

Chapter 2

Alternatives

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1. Introduction

This chapter describes the alternatives developed by the Bureau of Reclamation (Reclamation) and the New Mexico Interstate Stream Commission (NMISC) for conserving the Pecos bluntnose shiner (shiner) and Carlsbad Project water supply. Alternative development was guided by the National Environmental Policy Act of 1969 (NEPA), Reclamation planning regulations, input from public and agency scoping, and the efforts of technical workgroups established for this environmental impact statement (EIS).

This chapter presents the process used to develop and screen the alternatives, the elements of the No Action and action alternatives, and the process of defining and screening Carlsbad Project water acquisition (CPWA) options and additional water acquisition (AWA) options for the Carlsbad Project water supply and for the shiner, respectively. This chapter also provides a summary comparison of the alternatives and their impacts.

NEPA requires consideration of a reasonable range of management alternatives that meet the purpose of and need for the proposed action (40 Code of Federal Regulations [CFR] 1505.1(e)). The joint lead agencies also need to be responsive to issues identified during scoping; need to provide flexibility in order to address issues of uncertainty; and need to meet Federal, State, and local laws, regulations, and agreements. The alternatives include specific actions to be taken to meet the purpose of and need for the proposed action. Reclamation also developed a suite of options for acquiring water that is also needed to meet the project purpose and need. These options are not tied to particular alternatives. Not all elements of the water acquisition options can be precisely defined and analyzed. Implementation of options may require additional permitting, consultations, congressional authorization, and NEPA analysis. Additional NEPA analysis is expected to include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some actions, resource-specific field studies (cultural and biological resource studies) may be conducted. Entities other than Reclamation may need to implement some of these options. Reclamation actions must be in accordance with its existing Federal and State legal and statutory authorities and obligations, the Pecos River Compact (Compact), water rights, and contractual obligations. Figure 2.1 shows the alternative and water acquisition option development process.

Alternative and Option Development Process

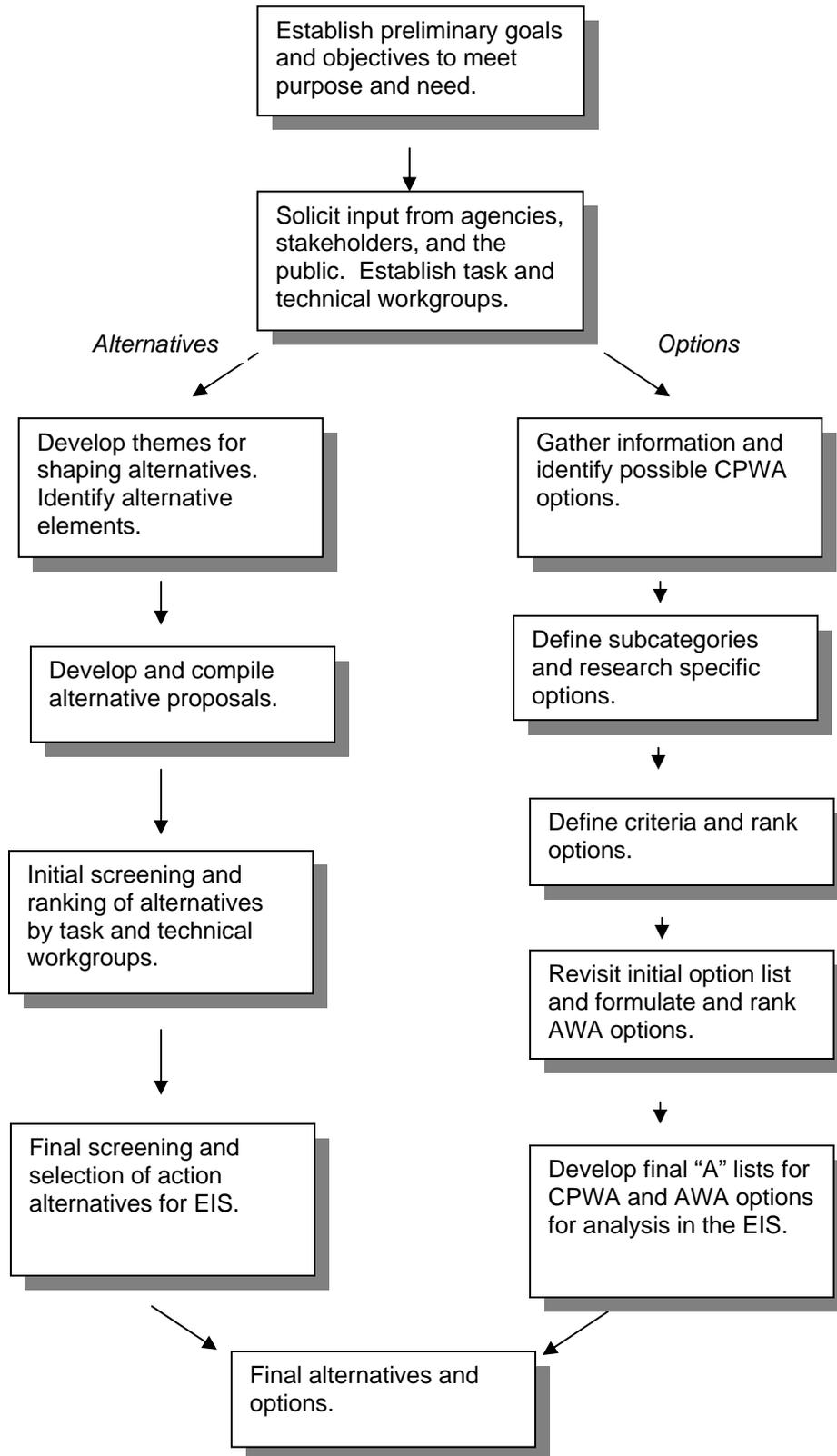


Figure 2.1 Alternative and option development process.

2. Alternative Development Process

Reclamation and NMISC developed the alternatives through a systematic process that used public input, research and recommendations from technical workgroups, and professional judgment. The process began with consideration of the dual purposes of the proposed action: (1) Reclamation's proposed changes in Carlsbad Project operations to conserve the shiner and (2) implementation of a water acquisition program to conserve the Carlsbad Project water supply. Comments were solicited from cooperating and participating agencies, resource specialists, and the public on how to meet these purposes and the range of issues to be analyzed in the EIS. Public scoping meetings were held in Santa Rosa, Fort Sumner, Carlsbad, and Roswell, New Mexico. Issues and alternatives identified in scoping and agency meetings in 1999 for the earlier proposed environmental assessment also helped direct the early alternative development process.

In October 2002, an alternatives development workgroup was formed with representatives and technical specialists from the cooperating agencies to fully consider all concepts and suggestions in formulating alternatives. During its first meeting, the alternatives development workgroup established a process for developing alternatives that included defining goals and objectives, establishing preliminary alternative themes, refining the themes into alternatives, establishing other actions required to finalize the alternatives, determining the viability of each alternative by comparing it to the goals and objectives, and moving forward to analyze the viable alternatives.

