RECLAMATION

Managing Water in the West

Pecos River Supplemental Water Project

Environmental Assessment

U.S. Department of the Interior
Bureau of Reclamation
Albuquerque Area Office
Environment Division
Albuquerque, New Mexico

August 2009

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Front Cover Photo – Pecos River looking downstream from Acme Gage, NM; 11/17/06.
Courtesy of Tomas Stockton

Pecos River Supplemental Water Project

Environmental Assessment

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United States Department of the Interior
Bureau of Reclamation
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Abstract

The US Department of the Interior, Bureau of Reclamation is proposing to acquire up to 2,500 acre-feet (af) of water annually for ten years from Fort Sumner Irrigation District (FSID). FSID would provide this water through forbearance of existing priority rights. The acquired water would be stored in Sumner Lake as Carlsbad Project water. Reclamation would also execute an agreement with the Carlsbad Irrigation District (CID) stating that any water acquired by Reclamation that is stored in Sumner Lake or Santa Rosa Reservoir would be released to meet flow targets in the Pecos River. This change of operations would not in any way affect the supply of water available to the Carlsbad Project. The supplemental water and agreements with FSID and CID would allow Reclamation the flexibility to meet target flows and keep the Pecos River continuous consistent with Reclamation's 2006 Record of Decision for the Carlsbad Project Water Operations and Water Supply Conservation Environmental Impact Statement (June 2006) and the 2006-2016 Biological Opinion for the federally threatened Pecos bluntnose shiner *(Notropis simus pecosensis)* (shiner). Based on the analysis, the proposed action would not result in any significant impacts to the environment.

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List of Acronyms and Abbreviations

µS/cm	micro-Siemens per centimeter
AF	Acre-foot or AF
APE	Area of potential effects
AWA	Additional water acquisition
AWN	Additional water need
BA	Biological Assessment
Block Release	High-volume, high velocity releases of water from a dam
BO	Biological opinion
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CID	Carlsbad Irrigation District
CIR	Consumptive irrigation requirements
Compact	Pecos River Compact
Corps	US Army Corps of Engineers
CPWA	Carlsbad Project Water Acquisition
EA	Environmental Assessment
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCP	Fish conservation pool
FEIS	Final Environmental Impact Statement
FONSI	Finding of No Significant Impact
FSID	Ft. Sumner Irrigation District
ITA	Indian trust Assets
NEPA	National Environmental Policy Act
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMISC	New Mexico Interstate Stream Commission
NMOSE	New Mexico Office of the State Engineer
NMWQCC	New Mexico Water Quality Control Commission
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
Reclamation	Bureau of Reclamation
ROD	Record of Decision
TDS	Total Dissolved Solids
Service	US Fish and Wildlife Service
shiner	Pecos bluntnose shiner *(Notropis simus pecosensis)*
USC	United State Code
USGS	United States Geological Survey

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Chapter 1: Purpose of and Need for Action

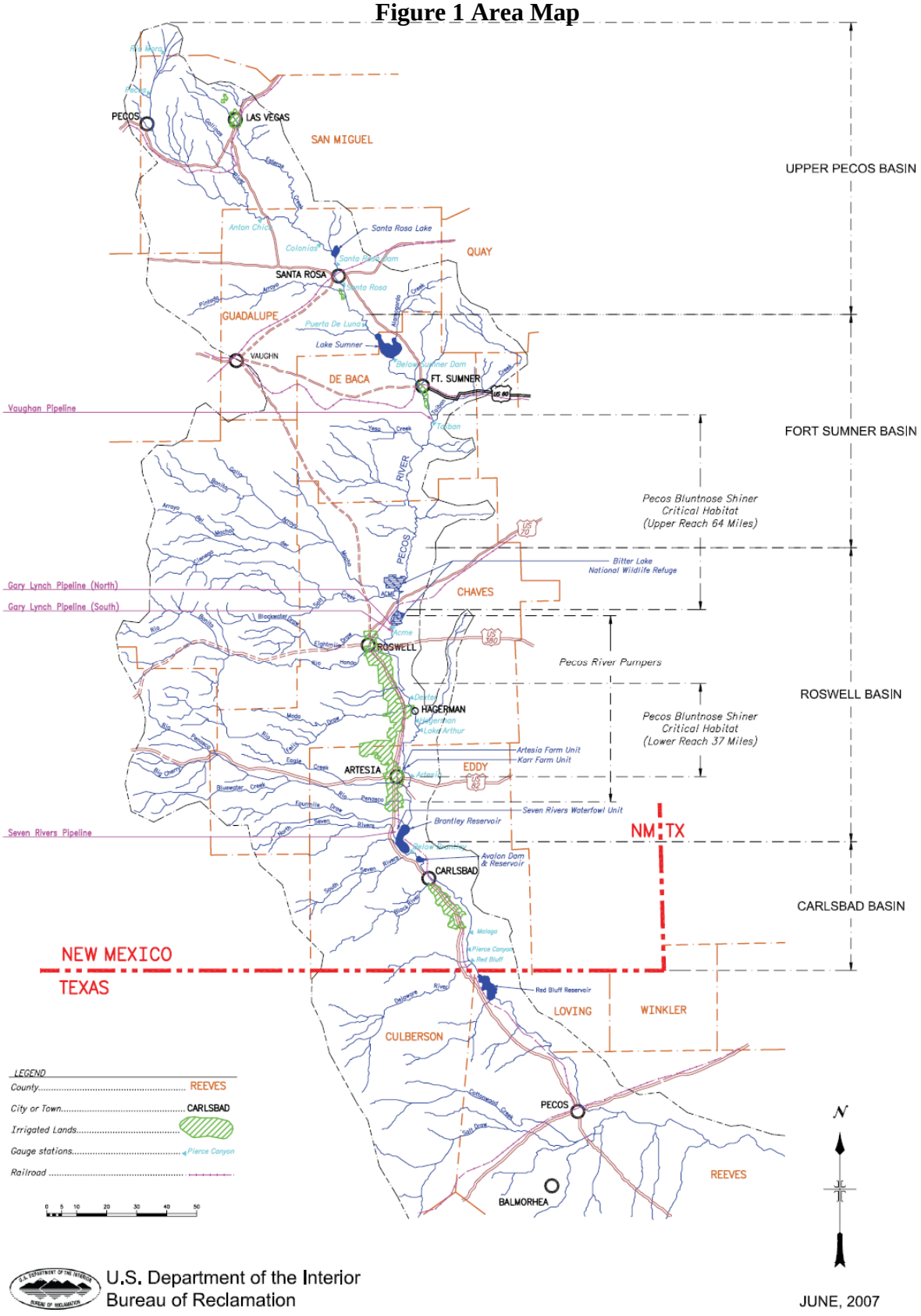
Introduction

This Environmental Assessment (EA) has been prepared by the US Department of the Interior, Bureau of Reclamation (Reclamation) to evaluate the environmental and socioeconomic impacts from proposed actions to obtain supplemental water within the Pecos River Basin in eastern New Mexico. The primary supplemental water source would be obtained through a 10-year contract between Reclamation and the Fort Sumner Irrigation District (FSID) in which Reclamation would acquire up to 2,500 acre-feet (AF) of water annually from FSID. FSID would provide this water through forbearance of priority water rights. The acquired water would be stored in Sumner Lake as Carlsbad Project water. Reclamation would also execute an agreement with the Carlsbad Irrigation District (CID) that any water acquired by Reclamation that is stored in Sumner Lake or Santa Rosa Reservoir will be released to meet flow targets in the Pecos River. This change of operations would not in any way affect the supply of water available to the Carlsbad Project. As part of these operations, Reclamation would continue to use the existing 1,000 AF fish conservation pool (FCP) at Sumner Lake and would acquire and pump water into Brantley Reservoir to replace any depletions to Carlsbad Project water supplies from the change in dam operations. These agreements would allow Reclamation the flexibility to obtain and manage supplemental water to meet the requirements of the Endangered Species Act (ESA) of 1973 (16 United States Code [USC] Section 1531 et seq.) and the Carlsbad Project. The proposed action is described in detail in Chapter 2.

Background

The Pecos River has its headwaters in the Sangre de Cristo Mountains in northern New Mexico. It meanders 500 river miles southward across the eastern part of the state until it crosses into Texas south of Carlsbad, New Mexico. From the Texas border, the river winds another 400 miles to its confluence with the Rio Grande near Langtry, Texas. The total drainage area at its confluence with the Rio Grande is approximately 33,000 square miles, with 19,000 square miles within New Mexico. The Pecos River system in New Mexico includes three major reservoirs: Santa Rosa Reservoir, Sumner Lake, and Brantley Reservoir. A fourth smaller reservoir (Avalon) just south of Brantley Reservoir is used by the CID for staging and diverting Brantley Reservoir releases (Figure 1).

Figure 1 Area Map



The Pecos River Basin supports irrigation and critical habitat for the Pecos bluntnose shiner. The proposed project would add supplemental water to the river upstream of the upper reach of critical habitat.

In July 2006, Reclamation issued a Record of Decision (ROD) for the Carlsbad Project Water Operations and Water Supply Conservation Final Environmental Impact Statement (FEIS) (Reclamation 2006a). The ROD mandated changes in water operations within the Pecos River in order to conserve the federally threatened Pecos bluntnose shiner (*Notropis simus pecosensis*) (shiner) and its designated critical habitat, while conserving the Carlsbad Project water supply. Specifically, Reclamation established a target flow of 35 cubic feet per second (cfs) as measured at the Taiban gage (Pecos River Below Taiban Creek Ft. Sumner, NM, USGS gage number 08385522), committed to maintain and pursue enlarging a previously permitted 500-AF FCP at Sumner Lake, and identified a range of actions to acquire water to meet flow requirements, replace any new depletions and to keep the Carlsbad Project water supply whole. Reclamation's decision is also protective of the federally endangered interior least tern (*Sternula antillarum athalassos*).

As part of the consultation process under the ESA, the US Fish and Wildlife Service (Service) issued a Biological Opinion (BO) (2006 – 2016) on the selected alternative from the FEIS (US Fish and Wildlife Service 2006; Reclamation 2006a). During ESA consultation, Reclamation committed to keep the river continuous by maintaining target flows of 35 cfs at the Taiban gage and 5-10 cfs at Acme gage. The non-jeopardy BO relies on this commitment, and to remain in compliance, Reclamation must ensure that the river does not experience intermittency between Sumner Dam and Brantley Reservoir (US Fish and Wildlife Service 2006).

Because changes in Carlsbad Project operations from historic operations to benefit the shiner would result in reduction to the available Carlsbad Project water supply, Reclamation must acquire supplemental water to keep the project whole. A variety of options for acquiring water was considered in the FEIS. Likewise, a variety of additional upstream water sources to directly benefit the shiner were identified, including the use of an enlarged FCP in Sumner Lake and/or Santa Rosa Reservoir. Reclamation subsequently applied for and received a permit from the State of New Mexico Office of the State Engineer (NMOSE) to store an additional 500 AF of water in the FCP, bringing the existing FCP to 1,000 AF, in the Fall of 2006.

In November 2006, Reclamation conducted public scoping, including meetings in Carlsbad and Ft. Sumner, to collect public comments and to help identify supplemental sources (Reclamation 2006b). In the Spring of 2007, Reclamation determined that some supplemental water actions were not defined enough for analysis; however, action was needed to ensure that the river remained continuous during the 2007 irrigation season. To meet its commitments, Reclamation proposed to enter into a long-term lease of groundwater rights near Ft. Sumner owned by the New Mexico Interstate Stream Commission (NMISC), to be conveyed to the Pecos River through the Vaughan pipeline (Figure 1). Reclamation entered into a long-term lease from 2007 through 2032 with the NMISC for these groundwater rights. Reclamation will annually lease a minimum

of 1,100 AF and up to a maximum of 2,564.26 AF of water, as needed, depending on river flow conditions. Reclamation issued an EA and Finding of No Significant Impact (FONSI) on this action in July 2007 (Reclamation 2007; available at: http://www.usbr.gov/uc/albuq/envdocs/index. html).

This EA is prepared pursuant to the National Environmental Policy Act of 1969 (NEPA), as amended; the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) 1500-1508); the Department of the Interior's NEPA Implementing Procedures (516 DM 1-15); and Reclamation's NEPA Handbook. In accordance with CEQ regulations (parts 40 CFR 1500.4(i), 1502.20, 1502.21, and 1508.28), Reclamation guidance, and the Paperwork Reduction Act of 1995, this EA is tiered to the Carlsbad Project Water Operations and Water Supply Conservation FEIS and incorporates relevant data and findings of the environmental impact statement (EIS) by reference. Tiering is defined by CEQ as a procedure that allows an agency to avoid duplication of paperwork through the incorporation by reference of the general discussions and relevant specific discussions from an EIS of broader scope into a document of lesser scope without duplication of the analysis prepared for the EIS (CEQ NEPA's 40 Most Asked Questions). The EIS is available upon request for review and may be viewed online at: http://www.usbr.gov/uc/albuq/envdocs/index.html.

Need for the Action

Reclamation needs to obtain supplemental water in order to have the operational flexibility to comply with the 2006-2016 BO for the selected alternative of the Carlsbad Project Water Operations and Water Supply Conservation FEIS, June 2006. The BO and FEIS commit Reclamation to operate the Carlsbad Project with a target flow of 35 cfs at the Taiban Gage and target flow of 5-10 cfs at the Acme Gage, thus keeping the river continuous in order to conserve the federally protected Pecos bluntnose shiner. Operation of the existing 1,000-AF FCP in Sumner Lake has proven to be an effective tool to allow Reclamation to control water releases to meet flow requirements. However, more water is needed to provide the reliability and flexibility to prevent river drying under a wide range of climatic conditions.

Purpose for the Action

The purpose of the project is to provide adequate water to allow Reclamation the operational flexibility to meet target flows and to keep the river continuous, while keeping the Carlsbad Project Water supply whole. The goal is to begin providing additional supplemental water to the Pecos River system during the 2009 irrigation season. Therefore, supplemental water sources should readily be available, be able to be applied above the critical habitat, have the capacity to provide "wet" water to the proposed storage pool and the system, and require minimal infrastructure investments.

Relevant Statutes, Regulations, and Other Plans

Reclamation's activities on the Pecos River are guided by a number of laws, agreements, and authorizations as detailed in the Carlsbad Project Water Operations and Water Supply Conservation FEIS (Reclamation 2006a). Examples include the Reclamation Act of June 12, 1902, the Carlsbad Project Authorization, Hope Decree of 1933, Pecos River Compact of 1948 (Compact), and the 1988 Texas v. New Mexico U.S. Supreme Court Amended Decree. Likewise, any actions taken as part of this supplemental water program will have to comply with all applicable laws and regulations. Table 1 lists required consultations, compliance actions, and permits that may be required to implement supplemental water options.

Table 1
Required Consultations, Compliance Actions, and Permits

Consultation/Permit	Agency/ Organization	Description
ESA (Section 7 consultation)	U.S. Fish and Wildlife Service	Consultation under Section 7 of ESA is required to determine if the project will adversely affect threatened or endangered species or designated critical habitat.
Permits pursuant to Sections 402, 404 of the Clean Water Act	U.S. Army Corps of Engineers (Corps) (also reviewed by the Service and the New Mexico Environment Department)	Section 404 permitting may be required for options that involve construction or discharge of material into wetlands and other waters of the U.S. National Pollutant Discharge Elimination System (Section 402) permitting may be required for options that require discharge.
Section 106, National Historic Preservation Act Compliance	New Mexico Historic Preservation Division (State Historic Preservation Office)	Reclamation is required to consult with the State Historic Preservation Office regarding the effects of the project on historic properties (sites eligible for listing on the National Register of Historic Places) and to mitigate any adverse effects on these sites. The Section 106 process provides the Advisory Council on Historic Preservation the opportunity to comment on adverse effects on historic properties.
Permits for water storage, place of use, or point of diversion	New Mexico Office of the State Engineer	Project actions, such as any water acquisition options, may require permits to change water storage, type of use, place of use, or points of diversion.

Reclamation and other federal, state, and local agencies are conducting other projects and NEPA evaluations in the Pecos River basin relevant to the proposed action. These activities are summarized below. The cumulative impacts of these activities and other relevant past, present, and reasonably foreseeable projects in the region are described in Chapter 4.

- **Pecos River Settlement Agreement.** The NMISC, CID, Reclamation, and the Pecos Valley Artesian Conservancy District (PVACD) executed a settlement agreement on March 25, 2003. Among other provisions, the settlement agreement is designed to ensure that New Mexico meets its interstate delivery obligation to Texas under the Compact. The settlement agreement includes an acquisition program that authorizes the NMISC to purchase up to 6,000 acres of land and water rights in the CID and up to 12,000 acres of land and water rights upstream of Brantley Dam, which includes the PVACD and the FSID. Land retirement is anticipated to increase base flows in the river to help state line deliveries to Texas. The settlement was finalized in June 2009.

- **Resource Management Plan Amendment and EA for Federal Mineral Leasing and Development at Brantley and Avalon Reservoirs.** Reclamation is preparing a plan amendment and EA to the existing resource management plan for lands around Brantley and Avalon Reservoirs, including those administered by Reclamation and CID. The plan will identify the lands within the project area that will be subject to the proposed stipulations and made available for oil and gas development through leasing, and what requirements or stipulations are needed to manage those lands and protect other resource values. The proposed RMPA would affect only those lands currently identified as containing Unleased Federal Minerals, or about 16 percent of the project area, as well as any lands within the project area that in the future will contain Unleased Federal Minerals (e.g., expired leases).

- **Mitigation Activities for Brantley Reservoir.** Reclamation has a number of ongoing actions that serve as mitigation measures for the construction and operation of Brantley Reservoir.

