. In addition, wetlands and backwater habitats are currently lacking in the project area. No flycatchers were observed in the project area (Reclamation 1999).

Bald Eagle

The project is also within the known and historic range of the bald eagle. The Service reclassified the bald eagle from endangered to threatened on July 12, 1995 (Service 1995b). The Service proposed removing the bald eagle from the list of endangered and threatened wildlife on July 6, 1999 (Service 1999b). Final delisting of the species has not yet occurred.

Adults of this species are easily recognized by their white heads and tails and dark bodies. Wintering bald eagles frequent all major river systems in New Mexico from November through March, including the Rio Grande. The favored prey of bald eagles is fish, waterfowl, and small mammals. Bald eagles prefer to roost and perch in large trees near water. There are potential perch sites in vicinity to the project area where large cottonwoods occur at the river's edge.

Winter bald eagle surveys were conducted annually for eight years from Albuquerque upstream to the confluence of the Rio Chama and the Rio Grande. The mean annual sightings from 1988-1996 is 64, with the largest number sighted in 1993 (88). The survey data show that wintering bald eagles use the habitat within the project area for feeding and perching (Reclamation 1999).

FUTURE CONDITIONS WITHOUT THE PROJECT

The river, floodplain, and the associated fish and wildlife would continue to experience adverse effects from Federal, State, and private actions, including new and long-term ongoing activities. In addition, increasing urbanization and development within the historic floodplain would continue to eliminate remnant riparian areas located outside the levees, while putting increased pressure on the habitat and wildlife in the riparian zone. Changes to the river channel and the floodplain that affect how base flow and flood currents move downstream and across the floodplain (dams, levees, channelization, etc.) would continue to have effects on patterns of erosion, aggradation, and maintenance or regeneration of riparian vegetation.

The river downstream of Cochiti Dam would become narrower and deeper, negatively affecting warmwater fishes and reducing native aquatic habitat, while the river in the lower end of the Middle Rio Grande near Elephant Butte Reservoir would continue to aggrade. Widespread extirpation of native fish species would continue, further altering the riverine community. The quality of river and ground water would be increasingly affected by urban discharges and agricultural runoff. The lack of overbank flooding and a lowered water table would continue to restrict opportunities for wetland maintenance and formation, causing the remaining cottonwoods to die off, and growth of non-native vegetation such as saltcedar and Russian olive

to increase. The native cottonwood/willow vegetative complex would be gradually replaced with non-native species. The overall quality and quantity of fish and wildlife habitat would continue to steadily
degrade, and species that do not adapt to the changes would be stressed and eventually disappear from the system (Crawford *et al.* 1993).

In the project area, chronic erosion of the banks of the Rio Grande and the channel degradation caused by changes in hydrology and sediment movement would continue, with channel narrowing and deepening. With no active floodplain, there would continue to be a lack of wetland and shallow water aquatic habitat in the project area. Lack of overbank flooding from channel incision would cause continued degradation of the adjacent riparian areas. Native vegetation would continue to be replaced by non-native vegetation, as the remaining native vegetation becomes decadent and dies. No new native vegetation would be regenerated. Fish and wildlife in the project area would continue to follow the same decline in the project area as throughout the Middle Rio Grande.

Threatened and Endangered Species

Without identification and effective implementation of recovery measures for the endangered Rio Grande silvery minnow and flycatcher, these species may become extinct in the foreseeable future. The wetted channel would continue to decrease in width and increase in depth, a situation that is detrimental to the Rio Grande silvery minnow. Suitable flycatcher habitat would continue to be absent in the project. Mature cottonwood trees would die naturally of senescence, with no recruitment of native riparian habitat. Without adequate cottonwood regeneration, bald eagle perch habitat would decline, thus impacting the bald eagle.

IMPACTS TO FISH AND WILDLIFE RESOURCES WITH THE PROJECT

General Long Term Impacts

The proposed restoration project provides an opportunity to positively affect the Rio Grande ecosystem. Most long-term effects should be beneficial to fish and wildlife resources. The GRFs would halt the current channel degradation trend, stabilize the channel slope, and provide upstream aggradation. The project would result in a wider operational channel and floodplain, with reduced water velocities, decreased flow depth, and increased width-to-depth ratios. This would improve aquatic habitat conditions for fish and water-dependent birds. Backwater and wetland habitat would be slightly increased, improving conditions for a wide variety of fish and wildlife. In addition, a portion of the riparian area would be restored by removing non-native vegetation and planting native vegetation through the proposed Corps project, improving wildlife habitat conditions, especially for birds.

Although project impacts to fish and wildlife resources are expected to be positive as a whole, the Service is concerned about predicted future channel degradation below the project area, including directly below the downstream sill. A barrier to upstream movement of fish would be created if a steep vertical drop forms. The launchable riprap unique to the design of the downstream sill could result in a 2:1 slope in the worst case scenario (Darrell Eidson, Corps Hydrologist, pers. comm. 2000). If fish cannot freely move within the river, they cannot effectively utilize all the habitats that are required to sustain life, vigor and reproduction. If additional barriers to upstream movement are placed within the system, benefits to aquatic organisms would not be fully realized.

Temporary Impacts from Project Construction

Temporary, short-term impacts to wildlife may occur from noise, dust, and the presence of workers and machinery during project construction. Placement and removal of temporary cofferdams, construction forms, and back-fill could increase turbidity. Runoff from construction work sites, access routes, staging areas, and unprotected fills could degrade water quality in the river. Uncured concrete could increase alkalinity and conductivity, water quality factors to which cold water biota are highly sensitive. Accidental spills of fuels, lubricants, hydraulic fluids and other petrochemicals, although unlikely, would be harmful to aquatic life. Changes in flow through de-watering of the construction site could cause direct mortality to fish and aquatic invertebrates, and could disrupt fish spawning and cause mortality of incubating eggs downstream of the construction site.

Disturbance of the riparian areas during non-native vegetation clearing and native plantings, and the subsequent seral stages of recovery of the riparian ecosystem, would cause a temporary impact to the animal and bird species that have been living in and using the habitat for travel corridors and cover. Over time as the values and functions return and improve, wildlife should benefit.

Impacts to Threatened and Endangered Species

Specific, detailed information concerning federally listed species will be addressed in a section 7 consultation between the Corps and the Service. The following information is provided for the Corps to use in their section 7 consultation.

Rio Grande Silvery Minnow

General long-term impacts: The changes in channel geometry with an increase in wetted channel area and off-channel habitat with reduced velocities, and arresting of channel degradation with bed elevation stabilization are habitat modifications that could provide improvements for the Rio Grande silvery minnow. The substrate would be sandier with new sediment deposition behind the GRFs, resulting in several miles of improved substrate. The GRFs would have 152.5 m-long (500 ft) downstream aprons to provide slopes flat enough (0.004) to be negotiated by small native fishes, based on pre-construction riffle slopes found in the upstream channel.

The predicted future channel degradation below the project area, including directly below the downstream sill, could cause a barrier to upstream movement of Rio Grande silvery minnow if a steep vertical drop forms. If Rio Grande silvery minnow were prevented from moving upstream, the newly created habitat would be unavailable to them.

Temporary construction impacts: The Rio Grande silvery minnow has been collected within the proposed project area, but few have been captured recently. Construction within the river channel would have a direct effect on any individuals present in the area. The Rio Grande silvery minnow, as well as other fish, have the ability to move downstream to safer and less stressful areas.

Southwestern Willow Flycatcher

General long-term impacts: Restoration of riparian habitat from non-native vegetation to native vegetation, creation of slack water areas, and the promotion of channel stability, should increase the possibility of suitable habitat development for the flycatcher. Project effects overall may be beneficial for the flycatcher.

Temporary construction impacts: Since no flycatchers have been located within the proposed project reach and no suitable habitat had been identified, it is unlikely that the species or its habitat would be harmed by the proposed habitat enhancement activities. It is possible that individual flycatchers could be displaced up or downstream from the construction area, if construction occurs during the migrating or breeding seasons of the bird (April-August).

Bald Eagle

General long-term impacts: Maintenance of mature cottonwood trees within the riparian area, especially near the river, should continue to provide perching habitat for the bald eagle, until those trees grow senescent and die. Newly planted vegetation may grow to a height in maturity that could provide future perch trees to replace the existing cottonwoods.

Temporary construction impacts: The proposed construction period may overlap with the bald eagle winter use season of their habitat in New Mexico. Bald eagles are sensitive to human perturbations. The proximity of the project area to bald eagle habitat may cause them to move and concentrate at other sites or use less than optimal habitat.

DISCUSSION

The Pueblo of Santa Ana Restoration Project provides an opportunity to restore some Rio Grande ecosystem biological components to benefit fish and wildlife resources. The project represents extensive coordination of ideas and plans on a multi-party level. Project implementation and reporting of the monitoring results would provide valuable information for future projects in a river-based ecosystem approach to restoration throughout the Middle Rio Grande.

The proposed restoration plan incorporates many of the recommendations from the Middle Rio Grande Ecosystem: Bosque Biological Management Plan (Crawford *et al.* 1993). The result of this initiative, a long-term inter-agency cooperative effort created and supported by Senator Pete Domenici, is a series of recommended actions to sustain and enhance the biological quality and ecosystem integrity of the Middle Rio Grande bosque, together with the river and floodplain that it integrates. The proposed restoration plan includes elements of at least twelve of the twenty-one recommendations in the Bosque Biological Management Plan. For example, re-introduction of the dynamics of surface water/ground water exchange, as described in the Bosque Biological Management Plan's second and third recommendations, would be achieved through construction of the GRFs, and lowering of bars within the channel. The proposed plan would also create wetlands within the Rio Grande riparian zone (recommendation no. 15); and would sustain and enhance existing cottonwood communities as well as create new native cottonwood communities (recommendation no. 16).

Activities that restore and enhance fish and wildlife habitat within the Middle Rio Grande are timely, as riparian and wetland habitats are scarce and disappearing at an astounding rate. About 90 percent of the historic wetland and riparian habitat in the southwest has been eliminated (Johnson and Jones 1977). Hink and Ohmart (1984) found a wetland and riparian area decrease of 87 percent along the Rio Grande from 1918 to 1982.

The value of riparian habitat is well known to resource managers because of the high diversity and abundance of animal species which rely on the ecosystem for its unique plant community types, hydrologic features, soil, topography, and other environmental features that do not exist in adjacent upland habitat. Many animal species are obligates (depending entirely on the riparian zone) while most are facultative (occurring in riparian habitat as well as in other habitat types).

The ecological attributes that contribute to the high value of riparian habitat should be maintained to preserve the value to wildlife include the following:

* heterogeneity of plant communities and structure
* predominance of woody plant communities
* presence of surface water, soil moisture, and high water table
* continuous, unfragmented corridors of habitat
* sustainability

These factors should all be seriously considered in this as well as other restoration activities within the Middle Rio Grande ecosystem.

In this reach of the river where it is narrow and deep, even the proposed restoration activities are unlikely to provide the overbank flows necessary for vegetation regeneration of the floodplain-associated species such as willows and cottonwoods. The Corps has explored ways to provide localized increased surface water/ground water interface, such as constructed shallow flow-through channels through the riparian area. Flows through the channel even for short periods of time, such as several months of the year, could be extremely beneficial for the environment and could establish regeneration of desirable native vegetation.

Because of the scarcity and high wildlife value of wetlands in the southwest, wetland restoration and creation is desirable wherever possible. Managed wetlands in areas removed and protected from humans, pets, and livestock would be most valuable to fish and wildlife. The easiest method to establish a wetland is to expand an existing one (lack of existing wetlands renders this not possible in the project area), or to allow natural flow regimes to re-establish former wetlands (this is also unlikely to occur in the project area). Wetlands with a variety of water depths, water movement through the wetland, small islands, an irregular water-land interface, and protection of adjacent uplands, are habitat requirements to produce a diverse healthy wetland. Some wetlands would be created through Reclamation's project in abandoned segments of the river channel. To maximize benefits to fish and wildlife resources, the Service recommends further exploration of wetland creation opportunities within the Pueblo of Santa Ana Reservation, including plastic- or bentonite-lined excavated areas away from the resort area, possibly farther upstream near the delta formed at the confluence of the Jemez River and the Rio Grande.