The workgroup first defined preliminary goals and objectives to meet the purpose of and need for the proposed action. The goals cited by the workgroup were to protect and conserve the shiner through management of water operations and other measures and to ensure that these actions do not impair the Carlsbad Project water supply. The alternatives development workgroup outlined the following objectives:

- To conserve the shiner
- To eliminate additional depletions
- To bypass flows for the benefit of the shiner, when possible
- To act in accordance with existing Reclamation authorities governing dam operations and the release and use of Carlsbad Project water
- To avoid impacting Fort Sumner Irrigation District (FSID) water users
- To comply with New Mexico State water law and water rights appropriation

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- To act in accordance with the State of New Mexico's State line delivery obligation to the State of Texas under the Pecos River Compact
- To acquire water rights from willing sellers
- To comply with storage limits
- To comply with the Endangered Species Act of 1973, as amended (ESA) for other species

The alternatives development workgroup considered several preliminary themes for shaping the alternatives. Initial alternative themes included higher target flows, current target flows, modified pre-1991 operations, natural hydrograph, and shiner habitat needs. Technical workgroups were assigned to refine the parameters and specific components of each preliminary alternative theme. The technical workgroups expended considerable effort in exploring these themes, but, ultimately, the alternatives development workgroup determined that the alternatives should focus on water operations and target flows. For example, the attempt to define an alternative designed around shiner habitat needs requires a better understanding and agreement on habitat needs than is possible at this point and may be limited by the range of actions available to the responsible agencies. Target flows and the rules for block releases became the primary variables among the preliminary alternatives considered. Table 2.1 outlines the range of elements that were considered in developing the preliminary alternatives.

Concurrently, a water offset options group was formed to gather information and evaluate possible options for augmenting the Carlsbad Project water supply. Modifying operations and bypassing flows through Santa Rosa and Sumner Dams to benefit the shiner have increased channel transmission losses. Typically, the most efficient way to move water through the river channel is to release a large volume of water quickly from a dam in what is called a "block release." Maintaining a slow, steady flow, such as a low-flow bypass, is less efficient in delivering Carlsbad Project water to the Carlsbad Irrigation District (CID) than a high-flow block release.

The purpose of and need for the proposed action requires conserving the Carlsbad Project water supply; thus, additional water needs to be acquired. These options are called Carlsbad Project water acquisition or CPWA options. The water offset options group also looked at proposals for direct water acquisition to augment riverflows to conserve the shiner, herein referred to as additional water acquisition or AWA options. The water offset options group worked independently of the alternatives development process to consider these options and to provide Reclamation with information on the relative merits of each. The effects of CPWA and AWA options are analyzed to the extent possible in this EIS, but some options may require further analysis and permitting to be implemented. These options were developed without seeking a definitive determination of

the authority of Reclamation or other agencies for their implementation. Reclamation, like all agencies, is limited to implementing actions that are within its authority. NEPA, however, requires consideration of all reasonable alternatives within or outside the jurisdiction of the Federal agency (40 CFR 1502.14). New authorities could be sought, or other entities may be able to acquire water using options analyzed here. The water offset options group screening processes are described in greater detail in Section 8, “CPWA Options Development Process.”

Table 2.1 Preliminary alternative elements

Element	Issues and variables
Flow	Target flows versus minimum/maximum flows
Flow	Target flows versus range of target flows
Flow	Variable target flows by season: irrigation/nonirrigation
Flow	Variable target flows by wet/dry/average hydrologic period
Flow	Target flows: ranging from 0 to 72 cubic feet per second (cfs) at Near Acme and Taiban gages
Block releases	Duration of individual releases
Block releases	Duration of releases per season
Block releases	Frequency: number of days between releases
Block releases	Delivery efficiency targets
Block releases	Magnitude of releases: ranging up to 1,400 cfs
Block releases	Block release ramp up/ ramp down: ranging from none to complex prescriptions
Block releases	Spawning spikes: releases timed to encourage fish spawn
Block releases	Season/time of year: restrictions by season, time of year
Habitat/conservation measures	Removal of non-native riparian vegetation
Habitat/conservation measures	Channel restoration: 15 miles south of Artesia, Bitter Lake
Habitat/conservation measures	Fish conservation pool: establish a pool of water in Sumner Lake to be released to benefit the shiner. Use wells at Seven Rivers to replace Carlsbad Project water used. (Note: a fish conservation pool (FCP) was established prior to release of the draft EIS.)
Habitat/conservation measures	Use pumps upstream of Near Acme gage
Habitat/conservation measures	Diversion to storage
Habitat/conservation measures	Buy or lease land to allow water to remain in the river or ground water system

2.1 Alternative Formulation and Evaluation Criteria

Alternative proposals suggested through public scoping, or developed by cooperating agencies and stakeholders, were compiled into a master alternative

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What are CPWA and AWA Options?

CPWA and AWA options are two sets of proposals for adding water to the Pecos River. **Carlsbad Project water acquisitions** focus on providing water to the Carlsbad Project for use in CID in compensation for depletions incurred as a result of changes in operations.

Additional water acquisitions focus on providing additional flows to meet target flows upstream where the shiners are found and to avoid intermittency in the river. Options provided in these sets are not necessarily mutually exclusive.

development matrix. The matrix included the full range of alternative elements that had been identified by the alternatives development workgroup and was a comprehensive list of alternatives that had been proposed by May 2003. Corrections and additions were made after an initial distribution to the study's interdisciplinary team and the alternative development, hydrology, biology, and water acquisition option workgroups for a preliminary review. After this review, the matrix included 28 potential alternatives (Reclamation, 2005).

Workgroups internally developed screening or ranking criteria to apply to this master alternative development matrix. The hydrology workgroup ranked each alternative on the basis of estimated net depletions associated with prescribed block release patterns and target flows designed to benefit the shiner. Net depletions are the additional depletions caused by a modification to operations. These additional depletions were determined against an established baseline scenario that is based on pre-1991 operations.

The biology workgroup screened the alternatives on the basis of the following criteria. An alternative was considered viable if it:

- Proposed appropriate target flows, or range of flows, that would manage water to avoid intermittency, to the extent possible, and protect and conserve the shiner and its critical habitat.
- Allowed, to the extent possible, the cessation of block releases of irrigation water for CID 4 to 6 weeks in July and August of each year to protect young-of-year fish (currently understood to be the peak time for the shiner to spawn).
- Did not suggest the manipulations of irrigation block releases that result in additional net depletions without it being demonstrated that there is a meaningful biological reason to do so (Reclamation, 2003).

Each criterion was given equal weight and applied in its respective category. If any one criterion caused the alternative to fail in its category, the biology workgroup eliminated the alternative from further consideration.

The water offset options group did not provide a formal screening process for the alternatives. Group members concluded that alternatives should first address the

conservation needs of the shiner based on biological considerations, followed by a determination of the potential depletions from hydrologic considerations. The role of the water offset options group was to propose and assess options for acquiring water to address net depletions, determine their potential costs, and quantify the amount of water that could be realized. The group did not attempt to determine a maximum available offset amount because this would most properly be a management decision based on balancing the flow requirements for conserving the shiner with the availability of funding and the environmental consequences of water acquisition options.

Representatives of the workgroups initially screened each alternative during meetings of the alternatives development workgroup. Additional alternatives were proposed to combine similar proposals and to address issues identified in this initial screening. A formal screening of all alternatives by the hydrology and biology workgroups followed; the formal screening resulted in a consensus alternatives list of five action alternatives and the No Action Alternative.

Section 5, “Alternatives Considered But Not Analyzed in Detail,” provides additional discussion of alternatives and alternative elements that were considered but not further analyzed. Reclamation formulated the final suite of alternatives by restoring an alternative that had been previously combined with others.

2.2 Summary of Alternatives

Table 2.2 provides a summary of the final alternatives, specifies target flows and minimum flows, and indicates U.S. Geological Survey (USGS) gage locations for monitoring flows. Target flows for the alternatives are either constant or variable by time of year or by whether hydrologic conditions are dry, average, or wet. The defined target flows do not preclude enhancing base inflows beyond target flows, if additional water is available and the Carlsbad Project water supply is conserved. The Near Acme gage on the Pecos River northeast of Roswell, New Mexico, is currently used to monitor target flows in critical habitat for the shiner. (See map 2.1.) Some alternatives include proposals to monitor target flows at the Taiban gage (located ½ mile downstream from the confluence of the Pecos River with Taiban Creek). Use of this gage may provide additional information on river conditions in the shiner upper critical habitat and improve the success of maintaining flows. The Near Dunlap gage is located in the middle of the upper critical habitat, 53 miles downstream from Sumner Dam and 52 miles upstream of the Near Acme gage. Target flows are not proposed at the Near Dunlap gage in the alternatives, but this location would also be used in monitoring flows for the Adaptive Management Plan (AMP).