- **Pecos River Channel Restoration at Bitter Lake National Wildlife Refuge (NWR).** Reclamation and the Service are conducting restoration actions to correct or improve degraded ecological conditions and create fish habitat for the shiner within the Bitter Lake NWR section of the Pecos River. Degradation has been caused by excavating straight channels, encroaching nonnative vegetation, and reservoir control of flows.

- **Carlsbad Project Vegetation Management Program.** Reclamation has prepared a five-year draft programmatic EA and biological assessment (BA) for the purpose of performing research and demonstration using integrated methods (herbicides, biological, and mechanical) on saltcedar to determine effective methods of control and rehabilitation while monitoring. Saltcedar is considered a noxious species. Research and demonstration work is conducted on Carlsbad Project land in the vicinity of Brantley and Avalon Reservoirs.

- **New Mexico Saltcedar Control Project.** The New Mexico Department of Agriculture (NMDA) coordinates state-funded nonnative phreatophyte control programs through local soil and water conservation districts along the Pecos River. This project primarily has used aerial spraying to kill saltcedar along the river banks in the hope of reducing the water loss associated with this invasive species through transpiration. The New Mexico Non-Native Phreatophyte/Watershed Management Plan (NMDA 2005) includes recommendations for saltcedar control, revegetation, rehabilitation, monitoring, and long-term maintenance throughout the state and specifically in the Pecos River Basin. The proposed restoration actions in this EA are compatible with the management plan and past efforts by the state to remove nonnative riparian species.

- **Pecos River Basin Water Salvage Project.** This project is a Reclamation-funded project to control saltcedar growth from the Sumner Dam area to the New Mexico-Texas state line. Reclamation began clearing saltcedar in 1967 and continued until 1971, during which time about 53,950 acres were cleared at various locations between Sumner Lake, New Mexico, and Pecos, Texas, a distance of about 370 miles. The clearing program began again in 1995 without the participation of Texas, and since then, the program has been limited to maintaining 33,000 cleared acres in New Mexico in cooperation with the CID.

- **Lower Pecos Valley Regional Water Plan.** There are ongoing regional planning efforts overseen by the NMISC to develop information, analysis, and documentation to address the region's available water supply and its means of meeting future demand. This planning is done at the regional level, bringing together such stakeholders as elected officials, public agencies, private citizens, and representatives of private industry. A part of the regional water planning effort is to compile and analyze information on water quantity and quality in their regions and to project population growth for 40 years. The objectives of the regional water plans are to answer questions about the water supply and the projected water requirements and to present a plan for meeting regional water requirements. Regional planning is intended to reflect the water-related goals and the knowledge of the public and the governing bodies of the region. The Lower Pecos Valley Water planning region includes Chaves County, Eddy County, and portions of De Baca, Lincoln, and Otero Counties. The plan encourages the study and implementation of riparian management, watershed management, and conservation programs in the Pecos River Basin.

Public Involvement and Issue Identification

Public scoping was conducted to solicit public input on the proposed action and to identify specific issues. Scoping began on October 30, 2006, with the publication and distribution of a project newsletter (*River Notes*). The newsletter was mailed out to over 120 people, including tribes, agencies, organizations, and individuals that are known to have an interest in water issues in the Pecos River basin. The newsletter provided an overview of the proposed project, announced the location and dates of two scoping meetings, and provided contact information. While Reclamation is collecting comments throughout the EA process, the public was encouraged to submit scoping comments by December 1, 2006, to help with issue identification and alternative development. No written comments were received.

Public scoping meetings were held on November 15, 2006, at Stevens Inn in Carlsbad, New Mexico, and on November 16, 2006, at the Community House in Ft. Sumner, New Mexico. Seven people attended the meeting in Carlsbad, and 10 attended in Ft. Sumner. Newspaper advertisements announcing the scoping meetings and soliciting public comments were published in the *Artesia News* (November 9, 2006) and the *Carlsbad Current- Argus* (November 8, 2006).

From the meetings, 13 unique comments were expressed, focusing on the following four issues. A detailed listing of the comments received is provided in the Pecos River Supplemental Water Project Scoping Report (Reclamation 2006b).

- Authorities and accounting for storing and exchanging water: Reclamation must ensure it has the authorities and correct accounting, including those administered by the State and CID, for storing and exchanging water;

- Handling of excess stored water annually ("carryover") in Sumner Lake: Carrying over excess water between years could provide additional flexibility in providing water for the fish, but should not infringe on the storage of CID;

- Supplemental water options; and

- BO and ensuring conformance with the ESA requirements.

Reclamation sent out letters in November 2007, to interested parties seeking any additional input for the EA and conducted periodic meetings with various stakeholders, including the Service, CID, FSID, NMDGF, and NMISC, to keep them updated in the process. A working draft EA was provided to interested stakeholders in February 2008 for their review and input. Comments were received from the Service, the Corps, NMISC, and PVACD.

Chapter 2: Alternatives

Introduction

This chapter provides an overview of the components and timing of the proposed action and a discussion of the activities that would take place if Reclamation takes no action (No Action Alternative). Other alternatives that were considered but dropped from detailed consideration are also presented, along with the rationale for not carrying them forward for more study. Table 2 provides a summary of the various components of the proposed action and the No Action Alternative, along with other alternatives that were considered.

Table 2
Summary of Alternatives Considered

Water Sources and Operations	Current Activities (No Action)	Proposed Action	Considered But Eliminated
Existing FCP at 1,000 AF	✓	✓	
Leases with river pumpers	✓	✓*	
Long-term lease with NMISC for water at the Vaughan pipeline	✓	✓	
Long-term contract with FSID for up to 2,500 AF per year		✓	
Agreement with CID on dam operations and management		✓	
Trans-basin diversions			✓
Modified FSID pump back program			✓
Remove 2,500 AF minimum pool requirement at Sumner Lake			✓

*Leases would be renewed on a case-by-case basis as they expire.

Description of the Alternatives

Proposed Action

Reclamation is proposing to acquire supplemental water and enter into agreements with FSID and CID to provide the operational ability to release water out of Sumner Lake and/or Santa Rosa Reservoir in order to meet a target flow of 35 cfs at the

Taiban Gage and to keep the river continuous, while also ensuring that the Carlsbad Project is kept whole. The primary supplemental water source would be obtained through a 10-year contract agreement between Reclamation and the FSID. Under the contract, FSID would provide 25,000 AF of water to Reclamation over a 10-year period. If 25,000 AF are not delivered within the 10-year period, then the agreement would be extended for enough time to provide for the full delivery. While there are no fixed minimum annual amounts that FSID would have to provide, it is expected that FSID would annually provide up to 2,500 AF of water to Reclamation.

FSID holds a water right with a priority date of March 18, 1903, to divert 100 cfs from the natural flow of the Pecos River during the months of March through October, and for two eight-day periods during the winter months. Reclamation currently bypasses the District's water through Sumner Lake and Sumner Dam based on two-week allotments calculated by the State Engineer, not exceeding 100 cfs. Under the contract, FSID would forebear exercising their priority water rights; therefore, by New Mexico state law, water would not be bypassed but would instead be stored in Sumner Lake as Carlsbad Project water. As part of this agreement, FSID would consult with the Service under the ESA (Section 10) for their activities on the Pecos River (US Fish and Wildlife Service 2006 - Section VIII, Conservation Recommendation 12).

Reclamation would also execute an agreement with the CID stating that any water acquired by Reclamation (e.g., FSID forbearance), will be released to meet flow targets for the ESA. Also, the agreement would cover water that is acquired by Reclamation and permitted by the NMOSE for exchange from Brantley to Sumner (e.g., current FCP). The acquired water would be used in the same manner as the FCP and would occur when scheduling a block release is infeasible, when bypass water is not available or insufficient to meet demand, and when pumping from the Vaughan Pipeline is consumed completely or is insufficient to meet demand.

FSID would agree not to divert any water that is released to benefit the shiner unless the water is needed to increase the head for the FSID main canal. In this case, FSID would return the same amount of diverted water to the river at the sand gate weir.

The agreement between FSID and Reclamation would provide for the parties to pursue transfer of title of any Fort Sumner Project facilities (e.g., diversion dam) held by the US to the district and to seek relief from the remaining payment obligation under an existing contract, subject to congressional authorization. The agreement would provide payments to FSID by Reclamation to cover FSID's annual repayment obligation until such time as debt relief is granted by Congress. Separate and specific NEPA compliance documentation would be conducted prior to any transfer of title unless exempted by Congress. Reclamation is seeking to sign the agreement with FSID and implement the action during the 2009 irrigation season.

Reclamation would continue to maintain and use the existing 1,000 AF FCP and would continue to pursue similar exchange water within the basin. Under the ROD for the Carlsbad Project Water Operations and Water Supply Conservation EIS, Reclamation established a 500-AF FCP, and in the Fall of 2006, Reclamation obtained a permit from the NMOSE to increase the FCP to 1,000 AF. Reclamation would continue fallowing approximately 180 to 360 acres of land with groundwater rights at Seven Rivers so that appurtenant water can be pumped into Brantley Reservoir in exchange for releases of up to 1,000 AF of water from Sumner Lake. Reclamation currently has agreements and permits in place to support the exchange. Under the agreement with CID, Reclamation would replace any depletion to the Carlsbad Project water supply resulting from modifications of Santa Rosa or Sumner dams or from other water acquisition efforts.

Likewise, Reclamation would continue leasing water from the NMISC for water at the Vaughan pipeline, and on a case-by-case basis, Reclamation would maintain existing leases of groundwater rights and surface water rights from river pumpers.

No Action Alternative

Under the No Action Alternative, Reclamation would not enter into a 10-year contract with FSID for supplemental water. Reclamation would continue to implement actions within its discretion to comply with the ROD and BO. The ROD provides a variety of tools to allow Reclamation to adaptively meet the BO requirements. These actions, however, generally require short-term agreements and do not provide long-term flexibility. During dry years, the lack of operational flexibility and potential lack of sufficient water sources could result in the river going intermittent. If this were to occur, Reclamation would no longer have ESA compliance and would need to reinitiate consultation with the Service and obtain a new BO that would include new requirements.

For the purposes of conducting hydrological modeling to evaluate the magnitude of impacts between alternatives, the following conditions are assumed:

1. Reclamation would maintain the existing 1,000-AF FCP by continuing to fallow approximately 360 acres of land at Seven Rivers in order to pump 750 AF of water into Brantley in exchange for the FCP water.

2. Reclamation would continue to lease groundwater rights and pump up to 900 AF from the Vaughan pipeline into the river per year.

3. Reclamation would continue to enter into short-term leases with river pumpers to leave water in the river to help make up for net depletions to the Carlsbad Project caused by bypass operations. The amount and timing varies by year, so historical averages are assumed.

Alternatives Considered but Eliminated from Further Study

Trans-Basin Diversions

During scoping, trans-basin diversions were brought up as a possible supplemental water source, specifically from the Canadian River basin. Reclamation determined that while this was an option, the infrastructure requirements, time to implement, and potential environmental impacts made it impractical for the purpose and need for this project. Trans-basin diversions were also considered and dismissed by the Water Offset Options Group convened to develop water acquisition options for the Carlsbad Project Water Operations and Water Supply Conservation EIS.

Modified FSID Pump Back Program, Remove Minimum Pool, and Other Options

Reclamation also considered a number of other less defined options and will pursue them further if support from stakeholders to agree to the actions is obtained. These included, but are not limited to, having FSID modify the pump back program, removing the 2,500 AF minimum pool requirement at Sumner Lake, modifying the currently permitted FCP, and establishing a exchange of water rights at Karr Farms.

Discussion of Preferred Alterative

Reclamation has selected the proposed action as its preferred alternative because it would provide a long-term and reliable source of supplemental water to meet the stated purpose and need.

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Chapter 3: Affected Environment

Introduction

Scope of Analysis

This section describes the current condition and trends of resources that may be affected by the proposed action. The information in this EA is tiered to and derived primarily from the information in the Carlsbad Project Water Operations and Water Supply Conservation FEIS (Reclamation 2006a), the 2006-2016 BO (US Fish and Wildlife Service 2006), the Long-term Miscellaneous Purposes Contract FEIS (Reclamation 2006c), the Long-term Lease of Groundwater Rights EA (Reclamation 2007), and site-specific studies for the Seven Rivers areas and for the Vaughan Pipeline (NMISC 2007; Reclamation 2007b). Information from these documents is incorporated by reference and is not repeated here unless needed to clarify discussions, to meet a legal requirement, to provide site-specific detail, or to address changes in the resource baseline. Each aspect of the environment that would be affected by the proposed action is discussed to the level of detail commensurate with the potential for environmental impact. The greatest potential for impacts would be to water resources and biological resources, specifically the shiner. Other resources discussed in this chapter include recreation, cultural resources, Indian trust assets, and environmental justice.

Acquiring and storing supplemental water and entering into agreements with FSID and CID would have negligible or no effect on air quality, noise, safety and human health, visual resources, and socioeconomics.

Study Area

Because the proposed action would allow flexibility in changes to river inflows and reservoir storage, there would be potential for minimal effects on water resources, biology, and riparian habitat throughout the Pecos River system (Figure 1).

Water Resources

Climatic and Geomorphic Setting

The Pecos River Basin is generally considered to be semi-arid, with an average rainfall in the Ft. Sumner area of 14 inches annually. Precipitation exhibits a distinct seasonality. In late fall and winter, lower-intensity precipitation typically associated with frontal storms enter the study area from the west and northwest. Weather patterns in July and August are characterized by scattered high-intensity thunderstorms that occur nearly daily, triggered by convective heating of a moisture-laden atmosphere. The moisture during the summertime “monsoon” season results from the atmospheric circulation from the Gulfs of Mexico and California to the

south. Air temperatures vary within the region depending on location, but the basin is characterized by a high rate of evaporation due to wind and low humidity. Springtime is the most consistently windy season.

From Santa Rosa Dam to Sumner Lake, the Pecos River floodplain is mostly incised into bedrock canyons of varying width and up to 300 feet deep. From Sumner Dam to Brantley Reservoir is a broad valley that was a relatively treeless, dry flood plain before the 1900s. Today, the lower valley, from the Near Acme gage to Brantley Reservoir, is covered by farm fields, and the flood plain includes mostly nonnative invasive species, although there are ongoing efforts by several agencies to eliminate them.

Irrigation Districts

Major irrigation districts diverting surface waters from the Pecos River within the study area include FSID and CID. FSID diverts directly from the Pecos River from a diversion dam approximately 15 river miles downstream of Sumner Dam. The farm fields in the district are located on the east side of the Pecos River several miles below the diversion dam. FSID irrigates approximately 6,000 acres out of 10,000 acres authorized by its diversion right, which is a direct flow right of the natural river flows up to 100 cfs during the irrigation season (Reclamation 2006a). FSID also has the right to divert up to 100 cfs for two eight-day periods during the non-irrigation season. According to USGS gage records at the FSID Main Canal, FSID has historically diverted an average of 38,200 AF per year (Reclamation 2007). Under the proposed action, FSID would forbear up to 2,500 AF per year of their diversion right per year. This water would be stored in Sumner Lake and put into Carlsbad Project supplies. This forbearance would mostly come from FSID's non-irrigation season entitlement, during periods when the diversion works are shut down from excessive rainfall, or during periods when agricultural consumptive use is low (such as the early spring and late fall).

CID has, under contract, four storage dams owned and operated by Reclamation as part of the Carlsbad Project. Santa Rosa Reservoir, Sumner Lake, Brantley Reservoir, and Avalon Reservoir provide storage for irrigation water used to irrigate about 25,000 acres within CID, which is located near the city of Carlsbad, NM. CID annually irrigates only approximately 20,000 acres of the 25,055 authorized by the Carlsbad Project because of fallowing, rotation, and permanent improvements (Reclamation 2006a). CID has historically diverted an average of 76,000 AF per year according to USGS gage records at the CID Main Canal (2007b). Currently, CID exchanges 1,000 AF/year of FCP water in storage in Sumner Reservoir with Reclamation for 750 AF/year of exchange water pumped into Brantley at Seven Rivers.

Operational Priorities

Flood control is the foremost operational priority on the Pecos River; however, floods requiring regulation are relatively infrequent in the Pecos River system. Irrigation deliveries of Carlsbad Project water to Brantley Reservoir (and eventually Avalon reservoir) through block releases for use by the CID and bypass of FSID

entitlement through Sumner Dam for diversion at FSID's diversion dam are next in priority to flood control. A "bypass" of water is defined as inflow to Sumner Lake that is allowed to flow through the reservoir for irrigation (such as FSID's diversion right) or for augmenting the instream flow for the shiner. Bypasses of Carlsbad Project supplies through Sumner Dam when available (such as during the non-irrigation season) for augmenting river flows for the shiner are next in priority. Following bypasses for the shiner, pumping from the NMISC's Vaughan Pipeline under Reclamation's long-term water leasing agreement with the NMISC is next in priority for mechanisms for keeping the Pecos River continuous for the shiner. FCP releases are a last effort in the chain of priority for keeping the river continuous and are used when bypasses cannot be used and scheduling a block release is not permissible with the exception of emptying the FCP at the end of the calendar year in order to utilize any leftover FCP storage completely. Since the FCP agreement with CID is on a "use or lose" basis annually, FCP storage is used in lieu of bypassing starting at the end of the irrigation season (November 1st). Otherwise if the storage is not used, it is reset at the end of the calendar year and Reclamation is allotted a new FCP for the new calendar year (effectively losing access to that water allotted in the previous calendar year). Leftover FCP storage is used in lieu of bypassing since FCP storage depletions are paid for up front by an exchange with CID at Seven Rivers; in contrast, bypassing depletion is paid back with Carlsbad Project Water Acquisition (CPWA), of which the unused portion of CPWA is credited and is not lost if left unused. This means that leaving an unused portion of the FCP at the end of the year is a wasted resource, but using this unused portion of the FCP in lieu of bypassing allows for it to be credited in the form of CPWA.