The Pueblo of Santa Ana plans to maintain the riparian corridor as a wildlife preserve. The value of the area for wildlife could be enhanced by the creation and maintenance of travel corridors for the wildlife species that live in upland areas removed from the floodplain but require periodic visits to the river for water and food. Travel corridors are often vegetated arroyos and drainages that provide cover during wildlife movements to and from the floodplain.

Erosion below the downstream sill is inevitable considering the sediment dynamics in the Pueblo of Santa Ana Reservation reach of the Rio Grande (Corps 2000). This could result in adverse impacts to upstream movement of aquatic species, and to the critical habitat of the Rio Grande silvery minnow. The downstream sill, as well as all GRFs, should be monitored to ensure upstream fish migration is not blocked, reduced, or otherwise limited. If the slopes become too steep for upstream movement of aquatic species, the slope should be reduced immediately. This impact should be anticipated and a commitment made to monitor and mitigate through implementation of a maintenance plan that would provide continuous upstream fish passage in the future.

The lack of fish passage structures in existing dams, including diversion dams and reservoir dams, creates an ongoing limitation for aquatic species that would normally travel upstream during their life cycle. Channel-wide diversions fragment the ranges of these species, entrain drifting eggs and larvae, prevent upstream movement necessary to maintain populations, and may be detrimental to their continued survival (Platania and Altenbach 1998). Providing fish passage structures at these dam sites would help restore the populations of these species, including the Rio Grande silvery minnow.

A coordinated program to monitor the biological quality (with emphasis on diversity and abundance of native species) and ecosystem integrity (with emphasis on restoring the functional connection between the river and riparian zone) of the Pueblo of Santa Ana's Restoration Project should be developed that would be comparable to other project studies within the Middle Rio Grande (from recommendation no. 18 in the Bosque Biological Management Plan). Consistency in monitoring and reporting among the various groups conducting studies within the project area and within the Middle Rio Grande could help integrate the results and maximize the value and use of the data for future restoration and water management projects. Distribution of this information could help the Service and others provide viable recommendations on similar habitat restoration and water resource projects.

In addition, monitoring studies are needed to assess the ecological trends in the bosque over a long period of time as well as to provide information about the life histories of individual species. Monitoring information can be used in developing research goals that specifically address management problems. Research related to management questions should be pursued, but research addressing purely scientific goals should also be encouraged. Both research approaches will generate information that can be applied to management issues.

Another component of restoration of the Rio Grande ecosystem is water management. The single most important adverse impact to the fish and wildlife habitat within the Rio Grande ecosystem has been the change in the flow regime through water management. Present water management, including reduced peak releases, reduced volumes due to consumption, irrigation, improper timing of water releases, water salvage attempts, and water drainage has produced an overwhelmingly negative effect on fish and wildlife and the habitat upon which they depend. Flow regimes determine the structure of the aquatic and adjacent riparian habitats. Properly managed flows have the greatest potential to preserve and create habitat. The Upper Rio Grande Water Operations Review that is currently taking place provides the Corps, as well as many others, with opportunities to explore alternative flow management scenarios. Many of the recommendations of the Bosque Biological Management Plan could be realized with changes in water management and water operations on the Rio Grande.

Temporary impacts from project construction should be mitigated through limiting construction to periods of low river flow or low precipitation, depositing only clean fills in the water, protecting temporary fills from erosion, containing any runoff from construction sites, and employing silt curtains, settling basins and other suitable means to control turbidity. Storing and dispensing fuels, lubricants, hydraulic fluids and other petrochemicals above the 100-year floodplain would minimize negative impacts. Containing and treating or removing wastewater from concrete batching, vehicle washdown, and aggregate processing could prevent impacts on water quality. Reasonable precautions, such as pouring concrete in sealed forms and/or behind cofferdams should reduce the risk of accidental discharges into the river. Surplus concrete should not be deposited within the 100-year floodplain. Additional precautions should include: inspecting all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids or fuels; and containing and removing petrochemical spills, including contaminated soil which should be disposed of at an approved upland location.

Fish should be removed from areas behind cofferdams prior to dewatering. A fish biologist must be available at the time of construction to move any fish trapped in construction areas within the river to avoid and mitigate direct adverse effects on fish species that may be present, including the Rio Grande silvery minnow.

Permanent structures, access roads, staging, parking, refueling, and work areas could directly impact riparian habitats through removal and/or trampling. Long-term impacts could be avoided by limiting all work and staging areas to the minimum area required, and using existing access routes. Unavoidable project impacts could be minimized by mowing rather than blading vegetation in construction access and work areas; minimizing the area of surface disturbing activities; and prohibiting off-road maneuvering by restricting vehicles from turning around except in designated areas.

The proposed construction period may overlap with bald eagle winter habitat use in New Mexico. Since bald eagles are sensitive to human perturbations, construction activities within the project area may cause them to move and concentrate at other sites or use less than optimal habitat. Therefore, if a bald eagle is present within 0.4 km (0.25 mi) upstream or downstream of the active project site in the morning before project activity starts, or following breaks in project activity, the contractor should be required to suspend all activity until the bird leaves of its own volition, or the Corps biologist, in consultation with the Service, determines that the potential for harassment is minimal. However, if an eagle arrives during construction activities or if an eagle is beyond that distance, construction need not be interrupted. The proposed project construction would occur near the Rio Grande at all work sites. If bald eagles are found consistently in the immediate project area during the construction period, the Corps should contact the Service to determine whether formal consultation under the Endangered Species Act is necessary.

Removal of mature cottonwoods and other native vegetation should be avoided, if possible, during the clearing process. Local genetic stock should be used when revegetating to ensure increased survival and plant vigor. Only uncontaminated soil suitable for plant growth should be used for backfills. Areas disturbed during construction should be revegetated, using a mixture of native grasses, forbs, and woody shrubs suitable to the site conditions. Compacted soils should be scarified before planting to promote water retention and seed germination.

RECOMMENDATIONS

Many of the standard recommendations the Service makes concerning fish and wildlife and their habitat are included in the Pueblo of Santa Ana Reservation Restoration Plan, including expansion of shallow, low velocity habitat in the Rio Grande, creation and restoration of riparian and wetland areas, protection and enhancement of aquatic habitat, and establishment of native species in riparian areas cleared of non-native vegetation. The Service is encouraged by the restoration and conservation of valuable fish and wildlife resources represented by this project.

The following recommendations are provided by the Service to prevent and reduce adverse project effects on fish and wildlife resources during construction, operation, and maintenance of the project:

1. To reduce adverse impacts to upstream movement of aquatic species, and to protect critical habitat of the Rio Grande silvery minnow, the downstream sill, as well as all GRFs, should be monitored to be sure upstream fish migration is not blocked, reduced, or otherwise limited. If it is found that slopes become too steep for upstream movement, the slope should be reduced immediately. The Service strongly recommends that a maintenance plan for maintaining fish passage be fully developed prior to project completion, to ensure future action when needed.

2. If a bald eagle is present within 0.4 km (0.25 mi) upstream or downstream of the active project site in the morning before project activity starts, or following breaks in project activity, the contractor should be required to suspend all activity until the bird leaves of its own volition, or the Corps biologist, in consultation with the Service, determines that the potential for harassment is minimal. However, if an eagle arrives during construction activities or if an eagle is beyond that distance, construction need not be interrupted. The proposed project construction would occur near the Rio Grande at all work sites. If bald eagles are found consistently in the immediate project area during the construction period, the Corps should contact the Service to determine whether formal consultation under the Endangered Species Act is necessary.

3. Fish should be removed from areas behind cofferdams prior to dewatering. A fish biologist must be available at the time of construction to move any fish trapped in construction areas within the river to avoid and mitigate direct adverse effects on fish species.

4. A monitoring plan should be developed and coordinated with others doing studies in the Middle Rio Grande to provide consistency in data collection. The monitoring plan should include vegetative planting success, and river channel and backwater cross-section information. Bird use and fish use of the restored areas should also be monitored.

5. Monitoring of compliance with State water quality standards during project construction should be conducted. Water quality should be protected by implementing the following measures:

a) Construction activities in the Rio Grande should be conducted during low-flow or low precipitation periods.

b) Construction work areas should be de-watered with coffer dams constructed of materials that cannot be brought into suspension by flowing water. Contain runoff from construction sites and contain any poured concrete in sealed forms and/or behind cofferdams to prevent discharge into the river. Place no surplus concrete within the 100-year floodplain. Contain and treat or remove wastewater from concrete batching, vehicle washdown, and aggregate processing.

c) Place only clean, coarse, and erosion-resistant fills in the water and employ silt curtains, settling basins, or other suitable means to control turbidity.

d) Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals above the 100-year floodplain. Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids, or fuels. Contain and remove any petrochemical spills, including contami-nated soil, and dispose of these materials at an approved upland disposal site.

6. Staging, parking, storage and refueling areas should be developed outside the 100-year floodplain, as described in the Corps' project description.

7. All work and staging areas should be limited to the minimum amount required. Existing roads and right-of-ways and staging areas should be used to the greatest extent practicable to transport equipment and construction materials to the project site, as described in the Corps' project description. Provide designated areas for vehicle turn around and maneuvering to protect riparian areas from unnecessary damage.

8. Backfill with uncontaminated earth or alluvium suitable for revegetation with indigenous plant species.

9. Scarify compacted soils or replace topsoils and revegetate all disturbed sites with a suitable mixture of native grasses, forbs, and woody shrubs.

10. Protect mature cottonwood trees from damage during clearing of non-native species or other construction construction activities using fencing, or other appropriate materials.

11. Use local genetic stock wherever possible in the native plant species establishment throughout the riparian area.

Other recommendations for the Corps' consideration for this and other restoration projects in the Middle Rio Grande:

12. Provide fish passage structures at mainstem dam sites in the Middle Rio Grande to assist in the recovery of species that require upstream movement as part of their life cycle, including the Rio Grande silvery minnow.

13. Continue coordination of Rio Grande water management activities that develop and maintain riverine and terrestrial habitats by mimicking the typical natural hydrograph. An integrated management of flows from Abiquiu, Jemez, and Cochiti Reservoirs should be pursued by the Corps for the purpose of protecting and enhancing the aquatic and terrestrial habitats along the Rio Grande. In addition, continue coordination of water management activities concerning operation of Heron and El Vado Reservoirs.

14. Pursue and conduct floodplain management activities that discourage further development in the floodplain and address existing physical constraints to the higher flows that would be part of a more natural hydrograph.

15. Explore expansion of the active floodplain of the Rio Grande at every opportunity, including relocation and removal of levees, and removal of Kellner jacks.

16. Develop a coordinated program to monitor biological quality (with emphasis on diversity and abundance of native species) and ecosystem integrity (with emphasis on restoring the functional connection between the river and riparian zone) of the Middle Rio Grande ecosystem.

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Appendix A. Common and Scientific Names of Mammals That May Occur in the Rio Grande Floodplain in Sandoval, Bernalillo, Valencia, Socorro, and Sierra Counties.