Under all action alternatives, additional water would be acquired to ensure that the Carlsbad Project water supply would be conserved. Options for acquiring water for both the Carlsbad Project water supply and for augmenting flows for the shiner were screened, and “A” lists for each option were developed for analysis in this EIS. Sixteen “A” list CPWA options and 18 “A” list AWA options were identified and are listed in sections 8 and 10, respectively, of this chapter. Some

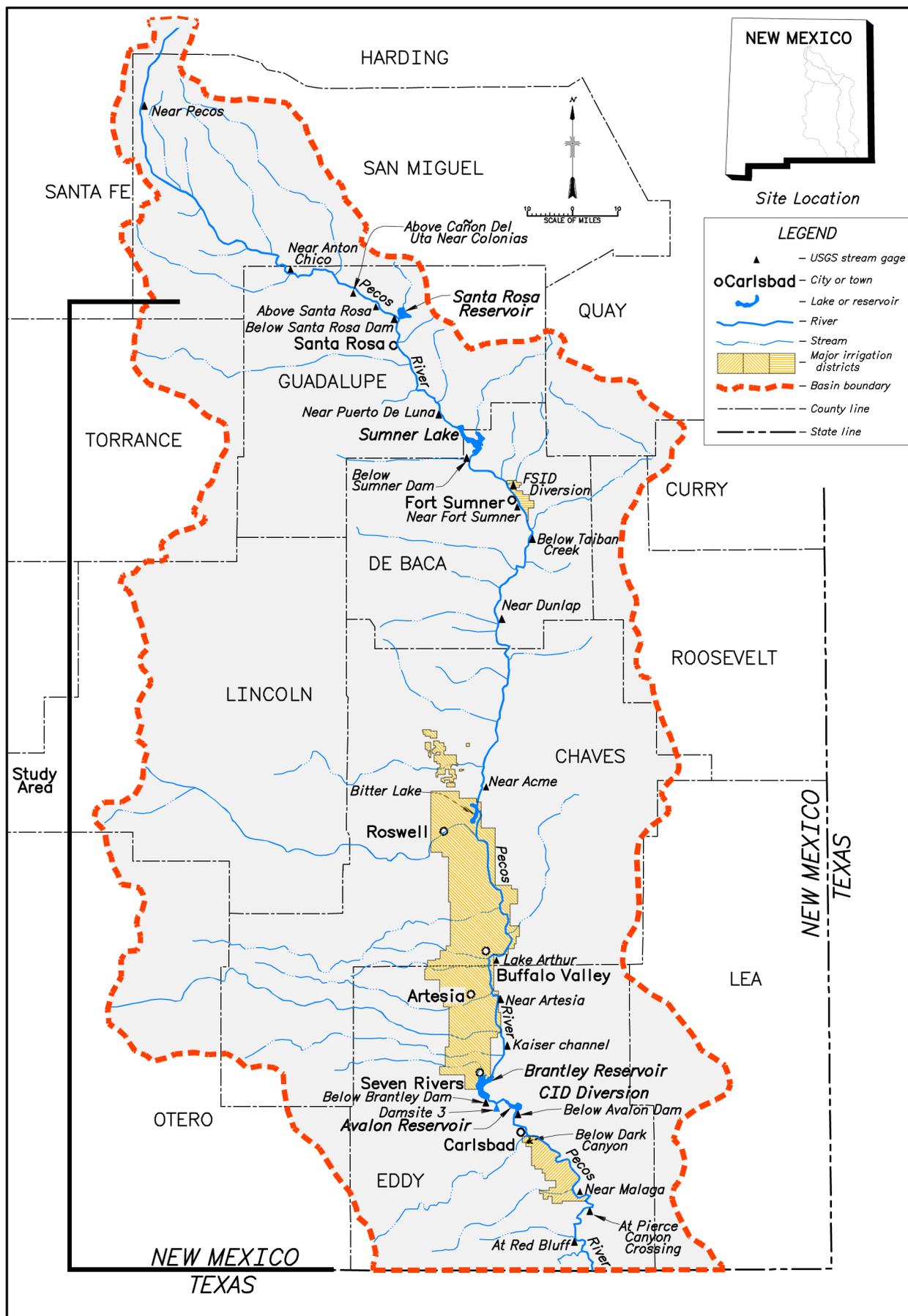
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of the options are the same action but have been developed using a different cost estimate for acquiring water. These options are not linked to specific alternatives but, instead, represent a suite of potential sources for water acquisition. The CPWA and AWA options are not necessarily mutually exclusive. The effects of each of the “A” list options are analyzed to the extent possible, but many would require further analysis to implement. Entities other than Reclamation may need to implement some of the options.

Table 2.2 Carlsbad Project Water Operations and Water Supply Conservation EIS alternatives

Alternative	Range of flows ¹						Block release protocols	Other elements
	Dry		Average		Wet			
Alternative	Nonirrigation season target flows	Irrigation season target flows	Nonirrigation season target flows	Irrigation season target flows	Nonirrigation season target flows	Irrigation season target flows	Time of year, magnitude, frequency, duration, ramp down	Water acquisition, shiner conservation and management measures, adaptive management
Taiban Constant	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	Time of Year: On CID request. Avoid releases during 6 weeks around August 1. Magnitude: On CID request and to maximize efficiency. Frequency: On CID request, but a minimum of 14 days between block releases. Duration: 15-day maximum per release. Maximum of 65 days per year. Ramp down: No ramp down required.	Within Reclamation's authorities, acquire water for the Carlsbad Project and for the shiner using respective “A” list options. Maintain fish conservation pool (FCP). Implement AMP. Continue existing shiner management measures and cooperate with others in shiner conservation measures.
Taiban Variable	35 cfs Taiban	45 cfs, -5, +10 Taiban	35 cfs Taiban	45 cfs, -5, +10 Taiban	35 cfs Taiban	45 cfs, -5, +10 Taiban		
Acme Constant	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme		
Acme Variable	35 cfs Acme	12 cfs Acme	35 cfs Acme	24 cfs Acme	35 cfs Acme	48 cfs Acme		
Critical Habitat	35 cfs Taiban minimum	Critical habitat kept wet; avoid intermittency Acme	35 cfs Taiban minimum	5 cfs Acme	35 cfs Taiban minimum	10 cfs Acme		
No Action (operations, based on 2003-2006 BO)¹	35 cfs Acme	Upper critical habitat kept wet; avoid intermittency Acme	35 cfs Acme	20 cfs Acme	35 cfs Acme	35 cfs Acme		

¹Target flows are based on the Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam Operations, March 1, 2003, through February 28, 2006, dated June 18, 2003 (BO) (U.S. Fish and Wildlife Service [Service], 2003).



Map 2.1 Pecos River stream gage locations

In accordance with the Council on Environmental Quality (CEQ) regulations implementing NEPA, a No Action Alternative must always be evaluated in an EIS. The No Action Alternative represents a projection of current conditions to the most reasonable future conditions and impacts that could occur if none of the action alternatives were implemented. The No Action Alternative may not meet the purpose of and need for the proposed action, but it is the basis for comparison of the impacts with other alternatives. The No Action Alternative for this DEIS is based on current water operations; the Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam

Why is a Determination of Hydrologic Condition Needed?

The formula for determining hydrologic conditions is derived from the Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam Operations, March 1, 2003, through February 28, 2006, dated June 18, 2003 (BO) (Service, 2003). To better manage river operations, an assessment of the current hydrologic condition is used to help ensure that water is available to maintain target flows. For this EIS, the No Action, Acme Variable, and Critical Habitat Alternatives vary target flows based on dry, average, or wet hydrologic conditions.