The FCP is used when scheduling a block release is infeasible, when bypass water is not available or is insufficient to meet demand, and when pumping from the Vaughan Pipeline is consumed completely or is insufficient to meet demand. If water leasing is insufficient to cover target demands for keeping the river continuous, FCP releases and water leasing may be used in tandem for this purpose. Also, if bypass water is available to meet some water demands, water leasing and FCP releases in that respective priority may be used to supplement bypasses.

Streamflows in the study area are derived from two primary sources: snowmelt runoff from the headwaters of the Pecos River in the Sangre de Cristo mountain range and monsoon (and other event) rainfall in the study area. To a lesser extent, groundwater inflows from mountain front recharge infiltrating into the Roswell and Capitan Reef aquifers, and subsequently discharging into the Pecos River, also contribute to streamflows in the study area. For a synopsis of streamflows in the entire study area, please refer to the Water Resources section in Chapter 3 of the Carlsbad Project Water Operations and Water Supply Conservation FEIS (Reclamation 2006a). For the purpose of this document, examination of streamflows is most important at the Near Acme gage, since this area is critical in determining whether flow in the Pecos River is continuous. Although targets are usually specified at the Taiban gage, the Pecos River does not go dry in this location, so the Near Acme gage is used for evaluating intermittency. Figure 2 is a flow duration curve,

which depicts the percentage of time that historic (or modeled) flow rates met or exceeded a given flow rate at the Near Acme gage for nearly the entire period of record at the gage (with the exception of 2007 provisional data), and Figure 3 depicts historic intermittency at the gage for the same time-period.

Figure 2
Flow Duration at the USGS near Acme Gage for the Historic Period of Record (7/1937 through 12/2006)

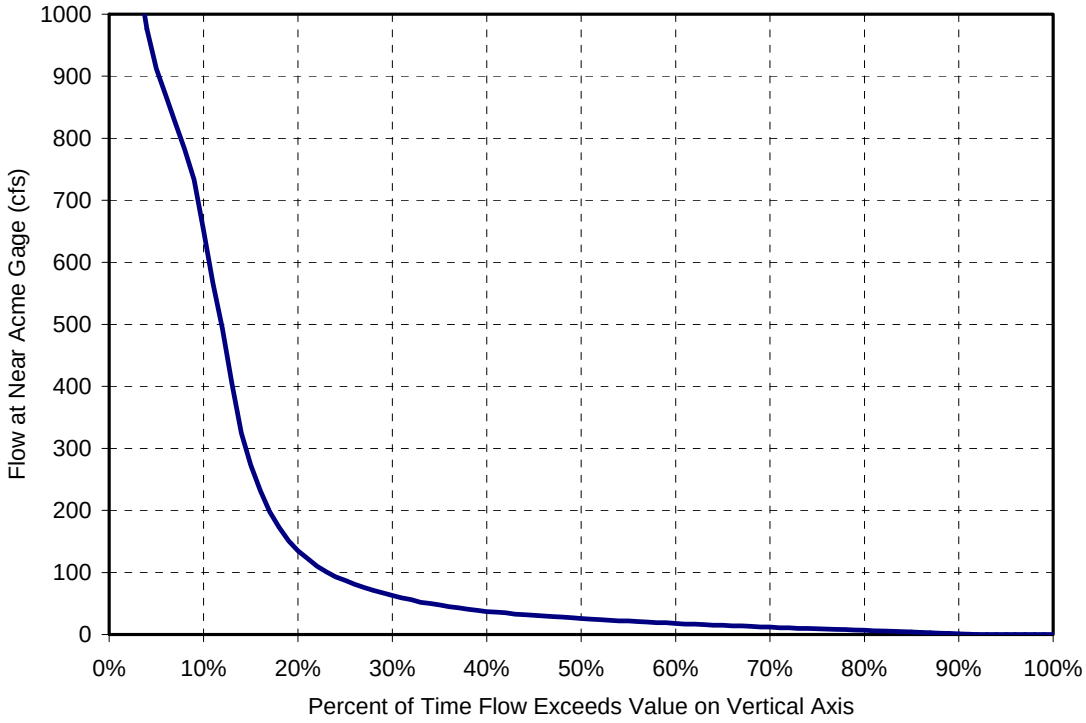
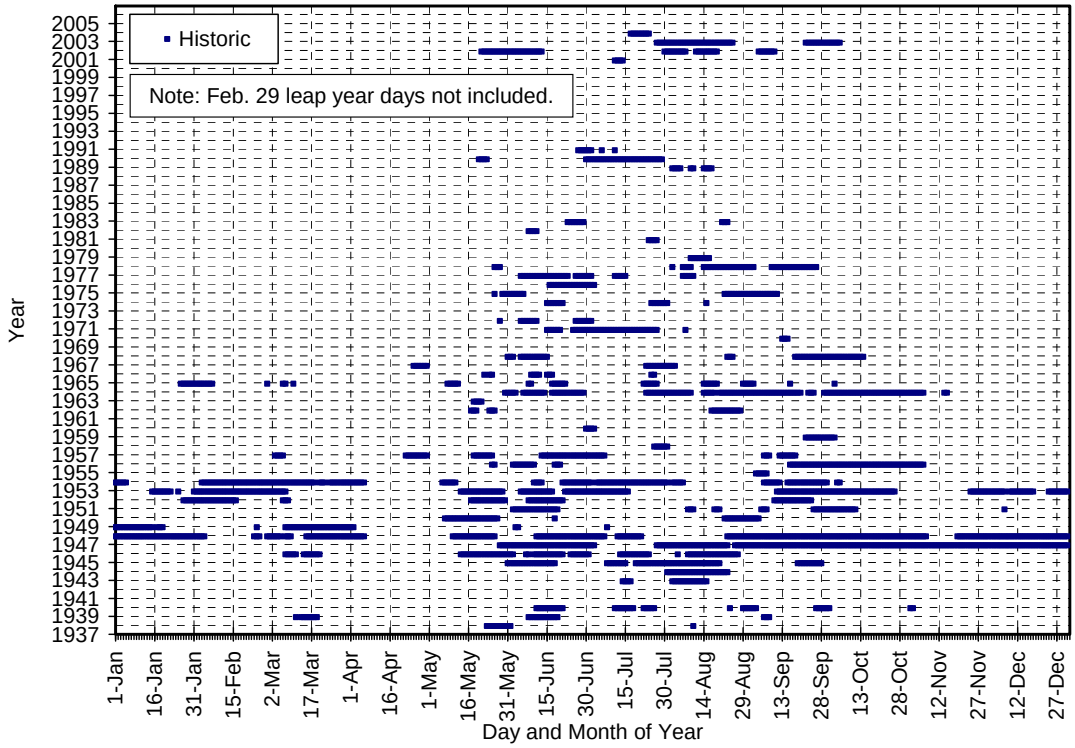


Figure 3
Historic Periods when Intermittency Occurred at the USGS Near Acme Gage (7/1937 through 12/2006)



Reservoir Storage

Four reservoirs are located within the study area on the mainstem of the Pecos River—Santa Rosa Reservoir, Sumner Lake, Brantley Reservoir, and Avalon Reservoir. With the exception of the existing 1,000-AF FCP, all of the reservoir storage is utilized for irrigation within the Carlsbad Project. Including the FCP, the maximum allowable entitlement storage or "conservation storage" for the Carlsbad Project is 176,500 AF. This maximum storage is divided among the four reservoirs depending on sedimentation levels in all four reservoirs (Reclamation 2006a). Table 3 contains pertinent information about the reservoirs, including purpose, conservation storage limits, total storage, ownership, year completed, and minimum pool (Reclamation 2006a).

Although Brantley Reservoir has a maximum conservation storage of 40,000 AF, it also exhibits additional storage because of its direct connection with the Major Johnson aquifer, which is a large aquifer at the southern boundary of the Roswell Basin Artesian aquifer. This additional storage for reservoirs is often referred to as "bank storage". The estimated total conservation storage for Brantley Reservoir including bank storage is close to 63,000 AF. Since approximately 10,000 AF of water still remains in the banks at the minimum storage of 2,000 AF, roughly 13,000 AF of this extra storage is available to the Carlsbad Project.

Table 3
Pecos River Reservoirs

Reservoir	Purpose(s)	Ownership	Year Completed	Allowable Conservation Storage Space[1] (AF)	Total Storage Capacity[2] (AF)	Minimum Pool (AF)
Santa Rosa	Flood control, irrigation, and sediment retention	Corps	1980	92,500	442,595	0
Sumner	Irrigation and flood control	Reclamation	1937	40,134	94,455	2,500
Brantley	Irrigation and flood control	Reclamation	1988	40,000	380,565	2,000
Avalon	Irrigation	Reclamation	1907	3,866	3866	600

[1] Excludes minimum pool and sediment accumulation
[2] Top of flood pool; accounts for sedimentation using latest surveys; does not include flood surcharge space.

Reservoir Evaporation

Reservoir evaporation is significant in the study area since all of the reservoirs are located in the semi-arid desert climate of Eastern New Mexico. Pecos River RiverWare modeling indicates that average annual evaporation from these four reservoirs is around 45,000 AF/year. Some reservoirs experience lower average annual evaporation rates per unit area because of their physical location in Eastern New Mexico. Typically, temperatures increase from upstream to downstream along the Pecos River, so it follows that evaporation rates also increase. Santa Rosa has the lowest average annual unit evaporation rate at 68 inches per year, Sumner averages 84 inches per year, and Avalon and Brantley Reservoirs experience an average of 89 inches per year (Reclamation 2006a).

Unit evaporation is not the only parameter affecting total reservoir evaporation. The amount of storage contained in a reservoir compared to the amount of surface area exposed to the atmosphere is also important. This comparison can be expressed as a ratio of reservoir storage amount to the corresponding reservoir surface area for that storage amount. Ratios are dependent on the particular geometry (or bank storage effect) in the reservoir at a given storage level. A comparison of ratios at the conservation limit of each reservoir is as follows. Santa Rosa is most efficient at 26 AF of storage to one acre of reservoir water surface exposed to the atmosphere. Brantley Reservoir is second most efficient, which is somewhat attributable to its large bank storage capacity, with a ratio of 19 to 1. Sumner is third most efficient at 15 to 1, which is mostly due to the sedimentation that has accumulated in the

reservoir over many years and its resultant shallow depth compared to Santa Rosa and Brantley. Avalon is least efficient with a ratio of 5 AF of storage per acre of exposed reservoir water surface.

Reservoir storage is an important concept in understanding depletions from the Pecos River System, and it is also a key parameter in net depletions or changes to the Carlsbad Project's water supply due to changes in river operations. Changing river operations can affect storage levels and detention times at reservoirs, which ultimately affects the amount of evaporation that occurs within them.

Groundwater

Groundwater in the study area includes two major confined aquifers and a shallow unconfined aquifer underlying the entire mainstem of the Pecos River within the study area. The two major confined aquifers include the carbonate aquifer in the Roswell Artesian Basin and the Capitan Reef Complex, which is a large arc-shaped aquifer underlying most of the Carlsbad area that stretches east into West Texas. Both the shallow and the confined aquifers are linked to the Pecos River.

Water Quality

Impaired waters and salinity are generally the two biggest factors in water quality in the study area. The four reservoirs and five river reaches within the Pecos River study area are listed as impaired waters (Reclamation 2006a). Four of the river reaches are listed as impaired primarily due to nutrient loading not supporting a typical warm water fishery (New Mexico Water Quality Control Commission [NMWQCC] 2004). Reservoirs are listed as impaired, and probable causes listed include mercury found in fish tissue, nutrient/eutrophication biological indicators, and sediment/siltation (NMWQCC 2004).

Salinity is primarily an issue for irrigation, since high salinity can stunt crop growth or possibly even result in plant mortality. Salinity is typically measured as Total Dissolved Solids (TDS), but is often approximated using Electrical Conductivity (EC). Waters in the Pecos River study area are governed by TDS standards. Although the standards have not been exceeded (Reclamation 2006a), salinity remains an issue for CID. EC (and subsequently TDS) generally increases from upstream to downstream in the study area. Median EC measurements range from less than 1,000 micro-Siemens per centimeter (µS/cm) above Santa Rosa to over 6,000 µS/cm at Artesia and over 4,000 µS/cm downstream of Brantley Reservoir (Reclamation 2006a). Generally, irrigation water stored in Santa Rosa and Sumner Reservoirs does not exhibit a high enough concentration of TDS to stunt or kill crops; however, Brantley Reservoir has known water quality problems at times mostly from upstream irrigation return flows that tend to increase TDS. These TDS increases occur as low discharge (~100 cfs or less) enters the reservoir from the Pecos River. CID sometimes uses block releases, large blocks of water (>1,000 cfs) with low TDS, to dilute the concentration of TDS in Brantley Reservoir (Reclamation 2006a). Groundwater is also known to generally increase in salinity in the upstream to downstream direction in the Pecos River study area (Reclamation 2006a).

Golden algae (*Prymneslum pervum*) is an extreme detriment to water quality in the study area. Golden algae blooms have recently been found in Brantley Reservoir, in the downstream reaches of the Pecos River from Brantley Reservoir to the State Line, and as far upstream in the Pecos River as Roswell (NMED 2007). Recurring blooms of golden algae have caused extensive fish kills in Brantley Reservoir and in downstream portions of the Pecos River (NMDGF 2007). Nitrogen rich stormwater runoff can cause an imbalance in nitrogen and phosphorus levels in the water, subsequently causing a toxic bloom. Control of toxic blooms of golden algae is uncertain, and it is anticipated that further spread upstream in the Pecos River is impossible for the organism, since salinity is too low in this part of the study area (NMED 2007).

Biological Resources

Wildlife and Habitat

A detailed discussion of the wildlife and habitat along the Pecos River and reservoirs is found in the Carlsbad Project Water Operations and Water Supply Conservation FEIS (Reclamation 2006a). This habitat supports a wide variety of birds, mammals, amphibians, and reptiles.

Generally, small-bodied fishes dominate the riverine fish community in the Pecos River; however, other aquatic species, including reptiles and amphibians, are also dependent upon Pecos River flows. Approximately 30 miles downstream from the Sumner Dam, the Pecos River enters a broad alluvial plain. Between Fort Sumner and Roswell, the river is more typical of a Plains stream, with a relatively wide channel and a shifting sand substrate. Shallow runs and braided channels are prevalent, and there are small wetlands along the river and in oxbows. This reach provides the necessary habitat components for the shiner and other aquatic species but has been subject to intermittency when base inflows are low and are diverted.

Changes to water levels and quality in the reservoirs are expected to have negligible effects on reservoir fisheries, wildlife, and habitat; therefore, they are not discussed in detail here.

Threatened, Endangered and Special Status Species

Special status species are those listed as threatened or endangered under provisions of the ESA; those proposed or considered as candidates for such listing; and those considered as rare or species of concern by the Service, NMDGF, and New Mexico Energy, Minerals and Natural Resources Department, Forestry Division. The ESA grants listed species protections from harassment, harm, or destruction of habitat.

There are over 65 sensitive status species known to occur in Guadalupe, DeBaca, Chaves, and Eddy Counties. Of these, the only federally protected species that is likely to be impacted by the proposed action is the Pecos bluntnose shiner (*Notropis simus pecosensis*).

The shiner is a state and federally threatened species. It is a small fish that is native to the Pecos River in New Mexico. The shiner was first collected in 1874 in the Rio Grande of New Mexico (Federal Register 52(34): 5295-5303). The Service designated the shiner as a federally threatened species, with critical habitat, in 1987 under the ESA. At the time of listing, the Service identified the "most important factors in the species' decline as reduced flow in the main channel of the river because of water storage, irrigation, and water diversion" (Federal Register 52(34): 5295- 5303).

Habitats utilized by this species are characterized by sand substrate, low water velocities (0 to 2.9 ft/sec.), and water depths of 0.5 to 47 inches (Hoagstrom 2002). An analysis of mesohabitat use found the Pecos bluntnose shiner utilized perpendicular plunge and parallel plunge habitats located mid-channel, and actively avoided run and flat habitat types (Kehmeier et al. 2004). This species has an extended spawning season, beginning in early summer and ending by October (Sublette et al. 1990).

There is scientific consensus that maintenance of a dynamic sand bed channel with low-velocity areas (0 to 2.9 ft/sec.) and avoidance of intermittency are essential elements of shiner habitat. Reclamation has committed to avoiding intermittency in the current range of the shiner by maintaining a river flow target of 35 cfs at Taiban Gage (US Fish and Wildlife Service 2006). The ongoing drought, combined with the continued demands on the river for irrigation and compact deliveries to Texas, may be putting additional strain on the genetic diversity of the remaining population and thus the long-term survival of the shiner.

Designated critical habitat for the shiner is divided into two reaches. The boundary of the upper critical habitat is located near the confluence of Taiban Creek and extends downstream to Crockett Draw. The lower critical habitat reach is from Hagerman to Artesia. The upper critical habitat has a wide sandy river channel with only moderately incised banks and provides habitat suitable for all age classes. The lower critical habitat is deeply incised, has a narrow channel, and has a compacted bed. Although the lower critical habitat has permanent flow, the habitat is less suitable for shiners, and only smaller size classes are common in this reach. Lack of growth, reduced survival, and reduced recruitment in this reach is attributed to poor habitat conditions and the periodic downstream displacement of eggs, larvae, and small juveniles.

Recreation

The affected environment for recreation includes the recreational opportunities that exist along the Pecos River. A detailed discussion of the attendance, use, and expenditures associated with recreation is found in the Carlsbad EIS (Reclamation 2006a).