Common Name	Scientific Name
Opossum	Didelphis virginiana
Desert shrew	Notiosorex crawfordi
Yuma myotis	Myotis yumanensis
Little brown bat	Myotis lucifugus
Long-legged myotis	Myotis volans
Silver-haired bat	Lasionycteris noctivagans
Big brown bat	Eptesicus fuscus
Hoary bat	Lasiurus cinereus
Spotted bat	Euderma maculatum
Townsend's big-eared bat	Plecotis townsendii
Pallid bat	Antrozous pallidus
Brazilian free-tailed bat	Tadarida brasiliensis
Desert cottontail	Sylvilagus auduboni
Black-tailed jackrabbit	Lepus californicus
Beaver	Castor canadensis
Gunnison's prairie dog	Cynomys gunnisoni
Colorado chipmunk	Eutamias quadrivittatus
Spotted ground squirrel	Spermophilus spilosoma
Rock squirrel	Spermophilus variegatus
Red squirrel	Tamiasciurus hudsonicus
Northern grasshopper mouse	Onychomys leucogaster
Deer mouse	Peromyscus maniculatus
White-footed mouse	Peromyscus leucopus
Pinon mouse	Peromyscus truei
Western harvest mouse	Reithrodontomys megalotis
Hispid cotton rat	Sigmodon hispidus
Norway rat	Rattus norvegicus
Muskrat	Ondatra zibethicus
New Mexican jumping mouse	Zapus hudsonius luteus
Ord kangaroo rat	Dipodomys ordii
Merriam kangaroo rat	Dipodomys merriami
Silky pocket mouse	Perognathus flavus
Plains pocket mouse	Perognathus flavescens
Yellow-faced pocket gopher	Pappogeomys castanops
Botta pocket gopher	Thomomys bottae
American porcupine	Erethizon dorsatum
Coyote	Canis latrans
Gray fox	Urocyon cinereoargenteus scottii
Raccoon	Procyon lotor
Striped skunk	Mephitis mephitis
Long-tailed weasel	Mustela frenata

Mink	*Mustela vison*
Badger	*Taxidea taxus*
Bobcat	*Lynx rufus*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*

Appendix B. Common and Scientific Names of Amphibians and Reptiles That May Occur in the Rio Grande Floodplain in Sandoval, Bernalillo, Valencia, Socorro, and Sierra Counties.

Common Name	**Scientific Name**
Tiger salamander	Ambystoma tigrinum
Couch's spadefoot	Scaphiopus couchii
Plains spadefoot	Spea bombifrons
New Mexico spadefoot	Spea multiplicata
Great Plains toad	Bufo cognatus
Green toad	Bufo dibilis
Red-spotted toad	Bufo punctatus
Woodhouse's toad	Bufo woodhousii
Canyon treefrog	Hyla arenicolor
Western chorus frog	Pseudacris triseriata
Plains leopard frog	Rana blairi
Bullfrog (introduced)	Rana catesbeiana
Northern leopard frog	Rana pipiens
Yellow mud turtle	Kinosternon flavescens
Snapping turtle	Chelydra serpentina
Painted turtle	Chrysemys picta
Ornate box turtle	Terrapene ornata
Big Bend slider	Trachemys gaigeae
Red-eared slider (introduced)	Trachemys scripta
Spiny softshell	Trionyx spiniferus
Collared lizard	Crotaphytus collaris
Leopard lizard	Gambelia wislizenii
Greater earless lizard	Cophosaurus texanus
Lesser earless lizard	Holbrookia maculata
Texas horned lizard	Phrynosoma cornutum
Roundtail horned lizard	Phrynosoma modestum
Desert spiny lizard	Sceloporus magister
Crevice spiny lizard	Sceloporus poinsettii
Eastern fence lizard	Sceloporus undulatus
Tree lizard	Urosaurus ornatus
Side-blotched lizard	Uta stansburiana
Chihuahuan whiptail	Cnemidophorus exsanguis
Checkered whiptail	Cnemidophorus grahamii
Little striped whiptail	Cnemidophorus inornatus
New Mexico whiptail	Cnemidophorus neomexicanus
Western whiptail	Cnemidophorus tigris
Desert grassland whiptail	Cnemidophorus uniparens
Plateau striped whiptail	Cnemidophorus velox
Many-lined skink	Eumeces multivirgatus
Great Plains skink	Eumeces obsoletus
Texas blind snake	Leptotypholps dulcis

Western blind snake	*Leptotypholps humilis*
Glossy snake	*Arizona elegans*
Trans-pecos rat snake	*Bogertophis subocularis*
Racer	*Coluber constrictor*
Ringneck snake	*Diadophis punctatus*
Great Plains rat snake	*Elaphe guttata*
Western hooknose snake	*Gyalopion canum*
Western hognose snake	*Heterodon nasicus*
Night snake	*Hypsiglena torquata*
Common kingsnake	*Lampropeltis getula*
Milk snake	*Lampropeltis triangulum*
Coachwhip	*Masticophis flagellum*
Striped whipsnake	*Masticophis taeniatus*
Bullsnake or gopher snake	*Pituophis melanoleucus*
Longnose snake	*Rhinocheilus lecontei*
Big Bend patchnose snake	*Salvadora deserticola*
Mountain patchnose snake	*Salvadora grahamiae*
Ground snake	*Sonora semiannulata*
Plains blackhead snake	*Tantilla nigriceps*
Blackneck garter snake	*Thamnophis cyrtopsis*
Wandering garter snake	*Thamnophis elegans*
Checkered garter snake	*Thamnophis marcianus*
Common garter snake	*Thamnophis sirtalis*
Lyre snake	*Trimorphodon biscutatus*
Western diamondback rattlesnake	*Crotalus atrox*
Blacktail rattlesnake	*Crotalus molossus*
Western rattlesnake	*Crotalus viridis*
Massasauga	*Sistrurus catenatus*

Appendix C. Common and Scientific Names of Birds That May Occur in the Rio Grande Floodplain in Sandoval, Bernalillo, Valencia, Socorro, and Sierra Counties.

Common Name	Scientific Name
Pied-billed grebe	Podilymbus podiceps
Common loon	Gavia immer
American white pelican	Pelecanus erythrorhynchos
Double-crested cormorant	Phalacrocorax auritus
Olivaceous cormorant	Phalacrocorax olivaceus
American bittern	Botaurus lentiginosus
Least Bittern	Ixobrychus exilis
Great blue heron	Ardea herodias
Great egret	Ardea alba
Snowy egret	Egretta thula
Little blue heron	Egretta caerulea
Cattle egret	Bubulcus ibis
Green-backed heron	Butorides striatus
Black-crowned night heron	Nycticorax nycticorax
White-faced ibis	Plegadis chihi
Snow goose	Chen caerulescens
Canada goose	Branta canadensis
Wood duck	Aix sponsa
Green-winged teal	Anas crecca
Mallard	Anas platyrhynchos
Northern pintail	Anas acuta
Cinnamon teal	Anas cyanoptera
Northern shoveler	Anas clypeata
Gadwall	Anas strepera
Hooded merganser	Mergus cuculatus
Red-breasted merganser	Mergus serrator
Ruddy duck	Oxyura jamaicensis
Virginia rail	Rallus limicola
Sora	Porzana carolina
Common moorhen	Gallinula chloropus
American coot	Fulica americana
Sandhill crane	Grus canadensis
Whooping crane	Grus americana
Killdeer	Charadrius vociferus
Black-necked stilt	Himantopus mexicanus
American avocet	Recurvirostra americana
Solitary sandpiper	Tringa solitaria
Spotted sandpiper	Actitis macularia
Long-billed curlew	Numenius americanus
Forster’s tern	Sterna forsteri
Black tern	Chlidonias niger

Turkey vulture	Cathartes aura
Osprey	Pandion haliaetus
Black-shouldered kite	Elanus caeruleus
Mississippi kite	Ictinia mississippiensis
Bald eagle	Haliaeetus leucocephalus
Northern Harrier	Circus cyaneus
Cooper's hawk	Accipiter cooperii
Common black-hawk	Buteogallus anthracinus
Swainson’s hawk	Buteo swainsoni
Red-tailed hawk	Buteo jamaicensis
American kestrel	Falco sparverius
American peregrine falcon	Falco peregrinus anatum
Ring-necked pheasant	Phasianus colchicus
Northern bobwhite	Colinus virginianus
Scaled quail	Callipepla squamata
Gambel’s quail	Callipepla gambelii
Rock dove	Columba livia
White-winged dove	Zenaida asiatica
Morning dove	Zenaida macroura
Common ground-dove	Columbina passerina
Yellow-billed cuckoo	Coccyzus erythropthalmus
Greater roadrunner	Geococcyx californianus
Common barn-owl	Tyto alba
Great horned owl	Bubo virginianus
Burrowing owl	Athene cunicularia
Lesser nighthawk	Chordeiles acutipennis
Common nighthawk	Chordeiles minor
White-throated swift	Aeronautes saxatalis
Black-chinned hummingbird	Archilochus alexandri
Rufous hummingbird	Selasphorus rufus
Belted kingfisher	Ceryle alcyon
Northern flicker	Colaptes auratus
Olive-sided flycatcher	Contopus borealis
Western wood-pewee	Contopus sordidulus
Southwestern willow flycatcher	Empidonax traillii extimus
Black phoebe	Sayornis nigricans
Say’s phoebe	Sayornis saya
Ash-throated flycatcher	Myiarchus cinerascens
Cassin’s kingbird	Tyrannus vociferans
Western kingbird	Tyrannus verticalis
Eastern kingbird	Tyrannus tyrannus
Violet-green swallow	Tachycineta thalassina
Bank swallow	Riparian riparia
Cliff swallow	Hirundo pyrrhonota
Barn swallow	Hirundo rustica
Northern rough-winged swallow	Stelgidopteryx serripennis

Black-billed magpie	Pica pica
American crow	Corvus caurinus
Chihuahuan raven	Corvus cryptoleucus
Black-capped chickadee	Parus atricapillus
Verdin	Auriparus flaviceps
White-breasted nuthatch	Sitta carolinensis
Cactus wren	Campylorhynchus brunneicapillus
Black-tailed gnatcatcher	Polioptila melanura
Eastern bluebird	Sialia sialis
Western bluebird	Sialia mexicana
Hermit thrush	Catharus guttatus
American robin	Turdus migratorius
Gray catbird	Dumetella carolinensis
Northern mockingbird	Mimus polyglottos
Curved-billed thrasher	Toxostoma curvirostre
Crissal thrasher	Toxostoma dorsale
European starling	Sturnus vulgaris
Bell’s vireo	Vireo bellii
Warbling vireo	Vireo gilvus
Orange-crowned warbler	Vermivora celata
Virginia’s warbler	Vermivora virginiae
Lucy’s warbler	Vermivora luciae
Yellow warbler	Dendroica petechia
Yellow-rumped warbler	Dendroica coronata
Common yellowthroat	Geothlypis trichas
Wilson’s warbler	Wilsonia pusilla
Yellow-breasted chat	Icteria virens
Summer tanager	Piranga rubra
Western tanager	Piranga ludoviciana
Northern cardinal	Cardinalis cardinalis
Pyrrhuloxia	Cardinalis sinuatus
Rose-breasted grosbeak	Pheucticus ludovicianus
Black-headed grosbeak	Pheucticus melanocephalus
Blue grosbeak	Guiraca caerulea
Lazuli bunting	Passerina amoena
Indigo bunting	Passerina cyanea
Painted bunting	Passerina ciris
Spotted towhee	Pipilo maculatus
Brown towhee	Pipilo fuscus
Dark-eyed junco	Junco hyemalis
Rufous-crowned sparrow	Aimophila ruficeps
American tree sparrow	Spizella arborea
Chipping sparrow	Spizella passerina
Lark sparrow	Chondestes grammacus
Black-throated sparrow	Amphispiza bilineata
Lark bunting	Calamospiza melanocorys

Lincoln’s sparrow	*Melospiza lincolnii*
White-crowned sparrow	*Zonotrichia leucophrys*
Red-wing blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brewer’s blackbird	*Euphagus cyanocephalus*
Great-tailed grackle	*Quiscalus mexicanus*
Bronzed cowbird	*Molothrus aeneus*
Brown-headed cowbird	*Molothrus ater*
Orchard oriole	*Icterus spurius*
Northern oriole	*Icterus galbula bullockii*
House finch	*Carpodacus mexicanus*
Lesser goldfinch	*Carduelis psaltria*

Appendix D. Common and Scientific Names of Fish That May Occur in the Rio Grande in Sandoval, Bernalillo, Valencia, Socorro, and Sierra Counties.