What is the Relationship Between Alternatives and Water Acquisition Options?

Alternatives are the six proposals for changes to Carlsbad Project water operations to conserve the shiner. They vary primarily in the target flows specified at the Near Acme or Taiban gages. Changes in Carlsbad Project operations would cause further depletions to the Carlsbad Project water supply, which is chronically short and must also be conserved. The amount of depletions anticipated varies by alternative.

Water acquisition options are a suite of prescreened potential sources of acquiring additional water for the Carlsbad Project (16 options) or for maintaining flows for the shiner (18 options). These options are not linked to specific alternatives, are analyzed independently, and are not necessarily mutually exclusive. When an alternative is chosen, any option or combination of options could be developed further to address depletions or provide water for the shiner. Additional planning and permitting may need to be conducted. Some options may not be within the current authority of Reclamation and may need to be implemented in cooperation with other entities.

Operations, March 1, 2003, through February 28, 2006, dated June 18, 2003 (BO) (U.S. Fish and Wildlife Service [Service], 2003); and other current and anticipated actions, trends, and agreements affecting flows and availability of water in the Pecos River basin.

A fish conservation pool (FCP) would be maintained in Santa Rosa Reservoir and Sumner Lake and managed for the benefit of the shiner. Each action alternative includes common guidance for block releases. The action alternatives include an AMP that is intended to monitor target flows and net depletions; to establish procedures when compliance with target flows is threatened; and to respond to new information and changing conditions. Under the action alternatives, Reclamation would cooperate with other agencies in ongoing and future conservation measures, including developing wells and pumping infrastructure for supplementing short-term flows, removing non-native riparian vegetation, participating in channel

How are Dry, Average, and Wet Hydrologic Conditions Determined?

The target flows for the No Action, Acme Variable, and Critical Habitat Alternatives vary based on dry, average, or wet hydrologic conditions. Hydrologic conditions are currently assessed using the methodology defined in the BO (Service, 2003). An annual assessment is made with the possibility for adjustment throughout the irrigation season. Dry, average, and wet hydrologic conditions are based on “effective Brantley storage” in conjunction with the Palmer Drought Severity Index (PDSI). Effective Brantley storage is an approximation of CID’s storage as if all of the water were stored in Brantley Reservoir. Effective Brantley storage is determined as follows:

Avalon storage + Brantley storage + (0.75 x Sumner storage) + (0.65 x Santa Rosa storage)

The monthly PDSI records from 1895 to 2003 were averaged to derive previous 9-month and 2-month average values on each April 1 evaluation date. Results were then classified for each interval (9 months, 2 months, and 1 month) as dry, average, or wet. If all indices were average, then that year was average. However, if any one of the indices was wet or dry, then that year was classified as such. None of the years had both wet and dry indices. As a result of this analysis, the following definitions were developed:

- Dry hydrologic condition: Effective Brantley storage is less than 75,000 acre-feet.
- Average hydrologic condition: Effective Brantley storage is greater than 75,000 acre-feet and less than 110,000 acre-feet.
- Wet hydrologic condition: Effective Brantley storage is greater than 110,000 acre-feet.

Storage would be assessed initially on March 1. However, because the amount of water in the system can change dramatically in the Pecos River basin, Reclamation, the Service, NMISC and other interested parties would meet regularly (May 1, June 1, July 15, and September 1) to assess whether the amount of water in storage has markedly increased or decreased. Target flows for alternatives that vary by hydrologic condition could be adjusted if there were a substantial increase or decrease in seasonal storage, consistent with prudent water management practices and fish conservation needs (Service, 2003).

restoration projects, and other direct and indirect actions to enhance shiner conservation. Reclamation participation would be limited by its authority, and most of these measures would require additional permitting and project-specific NEPA analysis.

3. Alternative Assumptions

3.1 Target Flows

Each of the alternatives prescribes target flows as measured at specific gage locations. These target flows would be monitored according to methods to be outlined in the AMP. Target flows are a goal, and they do not preclude higher flows or the possibility that target flows would not be met 100 percent of the time. Declines in shiner population have been associated with recent periods of intermittency. Keeping the river whole and avoiding intermittency is an important priority for conserving the shiner and in reversing the reported decline in shiner populations (Kehmeier, et al., 2004). Intermittency affects fish in two ways. First, drying of the channel traps fish in isolated pools which exposes fish to internal and external predators. Extended drying will degrade water quality conditions, further stressing fish to the point of death, and eventual dewatering of the pool

altogether. Secondly, movement and migration of the shiner helps redistribute and repopulate upstream habitats. Intermittency disrupts this process and affects

upstream population numbers. If intermittency does occur, the next priority would be to provide a continuous flow in the upper critical habitat. Rewetting of the river should be carefully assessed to avoid further isolating shiner in disconnected pools. Reclamation would fully use its authorities and discretion to prevent intermittency to the greatest extent possible, but intermittency could occur under all alternatives. Additional water could be acquired under the AMP process to keep the river whole.

3.2 Sumner Dam Operations

Reclamation has limited opportunities and discretion to store and release water from Sumner Lake under its State water rights permit and the Sumner Dam authorization. Reclamation must bypass through Sumner Dam the current amount of natural flow water that FSID is entitled to, an amount that is determined by the New Mexico Office of the State Engineer (NMOSE) using a flow calculation based upon flows from the previous 2 weeks at the Above Santa Rosa, Below Santa Rosa, and Near Puerto de Luna gages. If there is inflow into Sumner Dam in excess of the amount that must be bypassed for FSID, Reclamation would bypass all or a portion of that additional inflow as necessary to meet the downstream target flows. The additional inflows that are not bypassed would be diverted to storage for the Carlsbad Project. FSID may request that its water not be bypassed, which can occur when the soil is too wet to irrigate.

3.3 Block Releases

Water would be released from storage at the request of CID for the beneficial use of irrigation. The magnitude of individual releases would be set, based on the request of CID. With typical reservoir elevations, releases are limited to approximately 1,400 cubic feet per second (cfs) and, at full reservoir elevations, flows greater than 1,600 cfs are not possible. Historically, releases average approximately 1,060 cfs. Releases would be made in a manner to maximize efficiency and to avoid excessive losses through seepage and evaporation. No ramp up or ramp down of releases would be required. In the past, releases were sometimes initiated gradually (ramp up) and/or ended gradually (ramp down) with the intention of benefiting the shiner. There is a lack of consensus on the value of these releases to the shiner, and they are associated with large depletions. The duration of individual block releases from Sumner Lake would be restricted to a maximum of 15 days to avoid transporting shiner eggs and larvae into Brantley Reservoir. The frequency of block releases would be at the request of CID. There should be a minimum of 14 days between individual block releases. The cumulative duration of block releases from Sumner Lake in a calendar year would be restricted to a maximum of 65 days. All alternatives, except the No Action Alternative, include a stipulation that block releases should be avoided, if possible, during the 6 weeks around August 1 to reduce the impacts of releases on shiner reproduction. Under certain conditions, a release during this period may be desirable if needed to avoid intermittency or if demand is higher than expected during this time.

3.4 Adaptive Management Plan

The use of an AMP is specified as part of all of the action alternatives. An interagency workgroup developed an AMP focusing on the preferred alternative. (See attachment 2, “Adaptive Management Plan.”) Adaptive management is defined as follows:

... a cyclic learning-oriented approach to managing complex environmental systems with high levels of uncertainty about system processes and the potential ecological, social, and economic impacts of different management options. Adaptive management establishes a procedure for monitoring the results of management actions and integrating this new knowledge into future policy and management actions (Jacobson, 2003).

Adaptive management is based on the recognition that knowledge about natural resource systems and the effects of management actions are often uncertain and may require changes in management to respond to dynamic conditions. The adaptive management process provides a defined procedure to address uncertainty and respond to change.