Santa Rosa Reservoir is approximately seven miles north of Santa Rosa, NM. The primary purposes of Santa Rosa Reservoir include flood control, irrigation, and

sediment retention. In addition, limited benefits result from recreational use and fish and wildlife propagation. Facilities for activities such as boating, camping, fishing, hiking, picnicking, sailing, water-skiing, and wildlife–viewing are available at Santa Rosa Reservoir State Park. Fishing is encouraged, but quality can vary depending on water level; low levels result in poor fishing success.

Sumner Lake is on the Pecos River about 16 miles north of Fort Sumner. Sumner Lake is used primarily for irrigation, but recreation opportunities are available at Sumner Lake State Park. Visitor use in the summer is affected by extreme water levels below or above the conservation pool (Reclamation 2006a). Changes to water levels at Brantley and Avalon Reservoirs are expected to be negligible, and recreation at these reservoirs is not discussed here.

Cultural Resources

This section identifies cultural resources that may be affected by the proposed action. The affected environment for cultural resources includes the existing water channels or active flood zones of the Pecos River corridor.

Cultural resources include past and present expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, districts, natural features, and biota, which are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices, and are associated with community values and institutions. Historic properties are a subset of cultural resources that meet specific eligibility criteria found at 36 CFR 60.4 for listing on the National Register of Historic Places (NRHP).

Cultural resources have been organized into prehistoric resources, historic resources, and traditional cultural properties. These types are not exclusive, and a single cultural resource may have multiple components. Prehistoric cultural resources refer to any material remains, structures, and items used or modified by people before Europeans arrived in New Mexico in the late 16th century. Historic cultural resources include material remains and the landscape alterations that have occurred since the arrival of Europeans in the region. Traditional cultural properties are places associated with the cultural practices or beliefs of a living community. These sites are rooted in the community's history and are important in maintaining cultural identity. Examples of traditional cultural properties for Native American and Hispanic communities include natural landscape features, places used for ceremonies and worship, places where plants are gathered to be used in traditional medicines and ceremonies, places where artisan materials are found, and places and features of traditional subsistence systems, such as community-maintained irrigation systems and traditionally used fields, grazing areas, and firewood-gathering sites.

A detailed cultural setting and site record search for the Pecos River basin is included in the cultural resource technical report of the Carlsbad Project Water Operations and Water Supply Conservation FEIS (Reclamation 2006a). The affected environment for cultural resources is identified as the area of potential effects (APE), as described in the National Historic Preservation Act (36 CFR 800.16). The APE is defined as the geographic area within which federal actions may directly or indirectly cause alterations in the character or use of historic properties. Because the proposed action only involves the lease and delivery of water, the APE for cultural resources for the proposed changes in water operations includes existing water channels or active flood zones. No additional construction, ground disturbance, control and delivery infrastructure, or new land abandonment is proposed. The additional forbearance water will utilize existing storage facilities. Cultural resources, primarily archaeological sites, bridges, and water storage, control, and delivery infrastructure are located in the existing water channels and active flood zones. No traditional cultural properties have been identified in the Pecos River Basin during tribal consultations conducted for the Carlsbad FEIS (Reclamation 2006a). Letters describing the range of supplemental water proposals were sent to representatives of twelve tribes and Native American pueblos on January 22, 2007 (See Chapter 6). No traditional cultural concerns have been identified to date.

Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in assets held in trust by the United States through the Department of the Interior, Bureau of Indian Affairs, for Indian tribes or individual Indians. This trust responsibility requires that all federal agencies, including Reclamation, ensure their actions protect Indian Trust Assets.

"Assets" are anything owned that has monetary value. The asset need not be owned outright but could be some other type of property interest, such as a lease or a right-of-way. They can be real property, physical assets, or intangible property rights. Common examples of trust assets may include lands, minerals, hunting and fishing rights, water rights, other natural resources, and money. "Legal interest" means there is a primary interest for which a legal remedy, such as compensation or injunction, may be obtained if there is improper interference. Trust assets do not include things in which a tribe or individual have no legal interest, such as off-reservation sacred lands in which a tribe has no legal property interest. It should be noted that other federal laws pertaining to religious or cultural laws should be addressed if impacts to such lands were to occur from Reclamation actions.

No issues involving Indian Trust or specific ITAs were identified in the Pecos River Basin during the preparation of the Carlsbad EIS (Reclamation 2006a). Letters regarding the range of supplemental water proposals were sent to representatives of twelve tribes and Native American pueblos on January 22, 2007 (See Chapter 6). No ITA issues have been identified to date.

Environmental Justice

An evaluation of environmental justice impacts is mandated by Executive Order 12898 on Environmental Justice (February 11, 1994). Environmental justice addresses the fair treatment of people of all races and incomes with respect to Federal actions that affect the environment. Fair treatment implies that no group of people should bear a disproportionate share of high and adverse human health and environmental impacts from a federal action.

The impacts of an action can be considered disproportionately distributed if the impacts imposed on a specific group are greater than the percentage of the total population represented by that group. A group is typically defined by race, ethnicity, income class, or community identity. Evaluating potential environmental justice concerns requires an understanding of where the project impacts are likely to occur and where potentially affected groups are located. The analysis relies on demographic data from sources such as the U.S. Census Bureau, individual counties and municipalities, and local school districts to determine the location of different groups of people. Census demographic data and state economic development figures are typically the most complete and comparable information available for individuals and households. Demographic data compiled from the Census Bureau sources for the EIS are repeated here in Table 4.

Table 4
Population of Study Area by Race and Hispanic Ethnicity

Race and Hispanic Origin	Chaves County		De Baca County		Eddy County		Guadalupe County		Four-county Region	
	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total
White	44,167	72.0	1,882	84.0	39,438	76.3	2,530	54.1	88,017	73.4
Black or African American	1,209	2.0	1	0.0	805	1.6	62	1.3	2,077	1.7
American Indian and Alaskan Native	694	1.1	21	0.9	646	1.3	53	1.1	1,414	1.2
Asian	323	0.5	5	0,2	231	0.4	25	0.5	584	0.5
Native Hawaiian and Other Pacific Races	34	0.1	0	0,0	47	0.1	2	0.0	83	0.1
Other Race	13,042	21.2	281	12.5	9,129	17.7	1,828	39.1	24,280	20.2
Two or More Races	1,913	3.1	50	2.2	1,362	2.6	180	3.8	3,505	2.9
Hispanic or Latino (can be of any race)	26,904	43.8	790	35.3	20,023	38.8	3,801	81.2	51,518	42.9

The annual per capita income for the State of New Mexico in 2005 was $27,889. The 2005 per capita personal income by county is as follows: Chaves County: $24,880, DeBaca County: $22,565, Eddy County: $29,983, and Guadalupe County: $16,455 (Reclamation 2006a).

These data indicate that the distribution of population by race and ethnicity is similar for each of the study area counties, except for Guadalupe County, which has a very large percentage of residents who identify themselves as of "other race" and ethnically Hispanic. Race is considered by the U.S. Census Bureau to be a separate concept from Hispanic origin (ethnicity). People who identify their origin as Spanish, Hispanic, or Latino may be of any race. The per capita income of Guadalupe County is much lower than the rest of the counties in the study area and the state as a whole.

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Chapter 4: Environmental Consequences

Water Resources

The following indicators were used to evaluate water resources for the alternatives. A detailed definition for each of these indicators is provided in Appendix A.

- Flow duration or frequency at the Near Acme gage, or the amount of time that a certain flow has occurred at the Near Acme gage; and intermittency, which is the amount of time that zero flow has occurred at the Near Acme gage.
- Additional water need (AWN), or the amount of additional water required to satisfy the target demand of 35 cfs at the Taiban gage or a continuous river, which from average model loss relationships is defined as 2 cfs at the Acme gage in summer months.
- Carlsbad Project water supply, which is measured as the shortfall amount due to the project as a consequence of the proposed action, sometimes referred to as the net depletion to the Carlsbad Project water supply.
- Pecos River flows at the New Mexico-Texas state line, which is measured as the change in the amount of flow at the state line.
- Changes to Compact delivery obligation due to alternative operations affecting Sumner Reservoir outflows.
- Groundwater withdrawals, increases or decreases in groundwater withdrawals due to water leasing actions.
- Water quality impacts, qualitative impacts to the Pecos River and reservoirs considering water leasing agreements and changes in operations.

Hydrologic modeling was conducted to evaluate the majority of these indicators quantitatively. Appendix A provides an overview of the modeling methods and alternative modeling elements. In summary, the model assessed a prior to 1991 (pre-91) baseline condition, a no action condition, and the proposed action. A pre-91 baseline is used for modeling because it provides consistent conditions and water operations prior to a period of changes in water operations to address Pecos bluntnose shiner concerns. For the proposed action, two operational scenarios were developed to assess how the river might respond to two different FSID forbearance schedules.

No Action Alternative

Modeling results for the No Action Alternative are presented in this section (Figures 4 and 5). Flow duration and intermittency are presented along with remaining AWN, Carlsbad Project water supply, state line flows, compact obligations, groundwater withdrawals, and water quality.

Figure 4
Modeled Flow Duration at the Near Acme Gage Showing Pre-91 Baseline and No Action Results

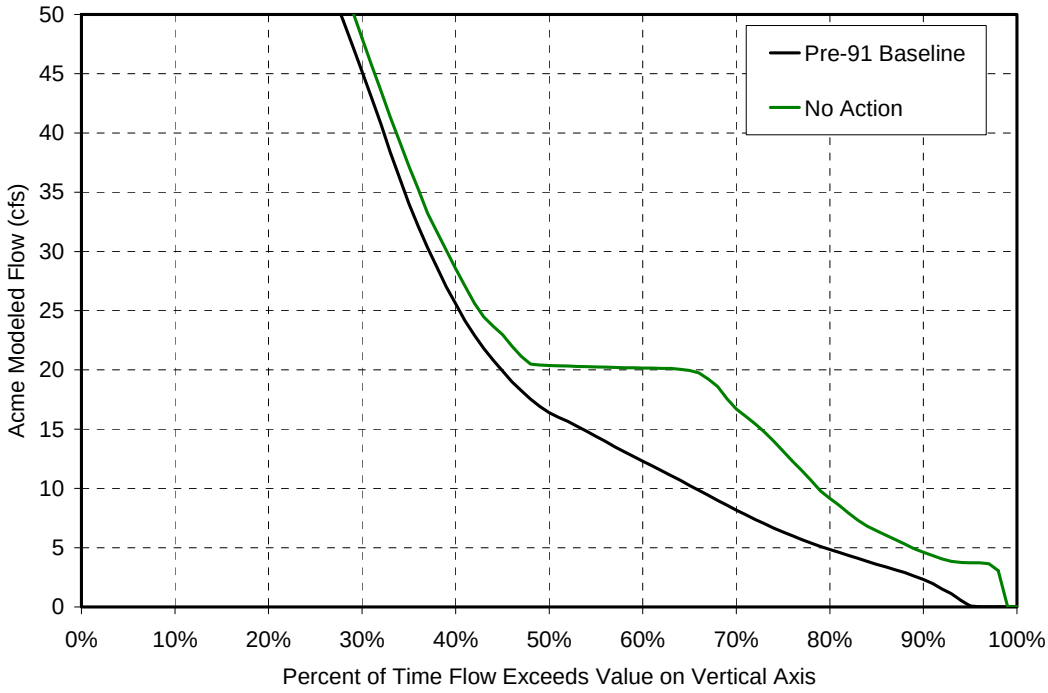
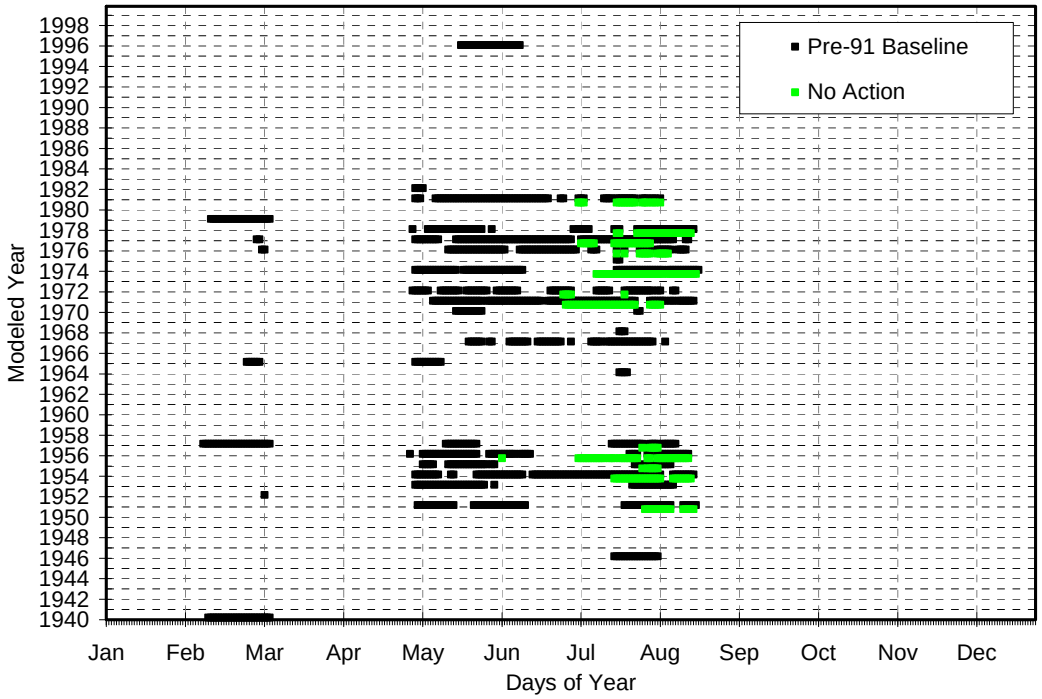


Figure 5
Modeled Intermittency at the Near Acme Gage Showing Pre-91 Baseline and No Action Results (*bars denote times when intermittency occurred*)



No Action Flow Duration and Intermittency

From Figure 4, it is apparent that bypassing for a constant target of 35 cfs at the Taiban gage benefits Pecos River flow at the Near Acme gage (note plateau at 20 cfs—this is due to constant inflow that is available for bypass through Sumner Lake during the non-irrigation season). See the FEIS (Reclamation 2006a) for further information concerning bypassing to augment Pecos River flow. Also note from the plot that the supplemental water sources put in place to date (Vaughan water lease of 1,100 AF per year and the FCP of 1,000 AF per year) in conjunction with bypassing reduces the amount of intermittency, an improvement from 5 percent to 1 percent. The days of modeled intermittency depicted in Figure 5 indicate that winter bypassing eliminates all of the intermittency occurring in the non-irrigation season and that supplemental water nearly eliminates intermittency during the late-spring and early-summer months when comparing the No Action results with pre-91 baseline results. See the Long-term Lease of Ground Water Rights EA (Reclamation 2007) for further information on use of the Vaughan water lease to augment Pecos River flow.

No Action Remaining Additional Water Needs (AWN)

Table 5 indicates the original and remaining AWN for meeting the constant target of 35 cfs at Taiban. Since 35 cfs at Taiban in the summer is roughly equal to 2 cfs at Acme under average river loss conditions, these AWN values include by default the amount of water to keep the Pecos River flow continuous at a discharge of 2 cfs at

the Near Acme gage in the summer months. AWN is the amount of water that is needed to meet all of the target flow demands after available bypass amounts are consumed. Total water needed is the sum of available bypass and AWN.

Table 5
No Action (Remaining) Additional Water Needs

Model Scenario / Alternative	60-Year Annual Averages			Maximum and Minimum Additional Water Needed			
	Total Water Needed (AF per year)	Available Water Bypassed (AF per year)	AWN (AF per year)	Maximum AWN (AF)	Maximum Occurs in Modeled Year	Minimum AWN (AF)	Minimum Occurs in Modeled Year(s)
Bypass Only	4,300	2,500	1,800	6,900	'56	0	'42
No Action Alternative	3,500	2,100	400	3,400	'56	0	'41, '42, '49, '58, '86, '91, '93, '95, '97, '99

Results in the table indicate that supplemental water sources under the No Action Alternative (the Vaughan water lease and the existing FCP) significantly contribute to reducing total and additional water needs. Total water needed is reduced because of the 1,100 AF per year Vaughan water lease, which adds water to the Pecos River system downstream of Sumner Dam, closer to the Near Acme gage location; subsequently, some of the loss incurred as Sumner Dam release is eliminated by applying the water that is needed closer to the Taiban or Near Acme gage locations. AWN is dramatically decreased when compared to bypassing alone from the contribution of the 1,100 AF per year Vaughan water lease in combination with the existing 1,000 AF per year FCP, amounting to a 1,400 AF per year reduction on average and 3,500 AF per year reduction for the modeled maximum.

No Action Alternative Water Supplies

Water supplies for the No Action Alternative are measured in comparison to the pre-91 baseline. Carlsbad Project total net depletions, changes to flows at the New Mexico-Texas state line, and changes in Compact delivery obligations are water supply resource indicators. Table 6 summarizes modeled impacts to these indicators. Note that all of the alternative modeling results and subsequent resource indicators for water supply include the effects of current Reclamation CPWA, which is represented in the modeling by retirement of roughly 4,200 AF per year of river pumpers located approximately between Roswell, NM and Artesia, NM.