Common Name	**Scientific Name**
Gizzard shad	Dorosoma cepedianum
Rainbow trout	Oncorhynchus mykiss
Kokanee salmon	Oncorhynchus nerka
Brown trout	Salmo trutta
Northern pike	Esox lucius
Red shiner	Cyprinella lutrensis
Common carp	Cyprinus carpio
Rio Grande chub	Gila pandora
Rio Grande silvery minnow	Hybognathus amarus
Fathead minnow	Pimephales promelas
Flathead chub	Platygobio gracilis
Longnose dace	Rhinichthys cataractae
River carpsucker	Carpiodes carpio
White sucker	Catostomus commersoni
Rio Grande sucker	Catostomus plebeius
Smallmouth buffalo	Ictiobus bubalus
Black bullhead	Ictalurus melas
Yellow bullhead	Ictalurus natalis
Channel catfish	Ictalurus punctatus
Western mosquitofish	Gambusia affinis
White bass	Morone chrysops
Green sunfish	Lepomis cyanellus
Bluegill	Lepomis macrochirus
Longear sunfish	Lepomis megalotis
Largemouth bass	Micropterus salmoides
White crappie	Pomoxis annularis
Black crappie	Pomoxis nigromaculatus
Yellow perch	Perca flavescens

Appendix E. Common and Scientific Names of Plants That May Occur in the Rio Grande Floodplain in Sandoval, Bernalillo, Valencia, Socorro, and Sierra Counties.

Common Name	Scientific Name
Baccharis	Baccharis spp.
Seepwillow	Baccharis glutinosa
Coyote willow	Salix exigua
Peachleaf willow	Salix amygdaloides
Gooddings willow	Salix gooddingii
Buttonbush	Cephalanthus spp.
False indigo	Amorpha fruticosa
New Mexico olive	Forestiera neomexicana
Black locust	Robinia pseudo-acacia
Boxelder	Acer negundo
Chinaberry	Melia azedarach
Fremont cottonwood	Populus fremonti
Mulberry	Morus spp.
Russian olive	Elaeagnus angustifolia
Saltcedar	Tamarix spp.
Siberian elm	Ulmus pumila
Tree-of-heaven	Ailanthus altissima
Apache plume	Fallugia paradoxa
Pale wolfberry	Lycium pallidum
Fourwing saltbush	Atriplex canescens
Sand sagebrush	Artemisia filifolia
Virginia creeper	Parthenocissus inserta
Phragmites	Phragmites communis
Sedge	Carex spp.
Saltgrass	Distichlis stricta
Spikerush	Eleocharis spp.
Horsetail	Equisetum spp.
Rush	Juncus spp.
Bulrush	Scirpus spp.
Sacaton	Sporobolus spp.
Cattail	Typha latifolia
Smartweed	Polygonum lapathifolium
American milfoil	Myriophyllum exalbescens
Yerbamanza	Anemopsis californica
Large yellow evening primrose	Calylophus primiveris
Fendler globemallow	Sphaeralcea fendleri
Pricklypear	Opuntia spp.
Buffalo gourd	Cuccurbita foetidissima
Spiny aster	Aster spinosus

APPENDIX B

PERTINENT CORRESPONDENCE

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DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA, NE
ALBUQUERQUE, NEW MEXICO 87109-3435
FAX (505) 342-3199

Reply to
Attention of

Received 24 JUL 2001 COE

June 6, 2001

Engineering and Construction Division
Environmental Resources Branch

RECEIVED JUN 11 2001 HISTORIC PRESERVATION DIVISION

Mr. Elmo Baca
State Historic Preservation Officer
New Mexico State Historic Preservation Bureau
228 East Palace Avenue, Room 101
Santa Fe, New Mexico 87503

Dear Mr. Baca:

Pursuant to 36 CFR Part 800, the U. S. Army Corps of Engineers (Corps), Albuquerque District, is seeking your concurrence in our determination of "No Historic Properties Affected" for the proposed project entitled, "**Riparian and Wetland Restoration, Pueblo of Santa Ana Reservation, New Mexico.**" The Corps, in cooperation with the Pueblo of Santa Ana, is planning the restoration project under the authority of Section 1135(b) of the Water Resources Development Act of 1986 (Public Law 99-662), as amended.

The project area along the Rio Grande is located in the Ranchiit'u area of the Pueblo of Santa Ana Reservation, Sandoval County, New Mexico. The proposed construction includes the installation of three (3) grade restoration facilities and one (1) downstream bed sill, the reshaping of 6 sand bars, and creation of 17 acres (6.8 hectares) of wetland within cleared overbank areas of the floodplain. Available funding may defer construction of some of the proposed features to a later time. The proposed construction area begins, at the upstream end, at the center of Section 16, Township 13 North, Range 4 East, extending downstream for approximately three (3) miles (4.8 kilometers [km]) and the project ends at a location about 0.7 mile (1.1 km) upstream of the Bernalillo-U.S. Highway 550-Rio Grande bridge.

On May 3, 2001, a Corps archaeologist and project team members conducted a site visit of the project area located along the Rio Grande on Pueblo of Santa Ana Reservation lands. On May 17, 2001, two Corps archaeologists conducted an intensive cultural resources inventory (Class III) of portions of the two west side access roads. No artifacts or cultural resource manifestations were observed during the site visit to the riverside construction areas or during the access road surveys. Information on the project location and dimensions are provided in the enclosed report.

Prior to the site visit and survey, a search of the New Mexico Historic Preservation Division's Archeological Records Management Section database was conducted to identify cultural resources sites reported within the vicinity of the project area. The database search found that no archaeological sites have been reported within the river's 100-year floodplain in the project area; and therefore, no sites are reported to occur in the vicinity of the proposed construction areas along the Rio Grande channel. Documentary evidence and cultural resources survey work in the project area supports the theory that, if cultural resources sites were within the 100-year floodplain, they would have been either washed away by the river and/or buried by significant sediment deposition. A recent archaeological survey and assessment that considered the potential for cultural resources to occur within the 100-year floodplain came to the same conclusion (as noted in the enclosed report): "Based on aerial photo analysis, preliminary geomorphic studies, and field inspection, it became clear that the low terraces within the bosque represent relatively recent historic period alluvial deposits with little or no potential to contain cultural materials of significant antiquity or archaeological integrity." (Penner *et al.* 2001).

A database search of the State Register of Cultural Properties and of the National Register of Historic Places found that numerous State and National Register properties occur within the historic community of Bernalillo as well as several that are located in the general vicinity of the project area. Of these, Coronado State Monument Museum (State Register No. 1515) and Kuaua Ruin (State Register No. 225) are located downstream of the project area. They are, however, located on gravel terraces well above the river channel (see Photograph No. 1). No State or Federal Register properties would be affected by this river restoration project.

During project planning, long-time Pueblo of Santa Ana Tribal Administrator, Mr. Roy Montoya, in consultation with tribal members, indicated that no Traditional Cultural Properties would be affected by this river restoration project. All other access and staging areas including overnight equipment, vehicle parking, rock stockpile and spoil areas, have been previously surveyed for cultural resources and received use clearance, have been previously disturbed and utilized for similar purposes, or are located within the disturbed 100-year floodplain.

Based on this information, the Corps is of the opinion that there would be "No Historic Properties Affected" by the proposed river restoration project. During construction, work operations may be temporarily suspended for Pueblo ceremonies or special functions. Temporary work suspensions would be coordinated through all appropriate project points-of-contact. Should previously unknown artifacts or cultural resource manifestations be encountered during construction, work would cease in the immediate vicinity of the resource, a determination of significance made, and a mitigation plan formulated in consultation with the Pueblo of Santa Ana and the New Mexico State Historic Preservation Officer pursuant to 36 CFR 800.11. If you have any questions or require additional information, please contact Gregory Everhart of my staff at (505) 342-3352, or John Schelberg, Ph.D. at (505) 342-3359.

Sincerely,

John D. Schelberg

for\ Mark C. Harberg
Chief, Environmental Resources Branch

Enclosure

Concur with recommendation of eligibility and/or effects as proposed.

Suzanne Duncan for
State Historic Preservation Officer
7/23/01

Copy Furnished w/o enclosure:

Governor Bruce Sanchez
Pueblo of Santa Ana
2 Dove Road
Bernalillo, New Mexico 87004

Mr. Roy Montoya
Tribal Administrator
Pueblo of Santa Ana
2 Dove Road
Bernalillo, New Mexico 87004

Don Klima, Director
Advisory Council on Historic Preservation
Office of Planning and Review
12136 W. Bayaud Ave., #330
Lakewood, Colorado 80228-2115

I CONCUR ______________________
ELMO BACA
NEW MEXICO STATE HISTORIC
PRESERVATION OFFICER

SANTA ANA PUEBLO
2 Dove Road
BERNALILLO, NEW MEXICO 87004

Office of the:
Governor
Lt. Governor
Secretary

Phone: (505) 867-3301
(505) 867-3302
Fax: (505) 867-3395

RECEIVED
26 Jun 01
REGULATORY BR.
CORPS OF ENGINEERS

Rec'd 6-26-2001
BDE

June 14, 2001

Lt. Colonel Raymond G. Midkiff
United States Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, N.E.
Albuquerque, NM 87109-3435

Dear Colonel Midkiff:

The Pueblo of Santa Ana has reviewed the cultural resources inventory report entitled "A Cultural Resources Inventory of 29.2 Acres for Riparian and Wetland Restoration, Pueblo of Santa Ana Reservation, New Mexico" and concur with its findings that no cultural resources will be affected by the project.

Please contact me if you need further information or support.

Sincerely,

Roy Montoya
Tribal Administrator

PUEBLO OF SANTA ANA

OFFICE OF THE GOVERNOR

March 5, 2008

LTC Bruce Estok
District Engineer
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109

Subject: Statement of Intent for Aquatic Habitat Restoration Project, Section 1135

Dear Colonel Estok:

The Pueblo of Santa Ana (Pueblo) is the sponsor of the Aquatic Habitat Restoration Project, Santa Ana Pueblo. The project is being carried out under the Corps' Continuing Authorities Program, Section 1135. The project contributes significantly to our restoration efforts along the Rio Grande through our community. This letter serves as a statement of intent to serve as the cost sharing sponsor to pursue this project through design and construction.

The Pueblo understands that in order to proceed with the project, we must enter into a Project Cooperation Agreement with the Corps which, among other things requires that 25 percent of the funding necessary for the project be provided as a local contribution. We further understand that the Pueblo will be responsible for all real estate requirements for lands, easements, rights-of-way, relocations and disposal areas, as well as for future operations and maintenance costs of the finished project.

Deborah Goss, Director of the Department of Natural Resources, will serve as the primary point of contact for the Pueblo. Please contact her at (505) 771-6771 with any further questions or requests that you may have.