3.4.1 Roles and Responsibilities

Reclamation would implement the AMP within the context of the existing Pecos River water management working group, consisting of Federal, State, and local agency managers and representatives, researchers, and water users. Interagency cooperation, long-term commitments, regular communications, and scheduled meetings are necessary for a successful adaptive management strategy. Pecos River stakeholders have different interests, legal rights, and responsibilities with regard to river management. Likewise, there is some disagreement on flow and habitat needs of the shiner and the effects of management actions.

What is the Purpose of an Adaptive Management Plan?

An Adaptive Management Plan provides a means to address **uncertainty**. Changing conditions in the future related to climate, hydrology, water use, and other factors will result in unexpected situations. The AMP serves as a guide for monitoring target flows, addressing actions to be taken for target flows that are in jeopardy, and addressing changing conditions in the future management of river operations by modifying operations within established parameters. The AMP provides a framework to ensure that the preferred alternative meets the purpose of and need for the proposed action.

The AMP would provide a structure for making decisions in this uncertain environment and provide conflict resolution methods that respect the different roles of stakeholders.

3.4.2 Communication Process

Reclamation will take the lead role in communication. During the irrigation season (March through October), Reclamation will coordinate weekly conference calls on flows and river operations and distribute weekly logs to the stakeholders. The conference calls will be the primary means of coordinating in response to changing

conditions along the Pecos River. Key adaptive management indicators such as gage measurements, flows, and intermittency will be discussed regularly. Other criteria will likely be discussed as appropriate.

During the year, the indicators will be monitored regularly to keep the Reclamation river operations manager informed of changing conditions in the river. The Reclamation river operations manager will be informed as soon as possible (within 24 hours) whenever a key trigger has been activated. The response process will then be followed.

Reclamation will prepare an Annual Adaptive Management Report after the end of the calendar year. An annual meeting of the Pecos River Stakeholder Group will be held to discuss the status of the AMP. The focus of the meeting will be on the review of the Annual Adaptive Management Report. The status of the indicators will be discussed, and needed changes to monitoring will be identified.

3.4.3 Documentation and Reporting

Reclamation will manage the documentation and reporting process for the AMP. Monitoring results will be incorporated into the Annual Adaptive Management Report. The report will describe the previous calendar year—January 1 through December 31. Monitoring results for each indicator will be incorporated into the report. In addition, the report will analyze trend data for indicators to determine if responses are needed to long-term changing conditions. The report could include recommendations for monitoring and river management for the next year. The annual report will be coordinated with the annual water accounting process. When a trigger has been activated, it will be logged, and the response process will be initiated.

3.4.4 Actions Available to Reclamation

The AMP is designed to ensure compliance with the long-term BO and the Record of Decision (ROD) for the Carlsbad Project Water Operations and Water Supply Conservation EIS. Actions currently available within Reclamation authority to change waterflows in the Pecos River include (not listed in any priority order): (1) releasing bypass water; (2) releasing FCP water to prevent intermittency in the shiner upper critical habitat; (3) obtaining water from the CPWA or AWA options as described in the EIS; (4) coordinating with CID for block releases; or (5) initiating other similar actions within Reclamation's authority. Such actions will be initiated by Reclamation according to the AMP in conformance with the Biological Opinion and ROD.

3.4.5 Criteria, Triggers, Monitoring, and Response

The core components of the AMP are criteria, triggers, monitoring, and response. These four components are described for the following indicators:

1. Intermittency
2. EIS target riverflows
- 2a. Gaining riverflows below Taiban

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3. Flow monitoring
4. Incoming flows available for bypass
5. Block releases
6. Life stage of shiner
7. CID status
8. Aquifer storage and base inflows from the Roswell ground water basin

The AMP defines thresholds that will trigger management responses if flow targets are not met or if Carlsbad Project water acquisitions are not sufficient to meet the purpose and need. The AMP describes the range of management options and the priorities for addressing unmet flow and offset targets (attachment 2).

3.4.6 Other Management Actions

Additional measures that complement the purpose of and need for the proposed action, such as salt cedar removal, habitat improvement projects, use of refugia, well and pumping infrastructure, or development of additional water sources, are anticipated and are not precluded by the ROD. Opportunities may exist in which additional water is temporarily available to enhance base inflows beyond target flows. Likewise, Reclamation anticipates that monitoring, new knowledge, and new technologies could lead to revised goals and new proposals. The AMP provides a decision and reporting process for considering other management actions or modifying operations within established parameters analyzed in this EIS in response to changing conditions. Actions not evaluated in this EIS would require additional NEPA compliance.

4. Alternatives Analyzed In Detail

4.1 No Action Alternative

Under the No Action Alternative, Reclamation would continue to manage Carlsbad Project operations in accordance with the 2003-2006 BO, Reclamation authorizations, water rights, and contractual obligations (Service, 2003). These management actions include operating Sumner Dam in a manner that not only seeks to avoid jeopardizing the shiner, but also conserves and protects the species under section 7(a)(1) of ESA. Prior to expiration of the 2003-2006 BO, Reclamation entered into section 7(a)(1) consultation with the Service to define management actions for the interim period before the ROD for this EIS. The No Action Alternative (current operations) includes the conservation of the Carlsbad Project water supply through lease of various water rights, an operational practice that would continue if this alternative were selected.

4.1.1 Target Flows

Under the No Action Alternative, target flows defined in the 2003-2006 BO would continue. Target flows vary by dry, average, and wet hydrologic conditions and by season, as defined in the 2003-2006 BO. (See sidebar entitled, “How are Dry, Average, and Wet Conditions Determined?”)

During dry hydrologic conditions from March 1 to October 31 (irrigation season), Reclamation would maintain flow through the upper critical habitat and avoid intermittency at the Near Acme gage, if at all possible. Block releases are suggested to be scheduled from May to September to alleviate the lowest of flows. In dry hydrologic conditions, the intent is to avoid intermittency, if at all possible. If not enough water is available to maintain a connected river, then, at a minimum, flowing water should be maintained through the upper critical habitat. Maintaining flows would provide at least a minimal amount of habitat for the shiner and reduce mortality of all life stages from entrapment in isolated pools. The No Action Alternative would seek to avoid rewetting or reconnecting the river if intermittency is likely to occur again, especially if dry conditions threaten to persist, because rewetting can cause further harm to fish if they become stranded later. From November 1 to February 28 (nonirrigation season), Reclamation would target flows of 35 cfs at the Near Acme gage.

During average hydrologic conditions, Reclamation would target flows of 20 cfs at the Near Acme gage during the irrigation season. Block releases would be scheduled from May to September to alleviate low flows during the irrigation season. During the nonirrigation season, Reclamation would target flows of 35 cfs at the Near Acme gage.

During wet hydrologic conditions, Reclamation would target flows of 35 cfs at the Near Acme gage throughout the year. Whenever possible, higher flows should be bypassed for the shiner and maintenance of channel morphology. Reclamation would fully use its authorities and discretion to prevent intermittency to the greatest extent possible, but it could occur under all alternatives.

4.1.2 Block Releases

Under the No Action Alternative, block release protocols would be the same as under the other alternatives, except that the 2003-2006 BO does not stipulate that block releases should be avoided during the 6 weeks around August 1. The frequency of block releases would be at the request of CID; there should be a minimum of 14 days between block releases. According to the BO, there may be times when the Pecos River is anticipated to have substantial intermittency. If there is only enough stored water available for one block release, Reclamation should attempt to schedule multiple smaller block releases with CID, to the extent that it is possible within beneficial use constraints.

4.1.3 Carlsbad Project Water Acquisition

Reclamation would continue to acquire additional water to conserve the Carlsbad Project water supply. Ongoing actions to conserve the shiner result in the need to acquire additional supply. Sources of water could include those water acquisition options and priorities developed by the water offset options group.