Table 6
Average Annual (60-Year) Changes in Water Supply Indicators for the No Action Alternative

Alternative	Total Net Depletion to Carlsbad Project Water Supply (AF per year)	Increased CID Diversions (AF per year)	Project Water Lost to Additional Conservation Spills (AF per year)	Estimated Increase in Flows at the State Line (AF per year)	Estimated Additional Compact Delivery Obligation (AF per year)
No Action	-1,000	900	1,200	1,650	-400

In reading the table, the second column represents the total net depletion to CID diversions and Carlsbad Project storage for the No Action Alternative. In other words, an average of 1,000 AF per year more water was made available to the Carlsbad Project under the No Action Alternative as compared to the pre-91 baseline. The third column shows increases in CID diversions from project water supplies, an average increase of 900 AF per year under the No Action Alternative. The fourth column shows how much water spilled from the project due to the No Action Alternative, 1,200 AF per year on average. The fifth column estimates the additional state line flow as a result of water spilled from the project and additional CID diversions, which assumes a 50 percent return flow component for CID diversions (EIS modeling indicated Carlsbad area ground water gains at 75 percent of CID diversions, but 50 percent is used here to be conservative in the absence of modeling these groundwater gains) (Reclamation 2006a). The sixth column shows the estimated relative change in Compact obligation due to increases (or decreases) in Sumner outflow.

No Action Alternative Groundwater Withdrawals

Groundwater withdrawals for the No Action model simulation include exchange of 750 AF per year of Seven Rivers groundwater rights pumped into Brantley reservoir (Carlsbad Project storage) for the 1,000 AF per year of FCP water stored in Sumner Reservoir and pumping of the long-term groundwater lease near Ft. Sumner to use in the Vaughan Pipeline.

At Seven Rivers, well records indicate historic withdrawals in 2002 and 2003 of 790 and 870 AF per year, respectively, for these water rights before FCP exchanges started. The full diversion amount for this right is 1,800 AF per year, and the consumptive irrigation requirement associated with the water right is 1,260 AF per year. A portion of this water right is used for water fowl under Brantley mitigation requirements. If Reclamation continues pumping at an amount similar to the 2002-2003 amounts for Brantley mitigation under the No Action Alternative in addition to pumping 750 AF per year for the FCP exchange, groundwater withdrawals at Seven Rivers will be approximately 1,600 AF per year in this location.

Near Ft. Sumner, modeled groundwater withdrawals for the No Action Alternative are 500 AF per year on average, and are significantly less than average historic withdrawals for the leased water rights used in the Vaughan Pipeline. Even if the leased water is pumped to its full entitlement for consumptive use (roughly 1,100 AF per year), it won't nearly reach historic levels since estimated well pumping records indicate a short-term historic average of 4,000 AF per year and a long-term historic average of 2,450 AF per year for the same water rights (NMISC 2006).

No Action Alternative Water Quality

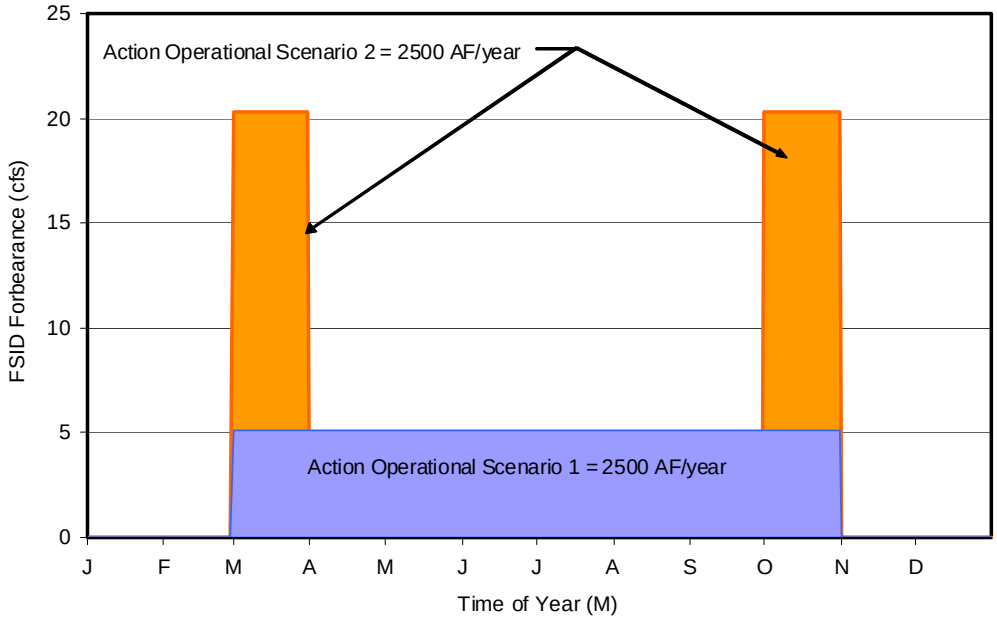
The Carlsbad Project EIS models show small increases in EC at Artesia and below Brantley Dam as a result of bypassing (Reclamation 2006a). EC is an indirect measurement of TDS, sometimes referred to as salinity. Stratification of high salinity water is historically a problem in Brantley Reservoir and is managed by using block releases to "turn over" the stratified layer and mix the reservoirs contents, subsequently diluting the stratified high-EC layer with fresh water from a block release. Bypassing actions included in the No Action Alternative will not impact the water quality of flows at Artesia or below Brantley anymore than was already identified in the FEIS.

The water leasing components of the No Action Alternative will have positive impacts on water quality in the study area. The lease of groundwater rights and subsequent pumping of those rights to the Pecos River through the Vaughan Pipeline serves to improve water quality in this reach of the river since a large portion of farm acreage is no longer irrigated with the leased water. Irrigation of lands, and subsequent return flows, serves to increase salinity in rivers from leaching salts from the irrigated lands. This leaching process increases the TDS in the water, whereas just pumping the water into the Pecos River will not cause an increase in TDS in the Pecos River, considering the previous (historic) use of the water was for irrigation.

Proposed Action

Alternative impacts for two simulated operational scenarios of the proposed action are presented in this section. Four operational scenarios were modeled to study the proposed action. Two are presented in detail in this section, and the other two are summarized quantitatively near the end of this section (See Appendix A for further information). Detailed modeling definitions for each operational scenario simulating the proposed action are shown in Appendix A. Both presented operational scenarios entail 2,500 AF per year of forbearance from FSID's water supply. For Operational Scenario 1 (Scenario 1), 2,500 AF per year of FSID's water supply is forborne as a constant discharge throughout the irrigation season (5.1 cfs per day for 245 days). For Operational Scenario 2 (Scenario 2), the 2,500 AF per year is forborne as a constant discharge in only the months of March and October (20.3 cfs per day for 62 days). Figure 6 is a graphical depiction of the forbearance schedules from FSID supplies for both operational scenarios.

Figure 6
Modeled Diversion Schedules from FSID Water Supply into FSID Forbearance



In addition to variations in FSID forbearance, variations in shortage impacts were also modeled. If FSID experiences an irrigation shortage that ultimately affects the amount of water it is able to forbear, it may ultimately reduce the total benefit in reduction to days of intermittency in the Pecos River under the proposed action. If CID absorbs the shortages without being made whole, their water supply will be negatively impacted. Adaptive management would most likely be needed to minimize impacts to the Pecos River and CID in these instances. Modeling results for variable shortages in FSID forbearance amounts ultimately impacting the flows in the Pecos River, which are presented as impacts to intermittency, and modeling results for CID absorbing shortages, which are presented as impacts to water supplies, are quantified later in this chapter.

Summary of Impacts for the Proposed Action

Table 7 shows qualitative measurements (as compared to the No Action Alternative) of the water resources indicators used in this chapter for both of the proposed action operational scenarios. To summarize, both scenarios showed a large reduction in intermittency compared with the No Action Alternative. For the proposed action, Scenario 1 showed a slightly larger reduction to modeled days of intermittency at the Near Acme gage when compared with Scenario 2. Scenario 1 was less detrimental than Scenario 2 to Pecos River flow duration, and both scenarios show a nearly equal improvement in AWN. Scenario 1 shows a slightly greater benefit to project water supplies, but also shows more detriment to state line flows than Scenario 2. Quantification of these resource indicators is discussed in the following sections.

Table 7
Qualitative Summary of Resource Indicators

Proposed Action Operational Scenario	Relative Change from the No Action Alternative				
	Flow Duration and Intermittency Near Acme	Additional Water Needs	Project Water Supply, State Line Flow, and Compact	Volume of Groundwater Withdrawals	Water Quality
Scenario 1	Small detriment to flow duration in 4-50 cfs range. Large reduction to days of modeled intermittency	Moderate improvement.	Small improvement for Project and Compact Obligation. Small detriment for state line flows	Small increase	No change to small improvement
Scenario 2	Small to moderate detriment to flow duration in the 4-50 cfs range. Large reduction to days of modeled intermittency	Moderate improvement.	Small improvement for Project. Small detriment for state line flows. No change for Compact Obligation	Moderate increase	No change to small improvement

Proposed Action Flow Duration and Intermittency

Modeled flow durations at the Near Acme gage for proposed action Scenarios 1 and 2 are shown in Figures 7 and 8, respectively. The flow duration plots for both action operational scenarios show a large improvement in the 0-4 cfs range of the plot. Note that the plateau in these graphs begins to extend around 4 cfs, which is due to the 2 cfs target for keeping the river wet, plus the additional constant 2.5 cfs from groundwater leasing and subsequent pumping through the Gary Lynch Pipelines (see Figure 1) upstream of the Near Acme gage. Both Scenarios 1 and 2 show a detriment to flow duration in the 4-20 cfs range; Scenario 1 shows the greater detriment in this range. Both operational scenarios also show a detriment in the 20-50 cfs range, and in this range, Scenario 2 shows the larger detriment to flow duration. These reductions in flow duration are due to lower return flows from FSID since part of FSID's water supply is now being used to provide water directly to the Pecos River under the proposed action. In other words, some flows are redistributed from the 4-20 cfs range and the 20-50 cfs range into the 0-4 cfs range. Scenario 1 shows a greater reduction in flow in the 4-20 cfs range since the forbearance from FSID's supply is constant (refer back to Figure 6); as a result, the entire range of return flow from FSID is affected. Scenario 2 shows a greater reduction in flow in the 20-50 cfs range because the forbearance from FSID in the months of March and October occurs at a much larger rate (20.3 cfs compared to 5.1 cfs); as a result, return flows in the spring (when depletions are low) and fall seasons (when FSID return flows are high) are reduced more drastically.

Figure 7
Modeled Flow Duration at the Near Acme Gage Showing Results for Proposed Action Operational Scenario 1

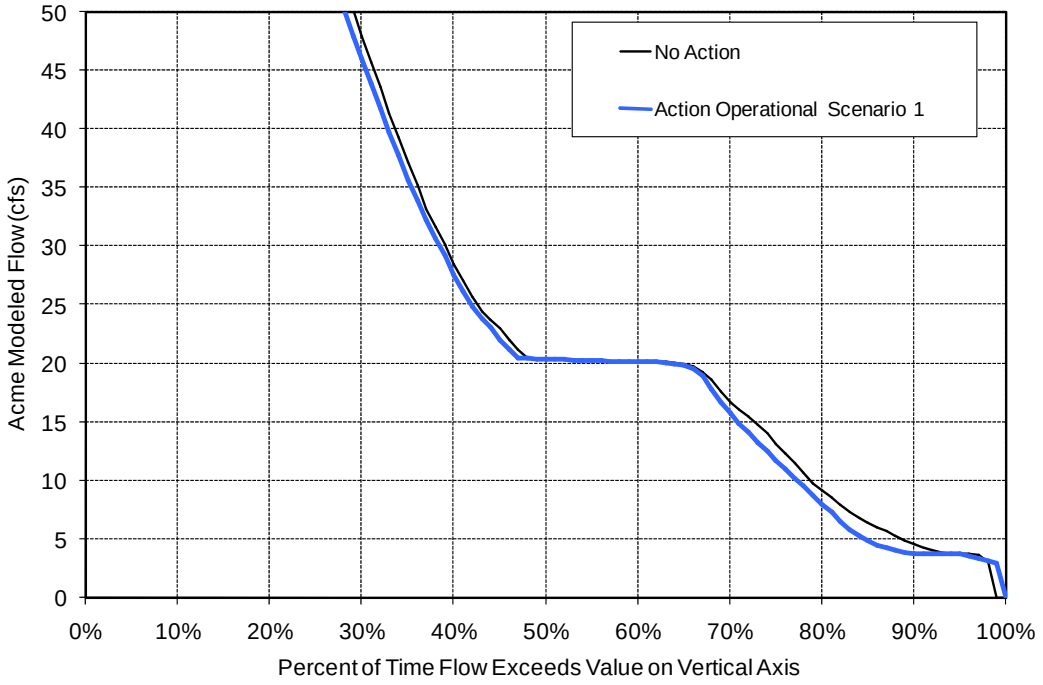
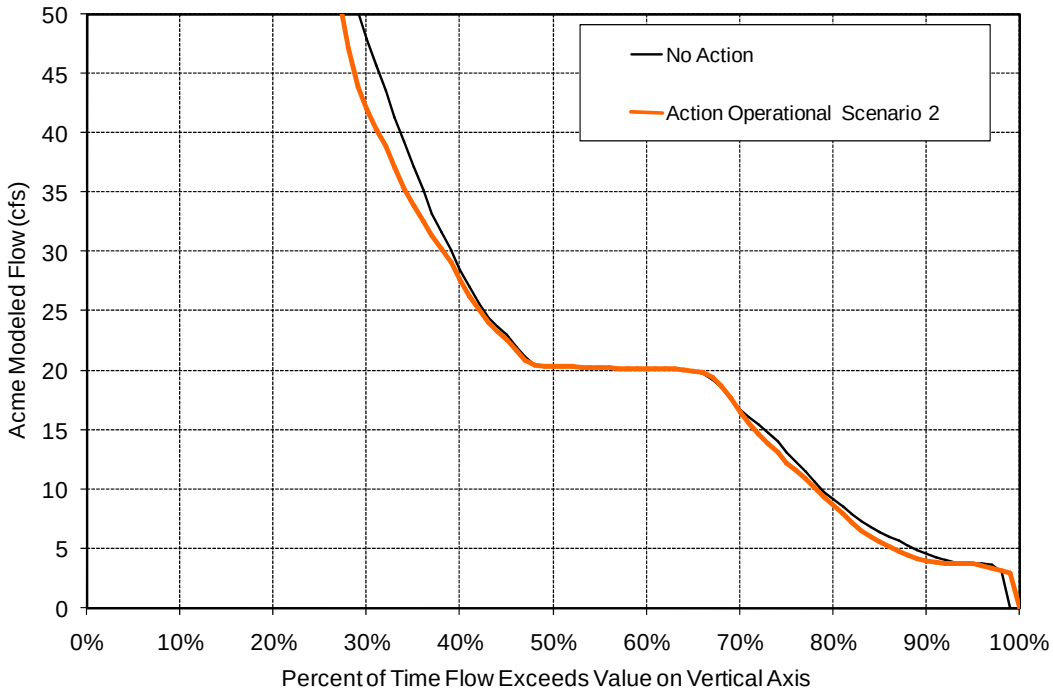


Figure 8
Modeled Flow Duration at the Near Acme Gage Showing Results for Proposed Action Operational Scenario 2



Intermittency results for the proposed action scenarios are quantified by comparison with the No Action Alternative and pre-91 baseline modeling in Table 8. Depictions of intermittency from the modeled results for flow at the Near Acme gage for Scenarios 1 and 2 are shown in Figures 9 and 10, respectively. The intermittency table and figures indicate that both proposed action scenarios perform well at reducing intermittency in comparison with the No Action Alternative (a near 1 percent reduction over the 60-year modeling period for both scenarios). Both scenarios show roughly the same improvements to intermittency, with Scenario 1 being slightly better (35 days out of 60 years compared with 54 days out of 60 years for Scenario 2). Scenario 1 reduces intermittency occurrences to just 4 years out of 60 (from 12 under No Action) in a total of six continuous events. Scenario 2 reduces intermittency occurrences to just 7 years out of 60 in a total of nine continuous events. Scenario 1 slightly outperforms Scenario 2 because of changes in FSID return flows in the two scenarios. Scenario 1 reduces return flows by a small steady constant amount, while Scenario 2 reduces the return flows from FSID in large concentrated amounts. For Scenario 2, the large concentrated return flow reduction creates concentrated demand for AWN, and subsequently, small increases in intermittency (in comparison with Scenario 1) if supplemental water sources have already been depleted during that (modeled) calendar year.