Sincerely,

Freddie A. Arroyo Lt. Governor for

Pueblo of Santa Ana
Ulysses G. Leon, Governor

02 DOVE ROAD • SANTA ANA PUEBLO • NM 87004
TEL: 505-867-3301 • FAX: 505-867-3395 • govt@santaana.org

APPENDIX C

COST ESTIMATE

Riparian and Wetland Restoration
OVERBANK LOWERING

Pueblo of Santa Ana Reservation
Sandoval County, New Mexico

Estimated by	USAENGR DIST ALB CE <> SPA-EC-S
Designed by	Ayres and Associates, Fort Collins, Colorado
Prepared by	C de Baca, Alan, R
Preparation Date	9/16/2006
Effective Date of Pricing	9/16/2006
Estimated Construction Time	Days

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Total Project Cost, Feature			*8,660,686*	*2,212,298*	*10,872,984*
A1 Overbank Lowering - (Depth)	*1.0000*	*LS*	*1,929,775*	*486,939*	*2,416,714*
A1 C Construction Cost	*1.0000*	*LS*	*1,619,175*	*435,539*	*2,054,714*
A1 C 06 Fish and Wildlife Facilities	*1.0000*	*LS*	*1,619,175*	*435,539*	*2,054,714*
A1 P Project Costs	*1.0000*	*LS*	*310,600*	*51,400*	*362,000*
A1 P 01 Lands and Damages	*1.0000*	*LS*	*0*	*0*	*0*
A1 P 30 Planning Engineering and Design	*1.0000*	*LS*	*150,000*	*15,000*	*165,000*
A1 P 31 Construction Management	*1.0000*	*LS*	*160,600*	*36,400*	*197,000*
A2 Overbank Lowering - (Depth + 0.5)	*1.0000*	*LS*	*2,627,256*	*672,629*	*3,299,885*
A2 C Construction Cost	*1.0000*	*LS*	*2,253,456*	*606,429*	*2,859,885*
A2 C 06 Fish and Wildlife Facilities	*1.0000*	*LS*	*2,253,456*	*606,429*	*2,859,885*
A2 P Project Costs	*1.0000*	*LS*	*373,800*	*66,200*	*440,000*
A2 P 01 Lands and Damages	*1.0000*	*LS*	*0*	*0*	*0*
A2 P 30 Planning Engineering and Design	*1.0000*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 31 Construction Management	*1.0000*	*LS*	*223,800*	*51,200*	*275,000*
A3 Overbank Lowering - (Depth + 1.0)	*1.0000*	*LS*	*3,313,166*	*854,746*	*4,167,912*
A3 C Construction Cost	*1.0000*	*LS*	*2,877,366*	*774,546*	*3,651,912*
A3 C 06 Fish and Wildlife Facilities	*1.0000*	*LS*	*2,877,366*	*774,546*	*3,651,912*
A3 P Project Costs	*1.0000*	*LS*	*435,800*	*80,200*	*516,000*
A3 P 01 Lands and Damages	*1.0000*	*LS*	*0*	*0*	*0*
A3 P 30 Planning Engineering and Design	*1.0000*	*LS*	*150,000*	*15,000*	*165,000*
A3 P 31 Construction Management	*1.0000*	*LS*	*285,800*	*65,200*	*351,000*
B1 Shrub Swale	*1.0000*	*LS*	*517,736*	*130,146*	*647,882*
B1 C Construction Cost	*1.0000*	*LS*	*440,036*	*116,846*	*556,882*
B1 C 06 Fish and Wildlife Facilities	*1.0000*	*LS*	*440,036*	*116,846*	*556,882*
B1 P Project Costs	*1.0000*	*LS*	*77,700*	*13,300*	*91,000*
B1 P 01 Lands and Damages	*1.0000*	*LS*	*0*	*0*	*0*
B1 P 30 Planning Engineering and Design	*1.0000*	*LS*	*37,000*	*4,000*	*41,000*

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
B1 P 31 Construction Management	1.0000	LS	40,700	9,300	50,000
C1 Pole & Shrub	1.0000	LS	79,140	19,160	98,300
C1 C Construction Cost	1.0000	LS	66,640	16,660	83,300
C1 C 06 Fish and Wildlife Facilities	1.0000	LS	66,640	16,660	83,300
C1 P Project Costs	1.0000	LS	12,500	2,500	15,000
C1 P 01 Lands and Damages	1.0000	LS	0	0	0
C1 P 30 Planning Engineering and Design	1.0000	LS	6,000	1,000	7,000
C1 P 31 Construction Management	1.0000	LS	6,500	1,500	8,000
D1 Saltgrass Meadow	1.0000	LS	25,609	6,552	32,161
D1 C Construction Cost	1.0000	LS	22,209	5,552	27,761
D1 C 06 Fish and Wildlife Facilities	1.0000	LS	22,209	5,552	27,761
D1 P Project Costs	1.0000	LS	3,400	1,000	4,400
D1 P 01 Lands and Damages	1.0000	LS	0	0	0
D1 P 30 Planning Engineering and Design	1.0000	LS	1,500	500	2,000
D1 P 31 Construction Management	1.0000	LS	1,900	500	2,400
E1 Shrub Stand	1.0000	LS	38,392	9,723	48,115
E1 C Construction Cost	1.0000	LS	32,092	8,023	40,115
E1 C 06 Fish and Wildlife Facilities	1.0000	LS	32,092	8,023	40,115
E1 P Project Costs	1.0000	LS	6,300	1,700	8,000
E1 P 01 Lands and Damages	1.0000	LS	0	0	0
E1 P 30 Planning Engineering and Design	1.0000	LS	3,000	1,000	4,000
E1 P 31 Construction Management	1.0000	LS	3,300	700	4,000
00 Plant Maintenance	1.0000	LS	129,611	32,403	162,014
00 C Construction Cost	1.0000	LS	129,611	32,403	162,014
00 C 06 Fish and Wildlife Facilities	1.0000	LS	129,611	32,403	162,014

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Total Project Cost, Item			8,660,686	2,212,298	10,872,984
A1 Overbank Lowering - (Depth)	1.0	LS	1,929,775	486,939	2,416,714
A1 C Construction Cost	1.0	LS	1,619,175	435,539	2,054,714
A1 C 06 Fish and Wildlife Facilities	1.0	LS	1,619,175	435,539	2,054,714
A1 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	1,619,175.14 1,619,175	435,539	2,054,714.48 2,054,714
A1 C 060373 Habitat and Feeding Facilities	1.0	LS	1,268,760	341,146	1,609,906
A1 C 06037302 Site Work	1.0	LS	1,268,760	341,146	1,609,906
A1 C 06037302 001 Clearing and Grubbing - (Bar 1)	14.0	ACR	1,174.85 16,448	4,112	1,468.56 20,560
A1 C 06037302 002 Clearing and Grubbing - (Bar 2)	11.0	ACR	1,166.24 12,829	3,207	1,457.80 16,036
A1 C 06037302 003 Clearing and Grubbing - (Bar 3)	22.0	ACR	1,041.90 22,922	5,730	1,302.37 28,652
A1 C 06037302 004 Clearing and Grubbing - (Bar 4)	7.0	ACR	1,174.85 8,224	2,056	1,468.56 10,280
A1 C 06037302 005 Clearing and Grubbing - (Bar 5)	2.0	ACR	1,151.18 2,302	576	1,438.98 2,878
A1 C 06037302 006 Clearing and Grubbing - (Bar 6)	7.0	ACR	1,174.85 8,224	2,056	1,468.56 10,280
A1 C 06037302 011 Excavation, Random - (Bar 1)	33,380.0	CY	9.89 330,047	89,113	12.56 419,160
A1 C 06037302 012 Excavation, Random - (Bar 2)	17,090.0	CY	9.98 170,586	46,058	12.68 216,644
A1 C 06037302 013 Excavation, Random - (Bar 3)	30,235.0	CY	9.93 300,380	81,103	12.62 381,483
A1 C 06037302 014 Excavation, Random - (Bar 4)	17,585.0	CY	9.91 174,295	47,060	12.59 221,354
A1 C 06037302 015 Excavation, Random - (Bar 5)	2,790.0	CY	10.63 29,667	8,010	13.50 37,677
A1 C 06037302 016 Excavation, Random - (Bar 6)	19,370.0	CY	9.96 192,837	52,066	12.64 244,902

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
A1 C 060399 Associated General Items	1.0	LS	350,415	94,393	444,808
A1 C 06039902 Site Work	1.0	LS	350,415	94,393	444,808
			1.59		1.99
A1 C 06039902 001 Waste	134,905.0	CY	214,629	53,657	268,286
			20,890.21		27,157.27
A1 C 06039902 002 Haul Roads	6.5	MI	135,786	40,736	176,522
A1 P Project Costs	1.0	LS	310,600	51,400	362,000
A1 P 01 Lands and Damages	1.0	LS	0	0	0
			0.00		0.00
A1 P 0101 Project Planning	1.0	EA	0	0	0
A1 P 010102 Project Design Memorandum	1.0	LS	0	0	0
A1 P 01010201 Real Estate Plan	1.0	LS	0	0	0
A1 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
A1 P 30 Planning Engineering and Design	1.0	LS	150,000	15,000	165,000
A1 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	150,000	15,000	165,000
A1 P 300401 Plans and Specifications (P&S)	1.0	LS	150,000	15,000	165,000
A1 P 30040102 Plans and Specifications	1.0	LS	150,000	15,000	165,000
A1 P 30040102 001 Design and Procurement Costs	1.0	LS	150,000	15,000	165,000
A1 P 31 Construction Management	1.0	LS	160,600	36,400	197,000
A1 P 3101 Supervision and Administration	1.0	LS	160,600	36,400	197,000
A1 P 310101 Project Office S&A	1.0	LS	72,300	17,300	89,600
A1 P 31010101 Project Office Operations	1.0	LS	64,300	15,100	79,400
A1 P 31010101 001 Daily Contract Oversite	1.0	LS	64,300	15,100	79,400
A1 P 31010102 Project Office Other S&A	1.0	LS	8,000	2,200	10,200
			8,000.00		10,200.00
A1 P 31010102 001 Other Daily Contract Oversite	1.0	EA	8,000	2,200	10,200
A1 P 310102 Area Office S&A	1.0	LS	24,100	4,300	28,400
A1 P 31010201 Area Office Other S&A	1.0	LS	24,100	4,300	28,400
A1 P 31010201 001 Project Coordination	1.0	LS	24,100	4,300	28,400

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
A1 P 310103 District Office S&A	1.0	LS	64,200	14,800	79,000
A1 P 31010303 District Office Other S&A	1.0	LS	48,200	10,800	59,000
A1 P 31010303 001 Budgetary Documents	1.0	LS	48,200	10,800	59,000
A1 P 31010301 Technical Management by Construction	1.0	LS	8,000	2,000	10,000
A1 P 31010301 001 Claims Management Documents	1.0	LS	8,000	2,000	10,000
A1 P 31010302 Technical Manager	1.0	LS	8,000	2,000	10,000
A1 P 31010302 001 Upward Reporting Documents	1.0	LS	8,000	2,000	10,000
A2 Overbank Lowering - (Depth + 0.5)	1.0	LS	2,627,256	672,629	3,299,885
A2 C Construction Cost	1.0	LS	2,253,456	606,429	2,859,885
A2 C 06 Fish and Wildlife Facilities	1.0	LS	2,253,456	606,429	2,859,885
			2,253,456.29		2,859,885.09
A2 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	2,253,456	606,429	2,859,885
A2 C 060373 Habitat and Feeding Facilities	1.0	LS	1,765,685	475,316	2,241,001
A2 C 06037302 Site Work	1.0	LS	1,765,685	475,316	2,241,001
			1,174.85		1,468.56
A2 C 06037302 001 Clearing and Grubbing - (Bar 1)	14.0	ACR	16,448	4,112	20,560
			1,166.24		1,457.80
A2 C 06037302 002 Clearing and Grubbing - (Bar 2)	11.0	ACR	12,829	3,207	16,036
			1,041.90		1,302.37
A2 C 06037302 003 Clearing and Grubbing - (Bar 3)	22.0	ACR	22,922	5,730	28,652
			1,174.85		1,468.56
A2 C 06037302 004 Clearing and Grubbing - (Bar 4)	7.0	ACR	8,224	2,056	10,280
			1,151.18		1,438.98
A2 C 06037302 005 Clearing and Grubbing - (Bar 5)	2.0	ACR	2,302	576	2,878
			1,174.85		1,468.56
A2 C 06037302 006 Clearing and Grubbing - (Bar 6)	7.0	ACR	8,224	2,056	10,280
			9.91		12.59
A2 C 06037302 011 Excavation, Random - (Bar 1)	44,510.0	CY	441,299	119,151	560,450
			9.98		12.68
A2 C 06037302 012 Excavation, Random - (Bar 2)	25,630.0	CY	255,879	69,087	324,967