4.1.4 Supplemental Water

Reclamation would continue to pursue agreements with FSID to lease a minimum of 20 percent of the irrigated acres in FSID. Reclamation recognizes that some

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current or anticipated water sources may not be available. If 20 percent of FSID's historical diversion amount were leased, Reclamation anticipates that approximately 16 cfs of water could be bypassed through the FSID Diversion Dam for the shiner.

Reclamation would continue to lease and pursue additional leases of water rights from ground water pumpers upstream of the upper critical habitat and pump the water to the Pecos River.

Reclamation would continue discussions with FSID about ceasing the pump-back operation when flows at the Taiban gage are less than 35 cfs. The pump-back operation is an action taken by FSID to pump flows directly out of return canals and reapply that water to nearby farmland within the district. When water is pumped out of return canals, return flows to the river are reduced or eliminated, which results in reduced riverflows and a greater probability of intermittency, especially in dry years. Although ceasing the pump-back operation would provide immediate water to the river, it is not known when or if an agreement can be reached on this source of water.

4.1.5 Shiner Management Measures

In cases of intermittency, Reclamation would follow procedures outlined in the BO for documenting and recording the extent of intermittency and its effect on the shiner. If the level of incidental take defined in the BO were exceeded, Reclamation would again consult with the Service and review the management measures. Reclamation would immediately provide the Service with an explanation of the cause of the taking and would review with the Service the possible need for modifying reasonable and prudent alternatives for managing the shiner within Reclamation's authority.

Reclamation would continue to conduct regular meetings of the existing Pecos River water management working group, consisting of managers, agency representatives, researchers, and water users, who would work to reach a common understanding of the issues, to build trust among the groups, and to develop innovative ways to manage the river to reduce the incidental take of the shiner.

4.1.6 Fish Conservation Pool

Reclamation would maintain the current 500-acre-foot FCP and continue working with NMISC, CID, and the Service to create a larger FCP in Santa Rosa Reservoir and/or Sumner Lake, consistent with State and Federal law. Storage currently is not subject to accounting for evaporative losses or losses attributable to reservoir spills. A larger pool would provide more flexibility and management options to respond to river conditions. The current 500-acre-foot pool cannot be exceeded unless authorized and funded by the Congress. Fish conservation water would be released to protect the shiner during low-flow periods by preventing intermittency in the upper critical habitat, to the extent possible.

Reclamation would continue to exchange artesian ground water (250 to 375 acre-feet) for surface water. Reclamation has authority to continue to pump water from wells in the Seven Rivers area to replace depletions caused by modified operations at Sumner Dam. An equivalent amount of water (approximately 500 acre-feet, accounting for delivery losses) could be stored in Sumner Lake and released downstream to maintain flows.

4.1.7 Shiner Conservation Measures

Reclamation would consider and cooperate with other entities in developing conservation programs for the benefit of the shiner, as detailed in the BO. Conservation recommendations are discretionary agency activities designed to minimize or avoid adverse effects of an action on listed species or critical habitat, to help implement recovery plans, or to develop information.

4.2 Taiban Constant (Preferred) Alternative

4.2.1 Target Flows

Reclamation has identified the Taiban Constant Alternative as the preferred alternative for this EIS. (See section 6 for selection criteria.) Under this alternative, Reclamation would target year-round flows of 35 cfs at the Taiban gage. The goal of the Taiban Constant Alternative is to avoid intermittency in the reach between the Taiban and Near Acme gages. Using the modeled average loss relationships between the Taiban and Near Acme gages, the Taiban target flows would provide a range of 2 to 20 cfs at the Near Acme gage, depending on hydrologic condition. Even when the target flows are being met, intermittency could still occur. Additional water could be acquired under the AMP process to keep the river whole.

4.2.2 Block Releases

Under the Taiban Constant Alternative, block release protocols would be the same as under all of the other action alternatives. No ramp up or ramp down of releases would be required. The duration of individual block releases from Sumner Lake would be restricted to a maximum of 15 days to avoid transporting shiner eggs and larvae into Brantley Reservoir. There should be a minimum of 14 days between individual block releases. The cumulative duration of block releases from Sumner Lake in a calendar year would be restricted to a maximum of 65 days. The frequency of block releases would be at the request of CID, but block releases during the 6 weeks around August 1 should be avoided, if at all possible, to reduce the impacts of releases on shiner reproduction. If the shiner have spawned, fertilized eggs can be washed down into Brantley Reservoir and not develop into maturity. CID, Reclamation, and the Service may coordinate on conducting a release during this period if water is available. A release may be desirable if needed to avoid intermittency, stimulate a spawn, or meet demand.

4.2.3 Carlsbad Project Water Acquisition

The Carlsbad Project water supply would be conserved through actions and priorities developed by the water offset options group and implemented by

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Reclamation. Bypassing inflows through Sumner Lake would deplete the water supply because the transmission efficiency of low-flow bypasses through the reservoir would be reduced. The amount of anticipated net depletions varies by alternative. The water offset options group examined and ranked options on their effectiveness for providing additional water for the Carlsbad Project water supply. The projected water amounts available would be further reduced by losses incurred in the conveyance of water to Brantley Reservoir. Any combination of options or single option may be used. Depletion accounting methodology (including water banking) and monitoring would be determined as part of a separate process. These options and their rankings are described in detail later in this chapter.

4.2.4 Additional Water Acquisition

Reclamation has identified options for direct water acquisition to augment riverflows to conserve the shiner. These options would provide water to upper reaches of the Pecos River system when changes in Carlsbad Project operations alone would not provide adequate flows to meet target flows or minimally avoid intermittency. The water offset options group examined and ranked these AWA options, which are described in detail later in this chapter.

4.2.5 Shiner Management Measures

Reclamation would continue to conduct regular meetings of the existing Pecos River water management working group, consisting of managers, agency representatives, researchers, and water users, who would work to reach a common understanding of the issues, to build trust among the groups, and to develop innovative ways to manage the river to reduce the incidental take of the shiner.

4.2.6 Fish Conservation Pool

Reclamation would maintain a permanent FCP in Santa Rosa Reservoir and Sumner Lake. The current 500-acre-foot pool would be used to provide water to maintain flows in the critical habitat for the benefit of the shiner. Reclamation would continue using the FCP to prevent intermittency in the upper critical habitat, to the extent possible. Reclamation would continue working with NMISC, CID, and the Service to create a larger FCP in Santa Rosa Reservoir and/or Sumner Lake, consistent with State and Federal law. A larger pool would allow more flexibility and management options to respond to river conditions, but would require congressional authorization and funding.

4.2.7 Shiner Conservation Measures

Reclamation would consider and cooperate with other entities in developing conservation programs for the benefit of the shiner. Conservation recommendations are discretionary agency activities designed to minimize or avoid adverse effects of an action on listed species or critical habitat, to help implement recovery plans, or to develop information.

4.2.8 Adaptive Management Plan

An AMP, as described previously and detailed in attachment 2, would be implemented under all action alternatives.

4.3 Taiban Variable Alternative

Under the Taiban Variable Alternative, target flows would vary by season and would be monitored at the Taiban gage. During the nonirrigation season, Reclamation would target flows of 35 cfs at the Taiban gage. During the irrigation season, target flows would be 40 cfs to 55cfs, depending on water availability and other operational constraints. The alternative is designed to promote higher flows for the benefit of the shiner during the irrigation season when water is available. Taiban target flows would provide minimum flows of 20 cfs at the Near Acme gage during the nonirrigation season and flows ranging from 5 to 12 cfs during the irrigation season, depending on hydrologic condition, but intermittency could occur under all alternatives. Additional water could be acquired under the AMP process to keep the river whole.