Table 8
Modeled Intermittency Statistics at the Near Acme Gage

Alternative / Baseline Model Scenario	Total Intermittency		Number of Occurrences over 60 years - For Single or Consecutive Days Of Intermittency					
	Percent of Time	Number of Days (out of 60 years)	1 Day	2 to 5 Days	6 to 10 Days	11 to 20 Days	21 to 30 Days	Greater than 30 Days
Pre-91 Baseline	4.9%	1064	13	32	20	18	13	5
No Action Alternative	1.1%	243	7	13	4	6	3	0
Proposed Action Operational Scenario 1	0.2%	35	1	2	2	1	0	0
Proposed Action Operational Scenario 2	0.2%	54	2	3	2	2	0	0

Figure 9
Modeled Intermittency at the Near Acme Gage Showing Results for the Proposed Action - Operational Scenario 1

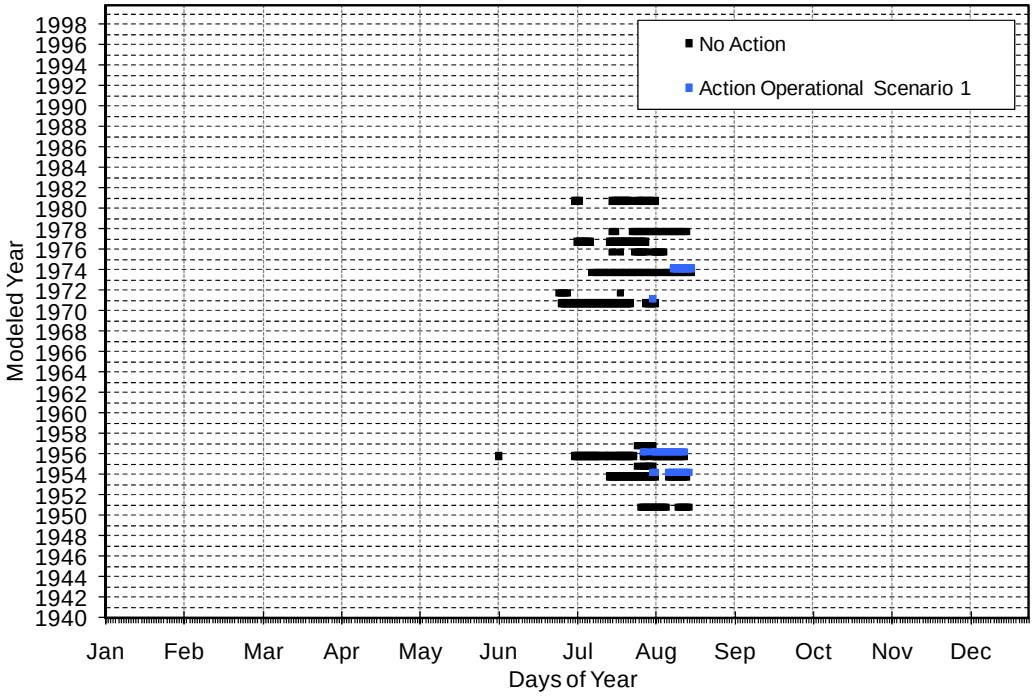
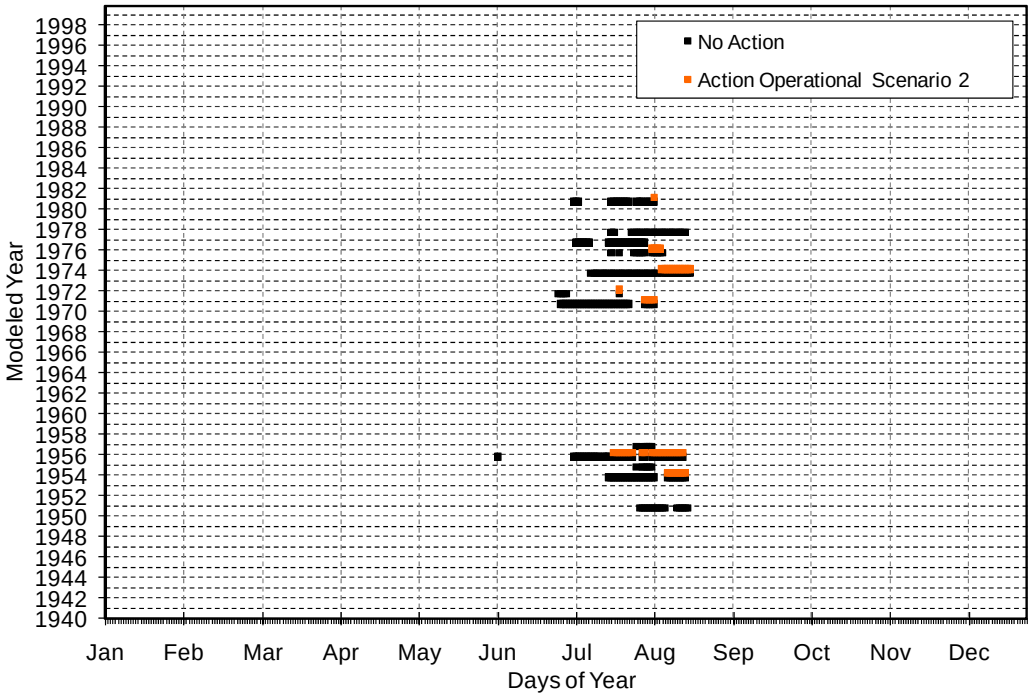


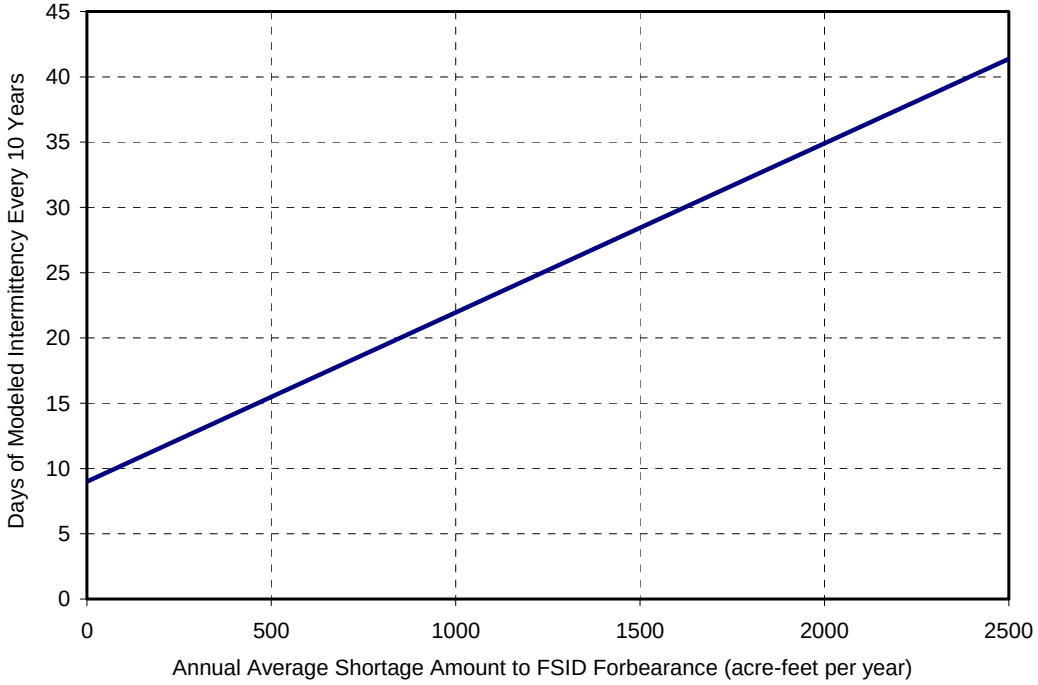
Figure 10
Modeled Intermittency at the Near Acme Gage Showing Results for the Proposed Action - Operational Scenario 2



Effect of FSID Water Supply Shortages on Intermittency

Since FSID's water supply is variable depending on the hydrologic inflow to the Pecos River above Sumner Reservoir, shortages to their water supply could eventually propagate to a shortage of supply to the Pecos River. This could eventually affect flows in the Pecos River if the shortage is not somehow mitigated. This possibility is investigated by modeling FSID forbearance with variable shortage amounts to estimate the effect on intermittency in the Pecos River at the Near Acme gage. The effects of this hypothetical shortage on modeled intermittency results at the Near Acme gage (for both diversion scenarios) are depicted in Figure 11. To summarize the results of the chart, for every 1,000 AF per year on average of water supply shortage up to the 2,500 AF per year FSID forbearance agreement, an increase of 13 days of modeled intermittency every 10 years (or nearly 80 days over 60 years) is observed. A complete shortage to the annual forbearance amount (2,500 AF per year) in this figure represents modeled intermittency results of the No Action Alternative.

Figure 11
Effects of Water Supply Shortages to FSID Forbearance on Intermittency at the Near Acme Gage



Proposed Action Remaining Additional Water Needs

The remaining amounts of AWN for the two operational scenarios are shown in Table 9. Also shown in the table are the original (bypass only) AWN amounts and the No Action Alternative AWN amounts for comparison. As stated previously, AWN is the sum of all the target demand (to achieve 35 cfs at Taiban or 2 cfs at Acme in the summer months) remaining after bypassing available supplies.

Table 9
Proposed Action and No Action (Remaining) Additional Water Needs

Alternative	60-year Annual Averages			Maximum and Minimum Additional Water Needed			
	Total Water Needed (AF per year)	Available Water Bypassed (AF per year)	AWN (AF per year)	Maximum AWN (AF)	Maximum Occurs in Modeled Year	Minimum AWN (AF)	Minimum(s) Occur(s) in Modeled Year(s)
Bypass Only	4,200	2,500	1,800	6,900	'56	0	'42
No Action Alternative	3,500	2,100	400	3,400	'56	0	'41, '42, '49, '58, '86, '91, '93, '95, '97, '99
Proposed Action Operational Scenario 1	4,300	2,100	100	2,400	'56	0	'41, '42, '49, '51, '57, '58, '64, '86, '91, '93, '95, '97, '99
Proposed Action Operational Scenario 2	4,500	2,200	100	2,500	'56	0	'41, '42, '49, '57, '58, '64, '86, '91, '93, '95, '97, '99

Examining the first column of the table, it is apparent that Scenarios 1 and 2 increase the average total water need slightly compared to the bypass only model and substantially compared to the No Action model. This increase in total water need for Scenarios 1 and 2 is caused by the reduction in return flows from FSID forbearance. Both scenarios show a 300-400 AF per year reduction in bypass amount on average than the bypass only model and nearly equal (0-100 AF per year) average bypass amounts when they are compared to the No Action Alternative. Average AWN decreases 300 AF per year in comparison to the No Action Alternative for both scenarios. Maximum AWN amounts, representing additional water needs in the most extreme of dry years, show substantial (900-1,000 AF per year) reductions for the proposed action scenarios in comparison with the No Action Alternative. The maximum AWN amount occurs in the modeled year 1956 for all the modeling scenarios. Note that both action operational scenarios show 3 to 4 more years with modeled AWN at a minimum in comparison to the No Action Alternative. This is largely the result of the combination of FSID forbearance of 2,500 AF per year operating in conjunction with the current FCP of 1,000 AF per year and the 1,100 AF per year Vaughan lease, which greatly exceeds the average AWN (occurs 50 percent of the time) for the bypass model (1,800 AF per year). Note that the rough aggregate (not adjusted for losses between Sumner Reservoir and the Vaughan pipeline outfall) volume of the forbearance, FCP, and the Vaughan lease (4,600 AF

per year) for either proposed action operational scenario still does not exceed the maximum AWN predicted by the bypass model (6,900 AF in the modeled year 1956). This AWN shortfall in some years also reflects the modeled intermittency results since intermittency is not eliminated completely for all 60 years under either modeled operational scenario of the proposed action.

Proposed Action Water Supplies

Proposed action water supplies are measured against the pre-91 baseline to determine the average annual volumes of net depletion as a result of augmenting flows for the shiner. Table 10 summarizes impacts to the three water supply indicators, including net depletions to Carlsbad Project supplies, changes to flows at the New Mexico-Texas state line, and changes in Compact delivery obligation. As noted previously, all of the alternative results include the effects of 4,200 AF per year of Reclamation CPWA leases.

Table 10
Average (60-Year) Changes in Water Supply Indicators for the Proposed Action Operational Scenarios Compared to the No Action Alternative

Alternative	Total Net Depletion to Carlsbad Project Water Supply (AF per year)	Increased CID Diversions (AF per year)	Project Water Lost to Additional Conservation Spills (AF per year)	Estimated Increase in Flows at the State Line (AF per year)	Estimated Additional Compact Delivery Obligation (AF per year)
No Action	-1,000	900	1,200	1,650	-400
Proposed Action Scenario 1	-1,500	1,400	500	1,200	-700
Proposed Action Scenario 2	-1,200	1,100	1,000	1,550	-400

This table shows that modeling results for the proposed action indicate a slight increase in Carlsbad Project water supplies. Scenario 1 results show a larger increase to project supplies due to less water being lost from the project to conservation spills. This reduction in conservation spills, although somewhat random, is most likely due to a low constant diversion from FSID supply as opposed to no diversion from FSID supply (No Action) or a large sporadic (every 5 or 7 months) diversion from FSID supply (Scenario 2). The proposed action also showed a slight reduction in estimated flows at the state line from the No Action Alternative, which varied from 100 AF per year on average (Scenario 2) to 450 AF per year on average (Scenario 1). These reductions are attributable to increases in depletions in the Sumner to Acme reaches of the Pecos River; increases in depletions are caused by the use of a supplemental water source (that is often depleted completely, especially in the summer months) derived from a previous surface water use (i.e., irrigation in the FSID). Lastly, the table shows a slight reduction in additional Compact delivery

obligation for Scenario 1 and no change for Scenario 2 as compared with the No Action Alternative. Estimated annual net depletions to CID are shown in Appendix A.

Effect of Shortages to the FSID Forbearance on Project Water Supplies

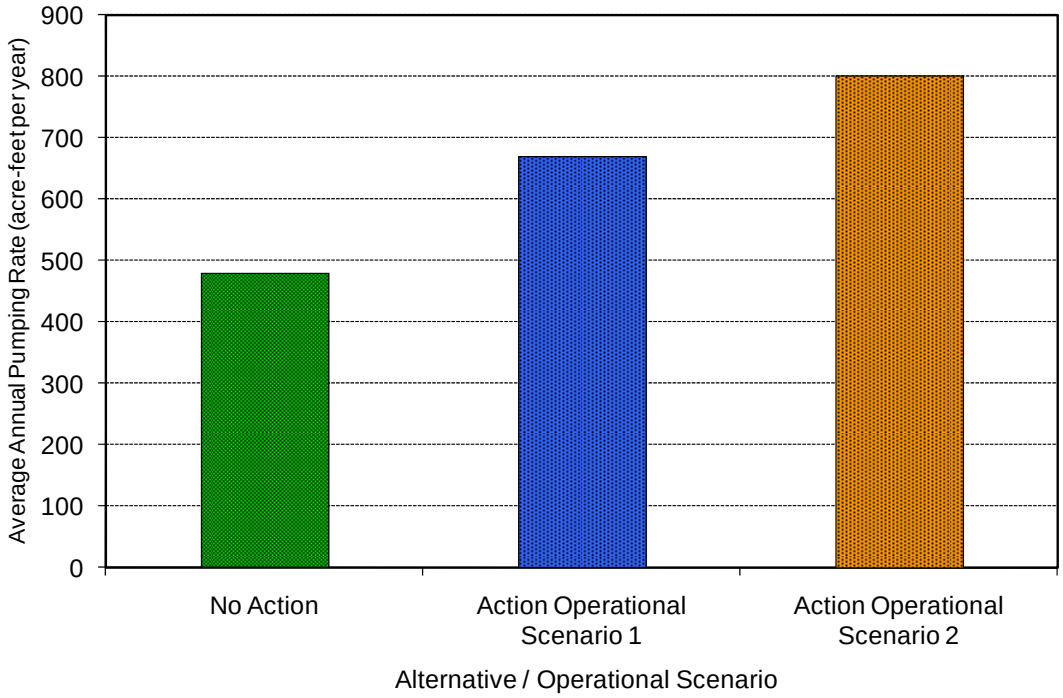
Similar to modeling the effects of shortages in water acquired through the FSID forbearance on intermittency, the sensitivity of the Carlsbad Project water supply to shortages in the FSID forbearance were modeled. For both scenarios, negligible effects to CID diversions were noted if the shortage amounts were passed along to the Pecos River (the FSID forbearance is reduced according the shortage amount and operated within that volume limit). Alternatively, if the shortage amounts were absorbed by CID (the FSID Forbearance is still operated with 2,500 AF annual volume even when diversions into it from FSID are shorted), both scenarios showed a variable detriment of 500 to 700 AF per year (as modeled diversions at the CID main) for all the modeled shortage amounts (0 to 2,000 AF per year).

Proposed Action Groundwater Withdrawals

Demand for water to achieve targets determines the utilization of the long-term lease with the NMISC for groundwater pumping into the Vaughan Pipeline (and ultimately the Pecos River). A change in return flow patterns from FSID (which affects target flow demand) ultimately changes the demand patterns for pumping from this supplemental water source. Figure 12 is a comparison of the average modeled amounts of Vaughan Pipeline groundwater withdrawals for the two proposed action scenarios and the No Action Alternative.

Figure 12 shows that diversions forbearance by FSID (Scenarios 1 and 2) increase the demand for pumping the local groundwater aquifer in the Ft. Sumner area for the Vaughan pipeline. This is caused by reduced FSID irrigation return flows since less water is diverted and applied to the fields; subsequently, more water is needed to meet target demand. Scenario 2 shows the highest average pumping because FSID forbearance occurs at the highest rate (20.3 cfs for two 31-day periods during the year). This ultimately causes the demand for Vaughan pipeline pumping to increase for two similar one-month periods during the year (like the forbearance schedule for Scenario 2 depicted in Figure 6, except pumping demands would include return flow lag effects). Note that all of the modeled average pumping rates are still far below the recent historic average, estimated at 4,000 AF per year and the long-term historic average, estimated at 2,450 AF per year for the same water rights (NMISC 2006). It is also apparent from the figure that this supplemental water source is only partially utilized in some years since the full consumptive use amount is 1,100 AF per year.

Figure 12
Comparison of Average Annual Pumping Rates for Reclamation's Long-term Water Lease with the NMISC for Supplementing Pecos River Flow with the Vaughan Pipeline



Analysis of Specific Components of the Proposed Action

In addition to the detailed results for the two operational scenarios presented in this section, three specific cases of the proposed action were analyzed. These three additional operational scenarios were modeled with increased detail for operational components, including forbearance of 2,500 AF per year of FSID's 16-day winter entitlement, and forbearance during (historic) FSID irrigation and maintenance shutdowns. Results indicated the following summarized impacts to applicable resource indicators (Please refer to Appendix A for more information pertaining to additional scenarios modeled):

- Forbearance of 2,500 AF per year of FSID's winter entitlement resulted in a higher average additional diversion to CID when compared to the No Action Alternative (1,800 compared to 900 AF per year, respectively), and also showed a 350 AF per year average increase in flows at the state line compared to the No Action Alternative.