Description	*Quantity*	*UOM*	*ContractCost*	*Contingency*	*ProjectCost*
A2 C 06037302 013 Excavation, Random - (Bar 3)	*47,765.0*	*CY*	9.94 *474,675*	*128,162*	12.62 *602,837*
A2 C 06037302 014 Excavation, Random - (Bar 4)	*23,445.0*	*CY*	9.96 *233,629*	*63,080*	12.66 *296,709*
A2 C 06037302 015 Excavation, Random - (Bar 5)	*4,185.0*	*CY*	9.75 *40,792*	*11,014*	12.38 *51,806*
A2 C 06037302 016 Excavation, Random - (Bar 6)	*25,060.0*	*CY*	9.91 *248,462*	*67,085*	12.59 *315,547*
A2 C 060399 Associated General Items	*1.0*	*LS*	*487,771*	*131,113*	*618,884*
A2 C 06039902 Site Work	*1.0*	*LS*	*487,771*	*131,113*	*618,884*
A2 C 06039902 001 Waste	*191,070.0*	*CY*	1.59 *304,371*	*76,093*	1.99 *380,464*
A2 C 06039902 002 Haul Roads	*6.5*	*MI*	28,215.38 *183,400*	*55,020*	36,680.00 *238,420*
A2 P Project Costs	*1.0*	*LS*	*373,800*	*66,200*	*440,000*
A2 P 01 Lands and Damages	*1.0*	*LS*	*0*	*0*	*0*
A2 P 0101 Project Planning	*1.0*	*EA*	0.00 *0*	*0*	0.00 *0*
A2 P 010102 Project Design Memorandum	*1.0*	*LS*	*0*	*0*	*0*
A2 P 01010201 Real Estate Plan	*1.0*	*LS*	*0*	*0*	*0*
A2 P 01010201 001 All Other Real Estate	*1.0*	*LS*	*0*	*0*	*0*
A2 P 30 Planning Engineering and Design	*1.0*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 3004 Construction Contract Planning, Engineering & Design	*1.0*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 300401 Plans and Specifications (P&S)	*1.0*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 30040102 Plans and Specifications	*1.0*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 30040102 001 Design and Procurement Costs	*1.0*	*LS*	*150,000*	*15,000*	*165,000*
A2 P 31 Construction Management	*1.0*	*LS*	*223,800*	*51,200*	*275,000*
A2 P 3101 Supervision and Administration	*1.0*	*LS*	*223,800*	*51,200*	*275,000*
A2 P 310101 Project Office S&A	*1.0*	*LS*	*100,700*	*24,100*	*124,800*
A2 P 31010101 Project Office Operations	*1.0*	*LS*	*89,500*	*21,100*	*110,600*

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
A2 P 31010101 001 Daily Contract Oversite	1.0	LS	89,500	21,100	110,600
A2 P 31010102 Project Office Other S&A	1.0	LS	11,200	3,000	14,200
			11,200.00		14,200.00
A2 P 31010102 001 Other Daily Contract Oversite	1.0	EA	11,200	3,000	14,200
A2 P 310102 Area Office S&A	1.0	LS	33,600	6,000	39,600
A2 P 31010201 Area Office Other S&A	1.0	LS	33,600	6,000	39,600
A2 P 31010201 001 Project Coordination	1.0	LS	33,600	6,000	39,600
A2 P 310103 District Office S&A	1.0	LS	89,500	21,100	110,600
A2 P 31010303 District Office Other S&A	1.0	LS	67,100	15,100	82,200
A2 P 31010303 001 Budgetary Documents	1.0	LS	67,100	15,100	82,200
A2 P 31010301 Technical Management by Construction	1.0	LS	11,200	3,000	14,200
A2 P 31010301 001 Claims Management Documents	1.0	LS	11,200	3,000	14,200
A2 P 31010302 Technical Manager	1.0	LS	11,200	3,000	14,200
A2 P 31010302 001 Upward Reporting Documents	1.0	LS	11,200	3,000	14,200
A3 Overbank Lowering - (Depth + 1.0)	1.0	LS	3,313,166	854,746	4,167,912
A3 C Construction Cost	1.0	LS	2,877,366	774,546	3,651,912
A3 C 06 Fish and Wildlife Facilities	1.0	LS	2,877,366	774,546	3,651,912
			2,877,366.11		3,651,911.77
A3 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	2,877,366	774,546	3,651,912
A3 C 060373 Habitat and Feeding Facilities	1.0	LS	2,255,193	607,483	2,862,676
A3 C 06037302 Site Work	1.0	LS	2,255,193	607,483	2,862,676
			1,174.85		1,468.56
A3 C 06037302 001 Clearing and Grubbing - (Bar 1)	14.0	ACR	16,448	4,112	20,560
			1,166.24		1,457.80
A3 C 06037302 002 Clearing and Grubbing - (Bar 2)	11.0	ACR	12,829	3,207	16,036
			1,041.90		1,302.37
A3 C 06037302 003 Clearing and Grubbing - (Bar 3)	22.0	ACR	22,922	5,730	28,652
			1,174.85		1,468.56
A3 C 06037302 004 Clearing and Grubbing - (Bar 4)	7.0	ACR	8,224	2,056	10,280

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
A3 C 06037302 005 Clearing and Grubbing - (Bar 5)	2.0	ACR	1,151.18 2,302	576	1,438.98 2,878
A3 C 06037302 006 Clearing and Grubbing - (Bar 6)	7.0	ACR	1,174.85 8,224	2,056	1,468.56 10,280
A3 C 06037302 011 Excavation, Random - (Bar 1)	55,635.0	CY	9.93 552,551	149,189	12.61 701,740
A3 C 06037302 012 Excavation, Random - (Bar 2)	34,170.0	CY	9.88 337,464	91,115	12.54 428,579
A3 C 06037302 013 Excavation, Random - (Bar 3)	65,295.0	CY	9.88 645,261	174,220	12.55 819,481
A3 C 06037302 014 Excavation, Random - (Bar 4)	29,305.0	CY	9.87 289,255	78,099	12.54 367,354
A3 C 06037302 015 Excavation, Random - (Bar 5)	5,580.0	CY	9.97 55,626	15,019	12.66 70,645
A3 C 06037302 016 Excavation, Random - (Bar 6)	30,760.0	CY	9.89 304,088	82,104	12.56 386,192
A3 C 060399 Associated General Items	1.0	LS	622,173	167,063	789,236
A3 C 06039902 Site Work	1.0	LS	622,173	167,063	789,236
A3 C 06039902 001 Waste	247,235.0	CY	1.58 391,788	97,947	1.98 489,735
A3 C 06039902 002 Haul Roads	6.5	MI	35,443.83 230,385	69,115	46,076.98 299,500
A3 P Project Costs	1.0	LS	435,800	80,200	516,000
A3 P 01 Lands and Damages	1.0	LS	0	0	0
A3 P 0101 Project Planning	1.0	EA	0.00 0	0	0.00 0
A3 P 010102 Project Design Memorandum	1.0	LS	0	0	0
A3 P 01010201 Real Estate Plan	1.0	LS	0	0	0
A3 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
A3 P 30 Planning Engineering and Design	1.0	LS	150,000	15,000	165,000
A3 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	150,000	15,000	165,000

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
A3 P 300401 Plans and Specifications (P&S)	1.0	LS	150,000	15,000	165,000
A3 P 30040102 Plans and Specifications	1.0	LS	150,000	15,000	165,000
A3 P 30040102 001 Design and Procurement Costs	1.0	LS	150,000	15,000	165,000
A3 P 31 Construction Management	1.0	LS	285,800	65,200	351,000
A3 P 3101 Supervision and Administration	1.0	LS	285,800	65,200	351,000
A3 P 310101 Project Office S&A	1.0	LS	128,600	30,700	159,300
A3 P 31010101 Project Office Operations	1.0	LS	114,300	26,900	141,200
A3 P 31010101 001 Daily Contract Oversite	1.0	LS	114,300	26,900	141,200
A3 P 31010102 Project Office Other S&A	1.0	LS	14,300	3,800	18,100
			14,300.00		18,100.00
A3 P 31010102 001 Other Daily Contract Oversite	1.0	EA	14,300	3,800	18,100
A3 P 310102 Area Office S&A	1.0	LS	42,900	7,700	50,600
A3 P 31010201 Area Office Other S&A	1.0	LS	42,900	7,700	50,600
A3 P 31010201 001 Project Coordination	1.0	LS	42,900	7,700	50,600
A3 P 310103 District Office S&A	1.0	LS	114,300	26,800	141,100
A3 P 31010303 District Office Other S&A	1.0	LS	85,700	19,200	104,900
A3 P 31010303 001 Budgetary Documents	1.0	LS	85,700	19,200	104,900
A3 P 31010301 Technical Management by Construction	1.0	LS	14,300	3,800	18,100
A3 P 31010301 001 Claims Management Documents	1.0	LS	14,300	3,800	18,100
A3 P 31010302 Technical Manager	1.0	LS	14,300	3,800	18,100
A3 P 31010302 001 Upward Reporting Documents	1.0	LS	14,300	3,800	18,100
B1 Shrub Swale	1.0	LS	517,736	130,146	647,882
B1 C Construction Cost	1.0	LS	440,036	116,846	556,882
B1 C 06 Fish and Wildlife Facilities	1.0	LS	440,036	116,846	556,882
			440,035.78		556,882.14
B1 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	440,036	116,846	556,882
B1 C 060373 Habitat and Feeding Facilities	1.0	LS	440,036	116,846	556,882
B1 C 06037302 Site Work	1.0	LS	440,036	116,846	556,882

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
B1 C 06037302 001 Clearing	6.5	ACR	774.69 5,035	1,259	968.36 6,294
B1 C 06037302 002 Excavation, Random	40,500.0	CY	8.44 341,871	92,305	10.72 434,176
B1 C 06037302 011 Stem Planting	6,880.0	EA	10.99 75,636	18,909	13.74 94,545
B1 C 06037302 012 Potted Shrub Planting	460.0	EA	22.32 10,266	2,567	27.90 12,833
B1 C 06037302 013 Pole Planting	159.0	EA	45.45 7,227	1,807	56.81 9,033
B1 P Project Costs	1.0	LS	77,700	13,300	91,000
B1 P 01 Lands and Damages	1.0	LS	0	0	0
B1 P 0101 Project Planning	1.0	EA	0.00 0	0	0.00 0
B1 P 010102 Project Design Memorandum	1.0	LS	0	0	0
B1 P 01010201 Real Estate Plan	1.0	LS	0	0	0
B1 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
B1 P 30 Planning Engineering and Design	1.0	LS	37,000	4,000	41,000
B1 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	37,000	4,000	41,000
B1 P 300401 Plans and Specifications (P&S)	1.0	LS	37,000	4,000	41,000
B1 P 30040102 Plans and Specifications	1.0	LS	37,000	4,000	41,000
B1 P 30040102 001 Design and Procurement Costs	1.0	LS	37,000	4,000	41,000
B1 P 31 Construction Management	1.0	LS	40,700	9,300	50,000
B1 P 3101 Supervision and Administration	1.0	LS	40,700	9,300	50,000
B1 P 310101 Project Office S&A	1.0	LS	18,300	4,400	22,700
B1 P 31010101 Project Office Operations	1.0	LS	16,300	3,900	20,200
B1 P 31010101 001 Daily Contract Oversite	1.0	LS	16,300	3,900	20,200
B1 P 31010102 Project Office Other S&A	1.0	LS	2,000	500	2,500
B1 P 31010102 001 Other Daily Contract Oversite	1.0	EA	2,000.00 2,000	500	2,500.00 2,500