Proposed block release protocols, Carlsbad Project and additional water acquisition, shiner management and conservation measures, FCP, and AMP are as described for the Taiban Constant Alternative and are the same for all action alternatives.

4.4 Acme Constant Alternative

Under the Acme Constant Alternative, Reclamation would continue to use the Near Acme gage as the primary flow monitoring location and would target year-round flows of 35 cfs there. Reclamation would fully use its authorities and discretion to prevent intermittency to the greatest extent possible, but intermittency could occur under all alternatives. Additional water could be acquired under the AMP process to keep the river whole.

Proposed block release protocols, Carlsbad Project and additional water acquisition, shiner management and conservation measures, FCP, and AMP are as described for the Taiban Constant Alternative and are the same for all action alternatives.

4.5 Acme Variable Alternative

Under the Acme Variable Alternative, target flows at the Near Acme gage would vary by season and by hydrologic condition. During the irrigation season in dry hydrologic conditions, Reclamation would target flows of 12 cfs at the Near Acme gage and flows of 35 cfs during the nonirrigation season.

During the irrigation season in average hydrologic conditions, Reclamation would target flows of 24 cfs at the Near Acme gage and flows of 35 cfs during the nonirrigation season.

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During the irrigation season in wet hydrologic conditions, Reclamation would target flows of 48 cfs at the Near Acme gage and flows of 35 cfs during the nonirrigation season.

Proposed block release protocols, Carlsbad Project and additional water acquisition, shiner management and conservation measures, FCP, and AMP are as described for the Taiban Constant Alternative and are the same for all action alternatives. Reclamation would fully use its authorities and discretion to prevent intermittency to the greatest extent possible, but intermittency could occur under all alternatives. Additional water could be acquired under the AMP process to keep the river whole.

4.6 Critical Habitat Alternative

Under the Critical Habitat Alternative, target flows and minimum flows would be monitored at the Taiban and Near Acme gages and would vary by season and by hydrologic condition. During the irrigation season in dry hydrologic conditions, when no other discretionary options are available, Reclamation would minimize intermittency at the Near Acme gage and would keep the critical habitat wet. During the nonirrigation season, Reclamation would target minimum flows of 35 cfs at the Taiban gage.

During the irrigation season in average hydrologic conditions, Reclamation would target flows of 5 cfs at the Near Acme gage. During the nonirrigation season, Reclamation would maintain minimum flows of 35 cfs at the Taiban gage.

During the irrigation season in wet hydrologic conditions, Reclamation would target flows of 10 cfs at the Near Acme gage. During the nonirrigation season, Reclamation would maintain minimum flows of 35 cfs at the Taiban gage.

Proposed block release protocols, Carlsbad Project and additional water acquisition, shiner management and conservation measures, FCP, and AMP are as described for the Taiban Constant Alternative and are the same for all action alternatives. Reclamation would fully use its authorities and discretion to prevent intermittency to the greatest extent possible, but intermittency could occur under all alternatives. Additional water could be acquired under the AMP process to keep the river whole.

5. Alternatives Considered But Not Analyzed in Detail

The final alternatives for analysis were shaped by the goals and objectives of the alternatives development workgroup and the study management team and were the result of a systematic screening process that evaluated more than 30 alternative proposals and refinements. This process is documented in the alternatives development report (Reclamation, 2005), but a general discussion of the rationale for the exclusion of certain alternatives and alternative elements is appropriate.

5.1 Pre-1991 Baseline as a No Action Alternative

As mentioned previously, the CEQ regulations implementing NEPA require a No Action Alternative to be included in an EIS. One of the primary purposes of the No Action Alternative is to provide a benchmark for comparing the magnitude of environmental effects of the action alternatives. Reclamation considered defining the No Action Alternative on the basis of conditions and water operations as they existed before 1991. This pre-1991 baseline recognizes that operations after the 1991 BO on the shiner have been either experimental or reactionary actions developed on a year-to-year basis. Given that recent operations are reactionary, not formalized, and variable, “normal conditions” would be those before 1991. The pre-1991 baseline would clearly disclose the impacts of the ESA-related actions. Under this scenario, the current operations and conditions (target flows and releases) defined by the BO would be addressed as one of the “action” alternatives, or there would be two no action, or baseline, alternatives.

The management team decided to use a more conventional approach for addressing the No Action Alternative and, therefore, based it on current conditions and operations. In the absence of a long-term reoperation program, the 2003-2006 BO is the closest approximation of present and near-term conditions. Action alternatives are compared against this No Action Alternative, which represents no change from current management direction, thereby providing a realistic picture of any changes that would take place under any of the action alternatives. A pre-1991 alternative would be difficult to present to the public and difficult to define for many resources and would not be viable, given the current regulatory context. Even though the pre-1991 baseline is not considered as a formal action alternative, pre-1991 baseline information is incorporated in the impact analysis, as appropriate, to demonstrate the degree and impacts of operational changes on the Carlsbad Project water supply. Comparisons with the pre-1991 baseline are used in the analysis of the effects of the alternatives on water resources, water quality, agricultural soil and land resources, biological resources, and the regional economy, as shown in chapter 4.

5.2 Range of Target Flows

The final alternatives include a range of target flows, gaging locations, seasonal variability, and variability for dry, average, and wet hydrologic conditions. Reclamation had considered target flows of up to 72 cfs at the Near Acme gage for some of the early alternatives. Preliminary modeling indicated that water would not be available within the Pecos River system to sustain these higher target flows, leading to increased intermittency, which would be harmful to the shiner and would deplete the Carlsbad Project water supply beyond levels that Reclamation could reasonably be expected to acquire. (See appendices 2 and 3.) Such alternatives clearly would not meet the purpose of and need for the proposed action. An alternative proposing year-round flows of 35 cfs at the Near Acme gage and one that has target flows of 48 cfs during the irrigation season in wet hydrologic conditions represent the high range of flows in the alternatives proposed for detailed analysis.

5.3 Block Release Proposals

The early alternatives included many proposals for specifying the block release duration, frequency, magnitude, ramp up/ramp down, delivery efficiency, and restrictions on time of year. In formulating the final alternatives, Reclamation proposed common rules for making block releases that would simplify alternative comparison and allow managers to be responsive to changing river conditions. In the case of duration, frequency, and delivery efficiency, most proposals were similar and compatible with typical release patterns. Depending on the level of Sumner Lake, the magnitude of releases through the outlet works is generally limited to approximately 1,400 cfs. Historically, block releases average approximately 1,060 cfs. Flows greater than 1,600 cfs are not possible and, thus, larger “flushing flows” could not be made and were not considered further. Proscriptions specifying the size of releases were dropped in order to allow flexibility.

Defining specific ramp-up and ramp-down protocols for releases also was eliminated from the alternatives because of a lack of consensus on their value to the shiner and anticipated depletions associated with these releases. These protocols had been part of experimental operations but, in effect, had extended the length of block releases beyond 15 days. The Service considers continuous flows greater than 300 cfs exceeding 15 days to be detrimental to the shiner, because these flows increase predation by washing eggs downstream into Brantley Reservoir. Lower flows at the beginning of a release essentially disappear as they travel down the river, and ramp downs also were inefficient in delivering irrigation water (and contrary to beneficial use requirements of State and Federal law). Also, the natural pattern of the steeply rising and falling flows, combined with the streambank storage and return effect along the river, yield a more gradual transition in flows through the critical habitat for the shiner.

Proposed block release restrictions ranged from total seasonal bans during the nonirrigation season or irrigation season to no restrictions or guidance. The common proposal brought forward would allow releases on CID demand but specifies avoidance to the extent possible during the 6 weeks around August 1 to minimize the transport of shiner eggs and larvae into Brantley Reservoir.