- Forbearance of an estimated historic 2,600 AF per year of FSID shutdown water resulted in no increase in average CID diversions compared with the No Action Alternative, but showed a 600 AF per year increase in estimated flows at the state line compared with No Action.

Proposed Action Water Quality

The proposed action alternative will not impact water quality in the study area any more than the No Action Alternative. The slight increase in pumping from the local aquifer in the Ft. Sumner Area under the proposed action (caused by the reduction in diversions to FSID) represents a lower diversion than the full diversion right, and a much smaller diversion than the historic pumping. Given that FSID forbearance water was previously used for agriculture and will no longer leach minerals from the soil under the proposed action (instead it will be put directly in the Pecos River), it is not anticipated that the proposed action will have any negative impacts on water quality in the Pecos River or the local aquifer in the Ft. Sumner area.

Biological Resources

The following indicators were selected to evaluate potential impacts on biological resources:

- Increased potential for overbank flows or inundation of habitats used by nesting shorebirds, terrestrial wildlife species, and wetland aquatic species.
- Changes in frequency, extent, duration of intermittency, or extreme low flows that would cause direct mortality of aquatic organisms and loss of aquatic habitat.
- Change in frequency, magnitude, or duration of managed or natural peak flows that could impact aquatic habitat or spawning activities.

No Action Alternative

Under the No Action Alternative, Reclamation would not enter into a contract with FSID to lease forbearance water. In order to avoid jeopardy, Reclamation would still be obligated to meet the conditions of the BO and would continue to acquire other supplemental sources of water or pursue other measures to meet the flow target and keep the river continuous. The ROD provides a variety of tools to allow Reclamation to adaptively meet the BO requirements. These actions, however, generally require short-term agreements and do not provide long-term flexibility. During dry years, the lack of operational flexibility and potential lack of sufficient water sources could result in the river going intermittent, which would negatively impact the shiner. Under the No Action Alternative, there is a predicted intermittency rate of 1.1 percent.

The No Action Alternative would have no effect on the potential for overbank flows, inundation of habitat, or changes in frequency, magnitude, or duration of peak flows.

Proposed Action

If the proposed action is implemented, Reclamation would have an additional tool to meet the flow target and keep the river continuous, which would be beneficial to the threatened shiner. Operational scenarios modeled for the proposed action predict an intermittency rate of 0.2 percent as compared with 1.1 percent under the No Action

Alternative (Table 8). This availability of water upstream on a more continuous basis during summer months should have a positive effect on terrestrial, riverine, and floodplain habitats and the species that use them.

FSID forbearance would occur when the river has low flows; therefore, the proposed action is not expected to have much effect on the potential for overbank flows or inundation of habitats. Most overbank flows and habitat inundations are the result of much larger natural events and large block releases. The use of smaller releases by CID or from the current FCP may reduce the need for larger block releases that can sweep eggs and larvae into the reservoirs and can cue spanning.

The proposed action is designed to benefit the shiner by providing more operational flexibly to release water to keep the river continuous. This represents a "may effect, is not likely to adversely affect" determination for the shiner and is "not likely to destroy or adversely modify" designated critical habitat. Reclamation has consulted with Fish and Wildlife Service and received concurrence on July 11, 2007.

The proposed action would not destroy or adversely modify any critical habitat. No impacts would occur to other threatened or endangered species in the basin, including the interior least tern, Southwest willow flycatcher, or black-footed ferret, or to any endangered, threatened, or sensitive plant species.

Recreation

The following indicators were selected to evaluate potential impacts on recreation:

- Recreation visitation and associated expenditures at Santa Rosa Reservoir and Sumner Lake.

- Water levels and their effects on recreation along the Pecos River.

No Action Alternative

Under the No Action Alternative, there would be no change from current recreational conditions or trends at recreational sites along the Pecos River or at reservoirs. The availability of recreational opportunities would continue to fluctuate widely based on flows and location. The No Action Alternative would have no effect on instream or reservoir water levels and therefore no effect on recreation.

Proposed Action

The proposed action is expected to have negligible to positive impacts on recreation. If the proposed action is implemented, slightly more water may be stored in Sumner Lake during the summer months; this may possibly increase opportunities for water-based recreation and visitor use. Intermittency in the Pecos River would be reduced; however, forbearance of FSID's water supply may lead to reduced flow durations in the medium (4-50 cfs) flow range. Effects on summer recreational activities in the Pecos River should be minimal. For both the reservoirs and the Pecos River, fluctuations in weather, timing, supply, location, and irrigation demand would be

more influential in determining recreational opportunity and use than the proposed action.

Cultural Resources

The following indicators are used to evaluate changes to cultural resources:

- The known presence or potential for cultural resources that may be eligible for listing on the NRHP or locations that are important to Native American or other traditional communities in areas affected by the action.
- River flow levels and fluctuation resulting from the action where there is a potential for directly disturbing resources, increasing access to resources, or exposing submerged resources.

Impact analysis for cultural resources incorporates the National Historic Preservation Act, Section 106 process. In the Section 106 process, the federal lead agency determines an APE for each undertaking or project. The APE is the physical area where the action may affect cultural resources and specifically those that are listed or meet the criteria for listing (36 CFR 60.4) on the NRHP. The APE for cultural resources includes the existing water channels or active flood zones of the Pecos River corridor.

Impacts on cultural resources are assessed by applying the criteria of adverse effect as defined in 36 CFR 800.5a. "An adverse effect is found when an action may alter the characteristics of a historic property that qualify it for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the action that may occur later in time, be farther removed in distance, or be cumulative." The criteria of adverse effect provide a general framework for identifying and determining the context and intensity of potential impacts on other categories of cultural resources as well, if these are present. Assessment of effects involving Native American or other traditional community, cultural or religious practices, or resources also requires focused consultation with the affected group.

No Action Alternative

The No Action Alternative would not affect cultural resources. Potential impacts would be limited geographically to known and unknown cultural resources in the existing water channels and active flood zones of the Pecos River corridor.

Ongoing impacts on cultural resources resulting from river operations include the potential for direct disturbance of the integrity of archaeological sites through erosion, wave action, and cycles of inundation and drawdown, and the potential for vandalism of formerly submerged archaeological resources. The potential for these kinds of impacts, including impacts on resources that may be eligible for listing on the NRHP or may be of traditional importance, is greater from natural drought cycles

and flood events. Future actions to acquire and develop additional water or to conserve the shiner would be expected to continue and may require further consideration of the effects on cultural resources.

Proposed Action

The proposed action would not affect cultural resources. No additional construction, ground disturbance, changes in water, control, storage, and delivery infrastructure, or new land abandonment is proposed. The action of leasing additional water and releasing it into the river at a slow rate would be a negligible change from current operations and would be similar in nature to other existing actions. Sites in the immediate vicinity of the river or in flood zones have been subject to past disturbances, reducing the likelihood of their intact preservation. Proposed flow levels and flow fluctuations would be within the range of normal river operations and would not be expected to exacerbate erosion of archaeological resources or exposure of submerged resources. Future actions to acquire and develop additional water and to conserve the shiner would be expected to continue and may require further consideration of the effects on cultural resources.

Indian Trust Assets

The following resource indicator is used to evaluate impacts on Indian trust assets:

- The potential for the action to affect Indian real property, physical assets, or intangible property rights. Actions which would adversely affect the value, use, or enjoyment of an ITA would be considered an impact.

As part of the preparation of the Carlsbad EIS (Reclamation 2006a), Reclamation contacted representatives of tribal groups with historic ties to the Pecos River basin or tribal groups who had expressed interest in Reclamation activities to identify any tribal trust interests. In addition, Reclamation contacted various representatives and offices of BIA, informing them of the consultation and requesting any feedback that the agency might have, including the potential of Reclamation's actions to affect ITAs. Letters describing the range of supplemental water proposals were sent to representatives of twelve tribes and Native American pueblos on January 22, 2007 (See Chapter 6). No ITAs or ITA issues have been identified to date. If present, impacts on ITAs include any actions that affect Indian real property, physical assets, or intangible property rights. In some cases, the measure of impact significance on ITAs may be estimated based on the monetary value of the assets to the Indian tribe, but ITAs may also have social and cultural values that will need to be considered in addition to their economic value.

No Action Alternative and Proposed Action

No ITAs have been identified in the Pecos River Basin in consultation with tribes and the Bureau of Indian Affairs. There are no reservations or ceded lands present. Because resources are not believed to be present, no impacts are anticipated to result from the No Action Alternative or the proposed action.

Environmental Justice

The following resource indicator is used to evaluate environmental justice:

- The potential for the action to cause a disproportionate share of high and adverse human health and/or environmental impacts on low-income and/or minority communities.

As discussed in Chapter 3, U.S. Census Bureau data indicate that the distribution of population by race and Hispanic origin is similar for each of the four study area counties, with the exception of Guadalupe County. The percentage of total population that is Hispanic in Guadalupe County is nearly double the percentage for the entire area. Income data indicate that the per capita income for all four study area counties is lower than the average for all of New Mexico. Data also show Guadalupe County has much lower per capita income than the rest of the study area.

No Action Alternative

Under the No Action Alternative, there would be no change from current conditions and trends. The No Action Alternative would have no effect on ongoing socioeconomic and environmental trends affecting minority and low-income populations. Other actions would be required to acquire and develop additional water sources. These actions may result in potential environmental justice issues if they involve minority and low-income populations.

Proposed Action

The action of leasing, storing, and delivering water would have little or no effect on environmental justice. Negligible or no environmental impacts are anticipated for other resources. Increased storage and water levels at Santa Rosa Reservoir (an indirect effect of water storage in Sumner Reservoir) may increase opportunities for water-based recreation in Guadalupe County and may have a minor positive economic effect on low-income and/or minority communities. Farmers in acequia communities in Guadalupe County may also benefit from additional upstream storage and summer deliveries through the river. Since the water required would be leased from the FSID, there may be some negligible effects on the local farm economy that may affect low-income residents. It is anticipated, however, that the FSID would be leasing excess water that they could not store under their water right, and effects on agricultural activity would be negligible. There would also be negligible positive inputs from payments to FSID by Reclamation. There would be no disproportionate human health, economic, and environmental impacts on any group of people, including minority and low-income populations.

Irretrievable Commitment of Resources

The implementation of the proposed action would result in the commitment of federal funds on a long-term basis to lease, store, and deliver water.

Cumulative Impacts

According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR §1508.7), a "cumulative impact" is an impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. It focuses on whether the proposed action, considered together with any known or reasonable foreseeable actions by Reclamation, other federal or state agencies, or some other entity combined to cause an effect.

There are ongoing efforts, primarily by the NMISC, to acquire land with water rights in the Pecos River Basin to ensure compliance with the Pecos River Compact and meet obligations under the Settlement Agreement. Reclamation has executed a long-term contract with the CID to allow NMISC to use water up to 50,000 AF for purposes other than irrigation. The result of these actions is that land is being taken out of agricultural production, land ownership is being shifted from private to public ownership, prices for land with water rights have increased, there is additional economic incentive to sell, there is additional short-term economic input into the region, and there is a long-term loss to agriculturally related segments of the regional economy. The NMISC and Reclamation recently completed the Seven Rivers Pipeline Environmental Assessment, which analyzed the construction and operation of the water delivery pipeline from the Seven Rivers Augmentation Well field to Brantley Reservoir for use as Carlsbad Project water as partial fulfillment of the Settlement Agreement and to help maintain Compact compliance. No significant impacts were found.

On a more limited scale, Reclamation is continuing its efforts through leases to acquire and transfer water to support the 2006-2016 BO. Additional efforts by federal, state, and local agencies in the Pecos River Basin are focused on saltcedar removal and river habitat restoration. Many thousands of acres have been treated to reduce the adverse effects of invasive plant species. Reclamation partnered with the Service in an EA on Pecos River restoration at Bitter Lake National Wildlife Refuge. The purpose of the Pecos River restoration is to improve riparian and in-channel habitat, extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. The 2006-2016 BO requires Reclamation to restore two reaches totaling 3 miles of the river and to cooperate with other agencies in restoration efforts. As part of this commitment, Reclamation has restored flows into one historic oxbow at the refuge. The Service has concurrently conducted other restoration actions such as saltcedar removal and bank lowering in the river corridor and has planned other river restoration phases. These actions are designed to correct or improve degraded ecological conditions caused by the excavation of straight channels that began in the 1930s and encroaching nonnative vegetation, and would restore parts of the river to more

natural flow conditions within the context of the modern hydrological regime, including reconnecting the river to the floodplain.

Under the 2006-2016 BO, Reclamation has created 56.6 acres of nesting and brood-rearing habitat for interior least terns on the western shoreline of Brantley Reservoir, at and above the Lake's conservation storage pool elevation. Reclamation created a third, 28-acre site for nesting and brood-rearing in the Winter of 2007, prior to the species' arrival in May. This total of 84+ acres of nesting and brood-rearing habitat will be maintained through regular vegetation removal for the next 10 years. In addition, Reclamation will monitor for possible tern nesting activity throughout this period of time.

Reclamation has determined that the proposed action would not have a significant adverse cumulative effect on any resources. The water proposed for leasing by Reclamation from FSID would not result in any additional loss or fallowing of agricultural land. The contribution of the proposed action to cumulative effects would likely be beneficial for most resources.

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Chapter 5: Environmental Commitments

The following environmental commitments would be implemented as part of the proposed action:

- The FCP and acquired water (through FSID forbearance) would be used when bypass water is not available or insufficient to meet demand, and when pumping from the Vaughan Pipeline is consumed completely or is insufficient to meet demand. All of the supplemental water options may be used individually or in combination, at the discretion of Reclamation, for meeting Pecos River flow targets and maintaining a continuous river.

- Monitor the river flow to adequately manage available supplemental water supplies to ensure that the Pecos River remain continuous.

- Reclamation is consulting with the Service under Section 7 of the Endangered Species Act.

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Chapter 6: Consultation and Coordination

The following lists the individuals and organizations that were consulted in preparing this environmental assessment and in developing the proposed action.

Districts and Agencies	Pueblo and Tribal Governments
Carlsbad Irrigation District Mr. William Ahrens Mr. Dudley Jones Ft. Sumner Irrigation District Mr. Leslie Armstrong Pecos Valley Artesian Conservancy District Mr. Fred Hennighausen New Mexico Department of Game and Fish Ms. Janell Ward Ms. Lisa Kirkpatrick Mr. Luke Shelby Mr. Richard Artrip Mr. Shawn Denny New Mexico Interstate Stream Commission Mr. Emile Sawyer Ms. Sara Rhoton U.S. Army Corps of Engineers LTC Bruce Estok U.S. Fish and Wildlife Service New Mexico Ecological Services Field Office Ms. Marilyn Myers Mr. Wally Murphy	Pueblo of Jemez Kiowa Tribe of Oklahoma Fort Sill Apache Tribe of Oklahoma Apache Tribe of Oklahoma Hopi Tribe Navajo Nation Jicarilla Apache Nation Comanche Indian Tribe Pueblo of Ysleta del Sur Pueblo of Isleta Mescalero Apache Tribe

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Chapter 7: List of Preparers

NAME	EDUCATION / EXPERIENCE	RESPONSIBILITIES
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Gary Dean	BS Fisheries Biology Colorado State University 22 Years	Biological Resources and Section 7 Consultation
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Todd Tillman	BS Civil Engineering New Mexico State University 2 years	Hydrology and Water Management
EMPS, Inc.		
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Leslie Bandy	BS Conservation/Resource Studies University of California, Berkeley 6 Years	Recreation
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APPENDIX A: Water Resources Modeling Methods and Definitions

Introduction

This appendix provides definitions for the resource indicators and overall methods used in the hydrologic modeling and water resource impact analysis.

Resource Indicators

1. Flow Frequency at the Near Acme Gage

Evaluation of the effectiveness of the water leasing action to augment river flows in the critical habitat for the Pecos Bluntnose shiner (shiner) is best accomplished by examining impacts to the duration of flows at the Near Acme gage and the occurrence of zero flow (or intermittency) at the Near Acme gage. The duration of flows and occurrence of intermittency are presented in flow duration curves and intermittency charts. The flow duration curves denote the percentage of time that a certain flow occurs over a given time period, and intermittency charts depict the exact days that zero flow occurred during a given time period. The Near Acme gage was used as a location on the river because it is located just downstream of the critical habitat in a location that often undergoes river drying (Reclamation 2006a).

2. Additional Water Needed to Meet Target Flows

Due to seasonal distributions of inflows to Sumner Lake and Santa Rosa reservoirs, bypassing Carlsbad Project inflows through Sumner Lake to meet target demands is insufficient during much of the irrigation season. Additional water needs (AWN) refers to the amount of water, measured as Sumner Reservoir outflow, that needs to be acquired to achieve downstream flow at the target location all of the time. AWN can apply to evaluation of an alternative that only considers bypassing as an option such as the alternatives presented in the EIS, or AWN can apply to the remaining water needs after additional water acquisition (AWA or often referred to as "supplemental water") has been implemented, such as the FSID forbearance considered in this document.

3. Carlsbad Project Water Supply

Along with the goal of augmenting Pecos River flows for the shiner, it is also desirable to not impact the water supply of the Carlsbad Project. Impacts to Carlsbad Project water supplies are measured in net depletions, or relative shortfalls to the project before Endangered Species Act (ESA) operations were established. These relative shortfalls are measured against the before 1991 (pre-

91) baseline, which refers to Pecos River operations before ESA, when river operations were tailored to be most efficient for irrigation operations. These relative shortfalls occur due to bypassing flows through Sumner Dam that under the baseline operations would have been stored and released in a block release. These "net depletions" are primarily caused by increases in evaporation from the river surface, seepage into the local groundwater system, and losses to transpiration from riparian corridor vegetation due to bypassing (or releasing in the case of an FCP) small amounts of water as opposed to releasing large blocks of water all at once. Net depletions to the project water supply can also occur due to changes in block release configurations (duration, magnitude, and frequency), reservoir storage configurations, or differences in conservation spills from the study area of the Pecos River system.