Description	*Quantity*	*UOM*	*ContractCost*	*Contingency*	*ProjectCost*
B1 P 310102 Area Office S&A	*1.0*	*LS*	*6,200*	*1,100*	*7,300*
B1 P 31010201 Area Office Other S&A	*1.0*	*LS*	*6,200*	*1,100*	*7,300*
B1 P 31010201 001 Project Coordination	*1.0*	*LS*	*6,200*	*1,100*	*7,300*
B1 P 310103 District Office S&A	*1.0*	*LS*	*16,200*	*3,800*	*20,000*
B1 P 31010303 District Office Other S&A	*1.0*	*LS*	*12,200*	*2,800*	*15,000*
B1 P 31010303 001 Budgetary Documents	*1.0*	*LS*	*12,200*	*2,800*	*15,000*
B1 P 31010301 Technical Management by Construction	*1.0*	*LS*	*2,000*	*500*	*2,500*
B1 P 31010301 001 Claims Management Documents	*1.0*	*LS*	*2,000*	*500*	*2,500*
B1 P 31010302 Technical Manager	*1.0*	*LS*	*2,000*	*500*	*2,500*
B1 P 31010302 001 Upward Reporting Documents	*1.0*	*LS*	*2,000*	*500*	*2,500*
C1 Pole & Shrub	*1.0*	*LS*	*79,140*	*19,160*	*98,300*
C1 C Construction Cost	*1.0*	*LS*	*66,640*	*16,660*	*83,300*
C1 C 06 Fish and Wildlife Facilities	*1.0*	*LS*	*66,640*	*16,660*	*83,300*
C1 C 0603 Wildlife Facilities and Sanctuaries	*1.0*	*EA*	66,640.32 *66,640*	*16,660*	83,300.40 *83,300*
C1 C 060373 Habitat and Feeding Facilities	*1.0*	*LS*	*66,640*	*16,660*	*83,300*
C1 C 06037302 Site Work	*1.0*	*LS*	*66,640*	*16,660*	*83,300*
C1 C 06037302 001 Clearing	*7.5*	*ACR*	733.91 *5,504*	*1,376*	917.39 *6,880*
C1 C 06037302 011 Potted Shrub Planting	*1,500.0*	*EA*	22.13 *33,196*	*8,299*	27.66 *41,494*
C1 C 06037302 012 Pole Planting	*375.0*	*EA*	47.66 *17,874*	*4,468*	59.58 *22,342*
C1 C 06037302 021 Seeding	*7.5*	*ACR*	1,342.25 *10,067*	*2,517*	1,677.81 *12,584*
C1 P Project Costs	*1.0*	*LS*	*12,500*	*2,500*	*15,000*
C1 P 01 Lands and Damages	*1.0*	*LS*	*0*	*0*	*0*
C1 P 0101 Project Planning	*1.0*	*EA*	0.00 *0*	*0*	0.00 *0*
C1 P 010102 Project Design Memorandum	*1.0*	*LS*	*0*	*0*	*0*

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
C1 P 01010201 Real Estate Plan	1.0	LS	0	0	0
C1 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
C1 P 30 Planning Engineering and Design	1.0	LS	6,000	1,000	7,000
C1 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	6,000	1,000	7,000
C1 P 300401 Plans and Specifications (P&S)	1.0	LS	6,000	1,000	7,000
C1 P 30040102 Plans and Specifications	1.0	LS	6,000	1,000	7,000
C1 P 30040102 001 Design and Procurement Costs	1.0	LS	6,000	1,000	7,000
C1 P 31 Construction Management	1.0	LS	6,500	1,500	8,000
C1 P 3101 Supervision and Administration	1.0	LS	6,500	1,500	8,000
C1 P 310101 Project Office S&A	1.0	LS	2,800	600	3,400
C1 P 31010101 Project Office Operations	1.0	LS	2,500	500	3,000
C1 P 31010101 001 Daily Contract Oversite	1.0	LS	2,500	500	3,000
C1 P 31010102 Project Office Other S&A	1.0	LS	300	100	400
			300.00		400.00
C1 P 31010102 001 Other Daily Contract Oversite	1.0	EA	300	100	400
C1 P 310102 Area Office S&A	1.0	LS	1,200	300	1,500
C1 P 31010201 Area Office Other S&A	1.0	LS	1,200	300	1,500
C1 P 31010201 001 Project Coordination	1.0	LS	1,200	300	1,500
C1 P 310103 District Office S&A	1.0	LS	2,500	600	3,100
C1 P 31010303 District Office Other S&A	1.0	LS	1,900	400	2,300
C1 P 31010303 001 Budgetary Documents	1.0	LS	1,900	400	2,300
C1 P 31010301 Technical Management by Construction	1.0	LS	300	100	400
C1 P 31010301 001 Claims Management Documents	1.0	LS	300	100	400
C1 P 31010302 Technical Manager	1.0	LS	300	100	400
C1 P 31010302 001 Upward Reporting Documents	1.0	LS	300	100	400
D1 Saltgrass Meadow	1.0	LS	25,609	6,552	32,161
D1 C Construction Cost	1.0	LS	22,209	5,552	27,761
D1 C 06 Fish and Wildlife Facilities	1.0	LS	22,209	5,552	27,761

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
			22,208.91		27,761.14
D1 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	22,209	5,552	27,761
D1 C 060373 Habitat and Feeding Facilities	1.0	LS	22,209	5,552	27,761
D1 C 06037302 Site Work	1.0	LS	22,209	5,552	27,761
			2,022.56		2,528.20
D1 C 06037302 001 Clearing and Grubbing	5.0	ACR	10,113	2,528	12,641
			2,419.22		3,024.03
D1 C 06037302 011 Seeding	5.0	ACR	12,096	3,024	15,120
D1 P Project Costs	1.0	LS	3,400	1,000	4,400
D1 P 01 Lands and Damages	1.0	LS	0	0	0
			0.00		0.00
D1 P 0101 Project Planning	1.0	EA	0	0	0
D1 P 010102 Project Design Memorandum	1.0	LS	0	0	0
D1 P 01010201 Real Estate Plan	1.0	LS	0	0	0
D1 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
D1 P 30 Planning Engineering and Design	1.0	LS	1,500	500	2,000
D1 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	1,500	500	2,000
D1 P 300401 Plans and Specifications (P&S)	1.0	LS	1,500	500	2,000
D1 P 30040102 Plans and Specifications	1.0	LS	1,500	500	2,000
D1 P 30040102 001 Design and Procurement Costs	1.0	LS	1,500	500	2,000
D1 P 31 Construction Management	1.0	LS	1,900	500	2,400
D1 P 3101 Supervision and Administration	1.0	LS	1,900	500	2,400
D1 P 310101 Project Office S&A	1.0	LS	800	225	1,025
D1 P 31010101 Project Office Operations	1.0	LS	700	200	900
D1 P 31010101 001 Daily Contract Oversite	1.0	LS	700	200	900
D1 P 31010102 Project Office Other S&A	1.0	LS	100	25	125
			100.00		125.00
D1 P 31010102 001 Other Daily Contract Oversite	1.0	EA	100	25	125
D1 P 310102 Area Office S&A	1.0	LS	300	50	350

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
D1 P 31010201 Area Office Other S&A	1.0	LS	300	50	350
D1 P 31010201 001 Project Coordination	1.0	LS	300	50	350
D1 P 310103 District Office S&A	1.0	LS	800	225	1,025
D1 P 31010303 District Office Other S&A	1.0	LS	600	175	775
D1 P 31010303 001 Budgetary Documents	1.0	LS	600	175	775
D1 P 31010301 Technical Management by Construction	1.0	LS	100	25	125
D1 P 31010301 001 Claims Management Documents	1.0	LS	100	25	125
D1 P 31010302 Technical Manager	1.0	LS	100	25	125
D1 P 31010302 001 Upward Reporting Documents	1.0	LS	100	25	125
E1 Shrub Stand	1.0	LS	38,392	9,723	48,115
E1 C Construction Cost	1.0	LS	32,092	8,023	40,115
E1 C 06 Fish and Wildlife Facilities	1.0	LS	32,092	8,023	40,115
			32,092.31		40,115.39
E1 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	32,092	8,023	40,115
E1 C 060373 Habitat and Feeding Facilities	1.0	LS	32,092	8,023	40,115
E1 C 06037302 Site Work	1.0	LS	32,092	8,023	40,115
			2,022.56		2,528.20
E1 C 06037302 001 Clearing and Grubbing	5.0	ACR	10,113	2,528	12,641
			21.98		27.47
E1 C 06037302 011 Potted Shrub Planting	1,000.0	EA	21,980	5,495	27,474
E1 P Project Costs	1.0	LS	6,300	1,700	8,000
E1 P 01 Lands and Damages	1.0	LS	0	0	0
			0.00		0.00
E1 P 0101 Project Planning	1.0	EA	0	0	0
E1 P 010102 Project Design Memorandum	1.0	LS	0	0	0
E1 P 01010201 Real Estate Plan	1.0	LS	0	0	0
E1 P 01010201 001 All Other Real Estate	1.0	LS	0	0	0
E1 P 30 Planning Engineering and Design	1.0	LS	3,000	1,000	4,000
E1 P 3004 Construction Contract Planning, Engineering & Design	1.0	LS	3,000	1,000	4,000

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
E1 P 300401 Plans and Specifications (P&S)	1.0	LS	3,000	1,000	4,000
E1 P 30040102 Plans and Specifications	1.0	LS	3,000	1,000	4,000
E1 P 30040102 001 Design and Procurement Costs	1.0	LS	3,000	1,000	4,000
E1 P 31 Construction Management	1.0	LS	3,300	700	4,000
E1 P 3101 Supervision and Administration	1.0	LS	3,300	700	4,000
E1 P 310101 Project Office S&A	1.0	LS	1,500	350	1,850
E1 P 31010101 Project Office Operations	1.0	LS	1,300	300	1,600
E1 P 31010101 001 Daily Contract Oversite	1.0	LS	1,300	300	1,600
E1 P 31010102 Project Office Other S&A	1.0	LS	200	50	250
			200.00		250.00
E1 P 31010102 001 Other Daily Contract Oversite	1.0	EA	200	50	250
E1 P 310102 Area Office S&A	1.0	LS	500	50	550
E1 P 31010201 Area Office Other S&A	1.0	LS	500	50	550
E1 P 31010201 001 Project Coordination	1.0	LS	500	50	550
E1 P 310103 District Office S&A	1.0	LS	1,300	300	1,600
E1 P 31010303 District Office Other S&A	1.0	LS	900	200	1,100
E1 P 31010303 001 Budgetary Documents	1.0	LS	900	200	1,100
E1 P 31010301 Technical Management by Construction	1.0	LS	200	50	250
E1 P 31010301 001 Claims Management Documents	1.0	LS	200	50	250
E1 P 31010302 Technical Manager	1.0	LS	200	50	250
E1 P 31010302 001 Upward Reporting Documents	1.0	LS	200	50	250
00 Plant Maintenance	1.0	LS	129,611	32,403	162,014
00 C Construction Cost	1.0	LS	129,611	32,403	162,014
00 C 06 Fish and Wildlife Facilities	1.0	LS	129,611	32,403	162,014
			129,610.84		162,013.55
00 C 0603 Wildlife Facilities and Sanctuaries	1.0	EA	129,611	32,403	162,014
00 C 060373 Habitat and Feeding Facilities	1.0	LS	129,611	32,403	162,014
00 C 06037302 Site Work	1.0	LS	129,611	32,403	162,014