4. Pecos River Flows at the New Mexico-Texas State Line

The Compact mandates that New Mexico must share a portion of Pecos River water with the State of Texas. The delivery of water under this Compact is measured at the New Mexico-Texas State Line, specifically at the US Geological Survey's Red Bluff gage. Because flow reduction in the Pecos River at this location is undesirable, the impact of the alternatives on this resource indicator is important. Flows at the New Mexico-Texas State Line are affected by changes in three primary sources: flood inflows downstream of Avalon Dam, diversions (and subsequent return flows) by the Carlsbad Irrigation District (CID), and conservation spills from Avalon Dam. Shortages in CID allotments (net depletions to the project water supply) may cause changes in supplemental well pumping in the CID; however, it is not anticipated that the project action will affect the pumping patterns of these irrigators as long as the project water supply is not impacted. Although river flows at this location were not modeled specifically for this document, the relative impacts to this resource indicator can be inferred from impacts to Carlsbad Project water supply and changes to conservation spills from the project water supply at Avalon Dam.

5. Changes to Pecos River Compact Obligation

Because the Pecos River Compact obligation is dependent on outflows from Sumner Reservoir in addition to flood inflows below Sumner Dam, changes to the Compact obligation are also an important resource indicator. The Compact obligation can vary because outflow from Sumner Dam can vary due to changes in water operations. Flood inflows below Sumner Dam are fixed and are not affected by changes in water operations; therefore, changes to the Sumner outflows can be evaluated in the context of Compact calculations, and a relative change in Compact obligation can be estimated. This resource indicator is important to consider in addition to flows at the New Mexico-Texas State Line since even though flows may increase (or decrease) due to an alternative, the obligation may also increase (or decrease) due to an alternative.

6. Changes to Groundwater Withdrawals in the Study Area

Since the action contemplated in this document includes the leasing of groundwater rights in the study area, it is appropriate to quantify those withdrawals and measure their relative change from historic withdrawals for the same water rights.

7. Changes to Pecos River Water Quality in the Study Area

A change in water quality in the Pecos River is also an important resource indicator since the purpose of use for the FSID forbearance water will change. Water quality impacts are handled qualitatively in this document.

Modeling of Alternatives

Modeling alternatives was accomplished using the latest version of the Pecos River RiverWare Model (Boroughs and Stockton 2006; Boroughs and Stockton 2005). The model runs 60 years (1940-1999) of hydrology inputs with policy and reservoir configurations as they are in the present. Five alternative / operational scenarios (including the No Action, but not including shortage scenarios) and three baselines were simulated with the model. The baselines are used to represent conditions in the Pecos River before any changes were made to operations for the ESA; in general, this type of baseline is called the pre-91 baseline. The No Action Alternative represents Reclamation's current operations on the Pecos River. The proposed action was subdivided into five operational scenarios to study in detail different elements of the proposed action.

Pre-91 Baseline

The modeled pre-91 baseline includes an operational policy that focuses solely on providing irrigation for agriculture. The pre-91 baseline is used to compare the impacts of the proposed action and No Action Alternative to operating conditions before changes were made for the shiner. Comparisons with the pre-91 baseline are made to determine impacts to Carlsbad Project water supplies, state line flows, and changes to Compact obligations. Since the pre-91 baseline represents a historical mode of operation with the current system elements (e.g., reservoirs presently operating along the Pecos River), it will not match historical Pecos River hydrology in the regulated system. To contrast with the alternatives, the pre-91 baseline does not bypass or release water to maintain river flows; does not have any stipulations on when block releases can be made; does not have any retirement of historical diversions; and does not have any supplemental water actions for augmenting river flows such as groundwater pumping or releases from an FCP or other acquired water sources.

No Action Alternative

The No Action Alternative represents current actions being conducted on the Pecos River by Reclamation. These actions include:

- Bypass of inflows when available to keep 35 cfs at the Taiban gage or prevent intermittency,
- Administration of a 1,000 AF per year FCP to prevent intermittency,
- Exchange of 750 AF per year of Roswell Artesian Basin well water pumped into Brantley to pay for depletions caused by the FCP,
- 4,215 AF per year retirement of the historical diversions by river pumpers in the study area,
- Pumping of 900 AF per year (2.5 cfs pumped for approximately 180 days) of groundwater rights upstream of the US Geological Survey's Near Acme gage to the Pecos River,
- On-demand pumping of the long-term water lease with NMISC through the Vaughan Pipeline up to a maximum of approximately 1,100 AF per year, and
- Constraints on block releases.

The constraints put on block releases for the alternatives amount to a maximum duration of 15 days, at least 14 days in between releases, a maximum of 65 days of block release per year, and a no-release period for 6 weeks centered on August 1 of every year. The No Action RiverWare model of this alternative contains all of these elements.

Proposed Action

The proposed action was split into four operational scenarios (not including shortage scenarios) for modeling with the Pecos River RiverWare model. All of the operational scenarios entail forbearance of 2,500 AF per year of FSID's water supply, with the exception of one scenario, which models forbearance of the average annual historic FSID shutdown of approximately 2,600 AF per year. For Operational Scenario 1 (Scenario 1), 2,500 AF per year of FSID's water supply is forborne as a constant discharge throughout the irrigation season (5.1 cfs per day for 245 days). For Operational Scenario 2 (Scenario 2), the 2,500 AF per year is forborne as a constant discharge in only the months of March and October (20.3 cfs per day for 62 days). Refer back to Figure 6 for a graphical depiction of the forbearance schedules from FSID supplies for Operational Scenarios 1 & 2. In Operational Scenario 3 (Scenario 3), 2,500 AF per year (78.8 cfs per day for 16 days) is forborne during FSID's 16-day winter entitlement period, which was assumed to start immediately preceding the irrigation season. Operational Scenario 4 (Scenario 4) models an estimated 60-year historic FSID shutdown sequence (an average of 2,600 AF per year) as an annual forbearance amount.

Within the model, FSID forbearance water was removed from the FSID entitlement either throughout the irrigation season (Scenario 1), at a constant rate during the winter (Scenario 3), at larger rates from the FSID entitlement during the months of March and October (Scenario 2), or at random time during the irrigation season (estimated historic FSID shutdowns – Scenario 4). In all cases, the water is diverted into Sumner Lake and later modeled as release from CID. Reclamation and FSID plan to make use of FSID's 16-day diversion entitlements in the winter and unused entitlements during rain or maintenance shutdowns. The standard Pecos River RiverWare pre-91 model does not simulate FSID's winter diversion entitlements (historically it was rarely used), and it also does not simulate FSID shutdowns for rain or maintenance. In absence of these mechanisms for forbearance in the standard pre-91 model, two modified pre-91 models were created to evaluate water supply resource indicators for Scenarios 3 and 4. Intermittency and flow duration results are not presented (in this Appendix) for these scenarios since their results aren't directly comparable with the No Action Alternative.

Table A-1 summarizes the modeling elements included for the pre-91 baseline, No Action, the proposed action operational scenarios, and the modified baselines. The table includes the target flow used for each model simulation, block release constraints, annual maximum release volumes for an FCP, low storage block release trigger settings, annual FSID surface water forbearance amounts, annual maximum groundwater lease amounts in the Ft. Sumner area, current groundwater lease amounts Near Acme, Carlsbad Project Water Acquisition for eliminating depletions from bypassing (retirement of river pumpers), and Seven Rivers exchange at Brantley for FCP depletions. The target flows for the alternatives consist of a 35 cfs target at Taiban and a 2 cfs target at the Near Acme location in the model to simulate a target for keeping the Pecos River continuous. It is also important to note that the groundwater lease in the Ft. Sumner area will not divert any additional amount from the local aquifer in this area than the original consumptive irrigation requirement (CIR) associated with the water right as it was used for agriculture. For all operational scenarios, this amount is precisely 1,107.6 AF per year or enough to pump 10 cfs per day to the Pecos River for 55.8 days.

Also shown in the table are four example model setups for the model simulations used to simulate the shortages. Both operational scenarios were setup with four different shortage amounts: 500 AF per year, 1,000 AF per year, 1,500 AF per year, and 2,000 AF per year. Two different permutations of shortage setup were simulated: shortages absorbed by CID, and shortages absorbed by the Pecos River. Considering both model scenarios, this resulted in 16 model permutations for simulating shortages (2 scenarios * 2 shortage setups * 4 shortage amounts). Table A-1 shows examples for the two types of shortage setups for each scenario (for the 1,500 AF per year shortage amount permutation).

Table A-1
Summary of Modeled Hydrologic Operations for Alternatives/Operational Scenarios and the Pre-91 Baseline

Model	Target Flow	Block Release Constraints[1]	Aggregate of FCP and For-bearance Used for River (AF)	Sumner Block Release Low Storage Trigger (AF) [2]	Forbearance from FSID Supply (AF/year)	Vaughn Pipeline (AF/year) [3]	Lynch Wells (AF/year) [4]	River Pumpers [5]	Seven Rivers Exchange	Comments
SEA Pre-91	N/A	N/A	N/A	4,980	N/A	N/A	N/A	4215 Diverted	N/A	
SEA Taiban Constant (Bypass Only)	35 cfs at Taiban	Typical	N/A	4,980	N/A	N/A	N/A	4215 Diverted	N/A	
No Action	35 cfs at Taiban	Typical	1,000	5,980	N/A	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	
Action Operational Scenario 1	35 cfs at Taiban	Typical	3,500	8,480	2,500	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	No shortage
Scenario 1 CID 1,500 AF/yr Shortage Example Setup	35 cfs at Taiban	Typical	3,500	8,480	1,000	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	Shortage is absorbed by CID
Scenario 1 Pecos 1,500 AF/yr Shortage Example Setup	35 cfs at Taiban	Typical	2,000	6,980	1,000	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	Shortage is absorbed by Pecos River
Action Operational Scenario 2	35 cfs at Taiban	Typical	3,500	8,480	2,500	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	No shortage
Scenario 2 CID 1,500 AF/yr Shortage Example Setup	35 cfs at Taiban	Typical	3,500	8,480	1,000	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	Shortage is absorbed by CID
Scenario 2 Pecos 1,500 AF/yr Shortage Example Setup	35 cfs at Taiban	Typical	2,000	6,980	1,000	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	Shortage is absorbed by Pecos River

Table A-1
Summary of Modeled Hydrologic Operations for Alternatives/Operational Scenarios and the Pre-91 Baseline

Model	Target Flow	Block Release Constraints[1]	Aggregate of FCP and For-bearance Used for River (AF)	Sumner Block Release Low Storage Trigger (AF) [2]	Forbearance from FSID Supply (AF/year)	Vaughn Pipeline (AF/year) [3]	Lynch Wells (AF/year) [4]	River Pumpers [5]	Seven Rivers Exchange	Comments
Scenario 3 (FSID Winter Entitlement)	35 cfs at Taiban	Typical	3,500	8,480	2,500	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	No shortage
Modified SEA Pre-91 for Scenario 3	N/A	N/A	N/A	4,980	N/A	N/A	N/A	4,215 Diverted	N/A	
Scenario 4 (FSID Shutdown)	35 cfs at Taiban	Typical	3,500	8,480	2,500	1,107.6 CIR (10 cfs for 55.8 days)	900 AF/year (2.5 cfs for 181.5 days)	No Diversion	750 AF/year Pumped into Brantley	No shortage
Modified SEA Pre-91 for Scenario 4	N/A	N/A	N/A	4,980	N/A	N/A	N/A	4,215 Diverted	N/A	

[1] A 35 cfs target at Taiban also includes a 2 cfs target at the Near Acme gage during summer months.
[2] Typical block release constraints include a 15-day maximum duration, 14-day no-release period between block releases, a maximum of 65 block-release days per year, and a no-release period for 6 weeks centered on August 1 of every year.
[3] Consumptive Irrigation Requirement (CIR) associated with groundwater lease amounts.

Additional Water Supply Modeling Results

Additional water supply resource indicator modeling results are presented in this section of the appendix. The 60-year average water supply resource indicators are shown in Table A-2 for Scenarios 3 and 4, along with the No Action Alternative and Scenarios 1 and 2, which were also presented in Chapter 4. Intermittency, flow duration, and AWN for Scenario 3 (winter entitlement) and Scenario 4 (shutdown) are not directly comparable to the No Action Alternative (which does not have the winter entitlement and shutdown features modeled within it) and are not presented here for that reason.

Table A-2
Average (60-Year) Changes in Water Supply Indicators for All Proposed Action Operational Scenarios Compared to the No Action Alternative

Alternative	Total Net Depletion to Carlsbad Project Water Supply (AF per year)	Increased CID Diversions (AF per year)	Project Water Lost to Additional Conservation Spills (AF per year)	Estimated Increase in Flows at the State Line (AF per year)	Estimated Additional Compact Delivery Obligation (AF per year)
No Action	-1,000	900	1,200	1,650	-400
Proposed Action Scenario 1	-1,500	1,400	500	1,200	-700
Proposed Action Scenario 2	-1,200	1,100	1,000	1,550	-400
Proposed Action Scenario 3 (FSID Winter)	-1,900	1,800	1,100	2,000	-100
Proposed Action Scenario 4 (FSID Shutdown)	-900	900	1,800	2,250	100

In addition to average annual water supply resource indicator results, estimated annual net depletions to CID, as estimated annual inflows at Brantley (including the primary reach transmission losses occurring from Sumner Lake to Brantley Reservoir), are presented in Table A-3. Note that the table includes only net depletion from Endangered Species Act Water (ESA Water), which in reference to the table is the sum of bypasses, FSID forbearance, and FCP releases made for the benefit of the Pecos bluntnose shiner (shiner). It does not include effects of evaporation, credit from leftover or spilled FCP, reach losses from Santa Rosa Reservoir to Sumner Lake, credit from Vaughan leasing, credit from Lynch leasing, or Carlsbad Project Water Acquisition (CPWA) through river pumper leasing (60-year model averages reflect contributions of depletion and credit from all these sources).

Technical Note: Annual net depletions cannot be quantified with typical baseline/alternative storage or transmission loss/evaporation comparisons as the 60-year average annual net depletions are computed. This is due to the unequal timing of operations between two different models. Segregating 60-year results into annual values for these types of comparisons leads to "erroneous net depletions." Please see pg. A-27 in Appendix 3 of the EIS (Reclamation 2006a) for further information on erroneous net depletions and pg. A-28 of EIS Appendix 3 for brief methodology on estimating annual net depletions to CID. Note that annual differences in flows at the New Mexico-Texas State Line and additional compact obligation as quantified with surface water modeling utilizing different operational policies are also subject to problems with these "erroneous net depletions" and currently do not have a satisfactory estimation method.

Table A-3
Estimated Additional Transmission Depletions (AF)
as Brantley Reservoir Inflow

Modeled Year	No Action	Scenario 1	Scenario 2	Scenario 3 (FSID Winter)	Scenario 4 (FSID Shutdown)
1940	1,050	1,090	1,080	1,050	1,080
1941	180	0	200	110	340
1942	0	0	20	0	20
1943	180	380	230	180	220
1944	450	490	520	410	470
1945	440	520	520	390	490
1946	650	1,330	1,460	650	730
1947	590	520	740	530	760
1948	560	670	600	460	570
1949	290	30	170	160	200
1950	120	210	90	110	120
1951	1,150	2,450	2,520	1,460	1,690
1952	650	630	730	530	640
1953	870	1,460	1,830	580	1,280
1954	1,220	2,640	2,750	1,570	1,940
1955	860	1,700	2,110	750	1,370
1956	1,340	2,600	2,860	2,660	2,830
1957	1,150	2,340	2,560	1,260	3,270
1958	0	0	0	0	0
1959	260	380	300	250	380
1960	390	410	450	380	670
1961	470	480	520	420	430
1962	560	610	560	470	730
1963	600	700	690	550	710
1964	810	1,300	1,600	710	780
1965	540	1,210	1,270	490	1,780
1966	580	610	660	520	730

Table A-3
Estimated Additional Transmission Depletions (AF) as Brantley Reservoir Inflow

Modeled Year	No Action	Scenario 1	Scenario 2	Scenario 3 (FSID Winter)	Scenario 4 (FSID Shutdown)
1967	1,120	2,330	2,440	1,190	2,050
1968	550	610	890	480	1,000
1969	410	380	450	390	440
1970	620	1,070	1,290	570	1,170
1971	1,640	3,270	3,190	2,480	2,720
1972	1,370	3,140	3,180	1,670	2,980
1973	390	210	280	340	690
1974	930	2,550	2,650	2,000	2,560
1975	520	880	1,170	440	1,390
1976	1,350	2,960	2,960	1,760	2,330
1977	1,320	2,790	2,990	1,880	2,930
1978	1,250	2,730	2,770	1,950	1,870
1979	1,010	1,920	1,870	710	1,580
1980	610	440	690	520	580
1981	1,270	2,730	2,900	1,870	2,360
1982	450	1,110	1,190	350	750
1983	450	400	490	390	440
1984	510	600	580	450	640
1985	350	200	330	210	320
1986	0	0	20	10	20
1987	170	50	230	170	200
1988	430	500	480	400	610
1989	480	500	520	440	530
1990	510	550	560	470	730
1991	210	50	230	150	210
1992	170	180	230	170	200
1993	250	170	260	190	280
1994	160	140	220	160	340
1995	140	0	100	130	30
1996	310	470	580	310	320
1997	220	50	240	160	320
1998	190	240	220	170	180
1999	270	190	300	210	380
Min	*0*	*0*	*0*	*0*	*0*
Max	*1,640*	*3,270*	*3,190*	*2,660*	*3,270*