Description	*Quantity*	*UOM*	*ContractCost*	*Contingency*	*ProjectCost*
			4,276.34		5,345.42
00 C 06037302 001 Landscape Maintenance, Shrub Swale	*8.0*	*MO*	*34,211*	*8,553*	*42,763*
			4,879.01		6,098.76
00 C 06037302 002 Landscape Maintenance, Pole & Shrub	*8.0*	*MO*	*39,032*	*9,758*	*48,790*
			3,523.00		4,403.75
00 C 06037302 003 Landscape Maintenance, Saltgrass Meadow	*8.0*	*MO*	*28,184*	*7,046*	*35,230*
			3,523.00		4,403.75
00 C 06037302 004 Landscape Maintenance, Shrub Stand	*8.0*	*MO*	*28,184*	*7,046*	*35,230*

APPENDIX D

SECTION 404(b)(1) EVALUATION

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DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT FOR AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO

Section 404 (b)(1) Evaluation

I. Project Description

a. Location: Rio Grande channel, Pueblo of Santa Ana Indian Reservation, Sandoval County, New Mexico. The project is located between 1.2 and 3.2 river-miles upstream from the US Highway 550 bridge over the Rio Grande near Bernalillo. Sections 16, 17 & 20; Township 13 North; Range 4 East.

b. General Description: Six sandbars (encompassing approximately 62 acres) would be lowered in surface elevation to increase their inundated area and frequency. Soil material would be removed from a uniform depth at each bar to preserve the existing variation in topography. The excavation depth varies among the bars from 1.0 to 2.2 feet. Additional features such as submerged berms, small channels, and embayments would be incorporated into the design to enhance slackwater areas over a range of discharges. All excess excavated material would be removed from the site; scraped material could be stockpiled on site for a short period (e.g., 24 hours). The deposition area for all spoil waste material would be along the upland margin of Jemez Canyon Reservoir, approximately 3 miles from the project area. If other suitable upland disposal sites closer to the work area should be identified by the Pueblo of Santa Ana prior to construction, these alternative sites would be used only if they are devoid of significant ecological and cultural resources.

c. Authority and Purpose: The proposed project would be implemented by the Corps and the Pueblo of Santa Ana under the authority of Section 1135(b) of the Water Resources Development Act of 1986 (Public Law 99-662), as amended. The purpose of the project is to improve riparian and aquatic ecosystem functions which have been degraded due, in part, to the construction and operation of Corps dams upstream from the project area. Specifically, the purpose of the features subject to Section 404 regulation is to improve aquatic habitat conditions for native fish species within the Rio Grande channel.

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material (grain size, soil type): Gravelly sand (alluvium).

(2) Quantity of Material (cu. yds.): Approx. 170,588 cubic yards (106 acre-feet).

(3) Source of Material: *In situ*.

e. Description of the Proposed Discharge Site

(1) Location (map): See Plates 1, 2 and 3 in the Detailed Project Report.

(2) Size (acres): Excavation activities encompass up to 62 acres, of which approximately 55 acres is below the OHWM (defined as the 2-year recurrence discharge of 5,400).

(3) Type of Site: Unconfined

(4) Type(s) of Habitat: Riverine Unconsolidated Shore, Temporarily Flooded (unvegetated) = approx. 39 acres; Riparian Salt Cedar (sparse), Intermittently Flooded = approx. 33 acres. (USFWS, NWI mapping, 2003.)

(5) Timing and Duration of Discharge: Overbank Lowering activities would occur within the period November 2008 through March 2009 when flows are lowest (approximately 200 - 1,400 cfs) in the Rio Grande.

f. Description of Disposal Method (hydraulic, drag line, etc.): Material will be removed or relocated using excavators, scrapers, or bulldozers.

II. Factual Determination (Section 231.11)

a. Physical Substrate Determinations (consider items in Sections 230.11 (A# and 230.20)

(1) Substrate Elevation and Slope: Elevation of overbank would be reduced 1 to 2.2 feet (and therefore wetted more frequently). Channel slope would not be affected.

(2) Sediment Type: Some finer material (silt drapes, etc.) would be removed, but would redevelop in the snowmelt runoff period following construction.

(3) Dredged/Fill Material Movement: Not applicable.

(4) Physical Effects on Benthos (burial, changes in sediment type, etc.): As a result of sandbar lowering, the benthic area may increase to slightly.

(5) Actions Taken to Minimize Impacts (Subpart H): Work would be performed during the annual low-flow period, and only on exposed sandbars outside of the wetted channel. Erosion control fences would be employed around temporary stockpile locations.

b. Water Circulation, Fluctuation and Salinity Determinations

(1) Water (refer to sections 230.11(b), 230.22 Water, and 230.25 Salinity Gradients; test specified in Subpart G may be required). Consider effects on:

(a) Salinity: No effect.

(b) Water Chemistry (Ph, etc.): No effect.

(c) Clarity: No effect.

(d) Color: No effect.

(e) Odor: No effect.

(f) Taste: No effect.

(g) Dissolved Gas Levels: No effect.

(h) Nutrients: No effect.

(i) Eutrophication: No effect.

(2) Current Patterns and Circulation (consider items in sections 230.11 (b), and 230.23), Current Flow and Water Circulation

(a) Current Patterns and Flow: Due to lowering of the elevation of overbanks, the percent of discharge within the overbank areas (at 5,400 cfs) would increase by approx. 62%.

(b) Velocity: Overall velocity would not change; however, the acreage of low-velocity (<1 fps) areas would increase by approx. 50%.

(c) Stratification: No effect.

(d) Hydrologic Regime: All 62 acres would be inundated more frequently following construction. Approximately 10 to 15 acres of Intermittently Flooded areas would become Temporarily Flooded.

(3) Normal Water Level Fluctuations: No effect.

(4) Salinity Gradients: No effect.

c. Suspended Particulate/Turbidity Determinations

(1) Expected changes in suspended particulates and turbidity levels in vicinity of disposal site: Bed material within the channel is primarily coarse sand and gravel with only a small percentage of suspendable fine particles. Based on previous work within the channel in this reach by the Corps and the Bureau of Reclamation, the increase in turbidity due to the proposed activities would be negligible. The initial reflooding of lowered sandbars would only slightly increase turbidity downstream due to the presence of fines in the disturbed area. This temporarily elevated turbidity would be similar to, or less than, levels occurring annually in the Rio Grande during the spring runoff period.

(2) Effects (degree and duration on Chemical and Physical properties of the water column (consider environmental values in section 230.21, as appropriate)

(a) Light Penetration: No effect.

(b) Dissolved Oxygen: No effect.

(c) Toxic Metals and Organics: No effect.

(d) Pathogens: No effect.

(e) Aesthetics: No effect.

(f) Others as Appropriate: No effect.

(3) Effects on Biota (consider environmental values in sections 230.21, as appropriate)

(a) Primary Production, Photosynthesis: No effect.

(b) Suspension/Filter Feeders: No effect.

(c) Sight Feeders: No effect.

d. Contaminant Determinations (consider requirements in section 230.11 (d): Prior to the start of work, the substrate would be analyzed for concentrations of metals and potential contaminants to verify that the material is suitable for disposal.

e. Aquatic Ecosystem and Organism Determinations (use evaluation and testing procedures in Subpart G, as appropriate)

(1) Effects on Plankton: No effect.

(2) Effects on Benthos: A slight increase in benthic area would result.

(3) Effects on Nekton: No effect.

(4) Effects on Aquatic Food Web (refer to section 230.31): The increase of shallow, low-velocity areas as a result of the project would improve habitat for red shiner, western mosquitofish, fathead minnow, Rio Grande silvery minnow, and longnose dace.

(5) Effects on Special Aquatic Sites (discuss only those found in project are or disposal site)

(a) Sanctuaries and Refuges (refer to section 230.40): Not applicable.

(b) Wetlands (refer to section 230.41): Not applicable.

(c) Mud Flats (refer to section 230.42): Not applicable.

(d) Vegetated Shallows (refer to section 230.43): Not applicable.

(e) Coral Reefs (refer to Section 230.44): Not applicable.

(f) Riffle and Pool Complexes (refer to section 230.45): Not applicable.

(6) Threatened and Endangered Species (refer to section 230.30): By design, the project would beneficially affect the Federally endangered Rio Grande silvery minnow. Preferred habitat of the minnow (depth less than 2 feet and velocity less than 1 foot per second) would increase in availability by about 50%.

(7) Other Wildlife (refer to section 230.32): No effect.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination (consider factors in section 230.22(f)(2))

(2) Determination of compliance with applicable water quality standards (present the standards and rationale for compliance or non-compliance with each standard)

(3) Potential effects on human use characteristic

(a) Municipal and Private water supply (refer to section 230.50): No effect.

(b) Recreational and commercial fisheries (refer to section 230.51): Not applicable.

(c) Water related recreation (refer to section 230.52): No effect.

(d) Aesthetics (refer to section 230.53): No effect.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and similar preserves (refer to section 230.54): Not applicable.

g. Determination of Cumulative Effects on the Aquatic Ecosystem (consider requirements in section 230.11(g)): In concert with similar restoration projects (e.g., near Los Lunas, I-40 in a Albuquerque, Alameda Bridge), the project would cumulatively improve habitat for the Rio Grande silvery minnow.

h. Determination of Secondary Effects on the Aquatic Ecosystem (consider requirements in section 230.11(h)): No effect.

III. Findings of Compliance or Non-Compliance with the restrictions on discharge

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation: None.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge site which would have less adverse impact on the aquatic ecosystem: Alternatives evaluated included three depths of excavation within the overbank area. The selected depth was determined to be the most cost-effective solution.

c. Compliance with applicable State Water Quality Standards: The project is local on Tribal lands. State of New Mexico standards downstream from the project area would not be violated.

d. Compliance with applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act: Not applicable.

e. Compliance with Endangered Species Act of 1973: The Corps has determined that the project may affect, but would beneficially affect, the endangered Rio Grande silvery minnow and will request concurrence on this determination from the USFWS in informal consultation pursuant to Section 7 of the Endangered Species Act.

f. Compliance with specified protection measures for marine sanctuaries designated by the Marine Protection, Research and Sanctuaries Act of 1972: Not Applicable

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant adverse effects on human health and welfare:

(a) Municipal and private water supplies: No effect.

(b) Recreation and commercial fisheries: Not applicable.

(c) Plankton: No effect.

(d) Fish: Improvement of habitat for several native fish species.

(e) Shellfish: No effect.

(f) Wildlife: No effect.

(g) Special Aquatic sites: Not applicable.

(2) Significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems

(3) Significant adverse effects on aquatic ecosystem diversity, productivity and stability

(4) Significant adverse effects on recreational, aesthetic, and economic values

h. Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem: Work would be performed during the annual low-flow period, and only on exposed sandbars outside of the wetted channel. Erosion control fences would be employed around temporary stockpile locations.

i. On the basis of the guidelines, the proposed disposal site(s) for the discharge of dredged or fill material is specified as complying with the requirements of these guidelines

FINDING OF COMPLIANCE
FOR
AQUATIC HABITAT RESTORATION AT SANTA ANA PUEBLO, NEW MEXICO
(Section 1135)

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The planned disposal of dredged material at site two would not violate any applicable State of Tribal water quality standards.

3. Use of the selected disposal site will not harm any endangered species or their critical habitat.

4. The Proposed disposal of dredged material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur.

5. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include working only on exposed, dry substrates during low-flow periods; and employing erosion control fencing around temporary stockpile areas.

6. On the basis of the guidelines the proposed disposal site for the discharge of dredged material is specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

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