5.4 Linking CPWA Options to Alternatives

The management team considered linking specific water acquisition options to specific alternatives. This idea was rejected, and implementation of any of the CPWA and AWA options is possible with any of the alternatives. In this way, impacts of these options are addressed, while allowing flexibility in determining how best to acquire additional water needed (AWN) to conserve the Carlsbad Project water supply. Following a sound evaluation process, anticipated availability, amounts, and timing are still variable and subject to changing conditions. Choice is also desirable in order to provide other benefits, such as incorporating options that would provide direct water for the fish or reducing environmental impacts or costs by using a combination of options. Reclamation

will define in the ROD those options that could be used to meet project purposes, whether current authority exists, and the process for implementation.

5.5 Habitat Restoration and Conservation Measures

Many of the early discussions of alternatives included proposals for specific habitat improvement projects, such as channel restoration and non-native vegetation removal, or conservation measures, such as creating a hatchery and rearing facility. Others have suggested that fish populations could be moved to reaches of the Pecos River or tributaries where intermittency does not occur or could be avoided more easily. These proposals may contribute to conserving the shiner, but likely would not be central to meeting the purpose of and need for the proposed action, not comply with the ESA, and may be outside the mission and authority of the lead agency. Therefore, specific proposals of this kind were not included in the final alternatives, but their consideration is recommended as discretionary actions by the responsible agencies and could be part of the adaptive management framework.

5.6 Dam Removal and Elimination of Irrigation

No alternatives calling for the removal of water storage facilities or the elimination of irrigated agriculture were raised during public scoping, meetings of the interdisciplinary team, or through the alternatives development process. One early alternative proposed changing operations to more closely mimic the “natural hydrograph,” based on passing water through the dams rather than dam removal and elimination of irrigated agriculture.

The management team has considered these concepts and found them unreasonable and not meeting the purpose of and need for the proposed action, which require alternatives that both conserve the shiner and the Carlsbad Project water supply. It is not clear whether dam removal and/or elimination of irrigation agriculture would conserve the shiner. Alternatives that do not address the conservation of the Carlsbad Project water supply cannot be evaluated further. Reclamation also lacks authority to remove or substantially alter the existing dams or to consider the elimination of agriculture. Carlsbad Project facilities exist and are operated for the congressionally mandated purposes of flood control and irrigation. Reclamation is obligated under contract to continue the Carlsbad Project and deliver Carlsbad Project water. Further, in developing alternatives for conducting Carlsbad Project water operations, Reclamation was required to respect existing water rights and Compact obligations.

6. Selection of Reclamation's Preferred Alternative

Reclamation has selected the Taiban Constant Alternative as the preferred alternative for this EIS and for initiation of section 7 consultation with the Service. Under this alternative, Reclamation proposes to operate the Carlsbad Project to (1) divert to storage when flows at the Taiban gage are greater than 35 cfs, and (2) deliver from storage Carlsbad Project water as contracted for

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irrigation and consistent with applicable Federal and State laws. This alternative best meets the purpose of and need for the proposed action. See the detailed description of the Taiban Constant Alternative in section 4.2.

The initiation of section 7 consultation requires the identification of a proposed Federal action. Selecting a preferred alternative does not define Reclamation's final decision. The intention is to let the public know what the agency considers the best alternative, based upon the information available. Public comments or other considerations may result in a change in the preferred alternative and may even result in the final decision (recorded in the ROD) not being the preferred alternative in either the draft or the final EIS.

6.1 Criteria Used for Selection of the Preferred Alternative

The Executive Committee developed criteria for selection of the preferred alternative (table 2.3). Reclamation assessed each alternative against these criteria. The following sections describe the criteria and the assessment of the Taiban Constant Alternative.

Table 2.3 Criteria used for selection of the preferred alternative, ordered by consideration

Ranked importance	Criteria
1	Ensuring that Reclamation's actions do not jeopardize the shiner
2	Amount of AWN to meet target flows and augment the supply for the Carlsbad Project
3	Ease of operation
4	Minimal restrictions on block releases
5	Occurrence of intermittency
6	Likelihood of the Service accepting the alternative
7	Stability of BO
8	Flexibility of the alternative

6.1.1 Ensuring that Reclamation's Actions Do Not Jeopardize the Shiner

ESA requires that Reclamation's discretionary actions on the Carlsbad Project cannot jeopardize the shiner or other listed species; therefore, conserving the shiner is part of the purpose of and need for the proposed action. Conserving the shiner means that Reclamation would ensure that any discretionary action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. Reclamation believes that the Taiban Constant Alternative provides target flows sufficient to avoid jeopardizing the shiner.

6.1.2 Amount of Additional Water Needed to Meet Target Flows

AWN is a modeled estimate of the amount of additional water that would need to be acquired for the Carlsbad Project to meet target flows specified in an alternative. The amount of AWN is an important consideration because of the need to conserve the Carlsbad Project water supply and to respect existing water rights and Compact obligations. Reclamation is limited in its authority to

implement options to acquire water. The demand for water is high, and financial and environmental costs are associated with the need to obtain greater amounts of additional water. Therefore, alternatives with a low amount of AWN are more desirable from a cost and environmental standpoint and more sustainable over the long term. The Critical Habitat Alternative, followed by the Taiban Constant Alternative, has the lowest estimated average annual AWN of all of the alternatives.

6.1.3 Ease of Operation

Ease of operation refers to the location of the target gages, the ease with which changes in flows can be made, and whether target flows are adjusted by hydrologic condition. The use of the Taiban gage is preferred because it is generally reliable, the travel time for flows from Sumner Dam is shorter, its proximity allows Reclamation to react to rain events, and its location upstream of the critical habitat allows better monitoring of drying conditions. Target flows under the Taiban Constant Alternative do not change by hydrologic condition; thus, the amounts of water acquired would be more predictable.

6.1.4 Minimal Restrictions on Block Releases

Block release restrictions can limit the timely delivery of Carlsbad Project water to irrigators. The Taiban Constant Alternative and all of the action alternatives would have the same block release restrictions and would include a 6-week avoidance period around August 1 that is not currently required.

6.1.5 Occurrence of Intermittency

Avoiding intermittency is an important priority for conserving the shiner. With bypass water only, all of the alternatives are essentially the same in the amount of modeled intermittency. Under all alternatives modeled, intermittency occurred at the Near Acme gage 1 percent or less of the time. With additional water acquisitions and monitoring under the AMP, the risk of intermittency would be further reduced. Under the Taiban Constant Alternative, intermittency could still occur even if target flows are met.

6.1.6 Likelihood of the Service Accepting the Alternative

Reclamation is required to consult with the Service on the effects of the operation of the Carlsbad Project on federally threatened or endangered species. In assessing the alternatives, Reclamation considered whether each alternative would be seen as an acceptable basis for a long-term BO on Carlsbad Project operations.

6.1.7 Stability of Biological Opinion

This refers to an evaluation of whether the alternative and measures in the BO would be sustainable in the long term by Reclamation. Reclamation seeks to avoid future jeopardy determinations and new section 7 consultations. Reclamation has determined that the reasonable target flows, small amount of AWN, use of the Taiban gage, and the adaptive management process under the Taiban Constant Alternative would avoid the potential for jeopardy better than other alternatives.

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6.1.8 Flexibility of the Alternative

Maintaining flexibility in operating the Carlsbad Project is also a consideration in defining a preferred alternative. All of the action alternatives include measures that are designed to provide maximum flexibility to Reclamation managers in meeting the needs of the shiner. These include the use of the adaptive management process to respond to changes in river conditions and the use of a suite of water acquisition options. Because the Taiban Constant Alternative requires a relatively low amount of AWN, Reclamation would have more flexibility to choose among the CPWA options and obtain sufficient water than would be available under the alternatives that require more AWN.

7. Water Acquisition Options

To conserve the water supply of the Carlsbad Project, options for acquiring additional water were developed, analyzed, and ranked by the water offset options group. The additional water would be needed because changes in Carlsbad Project operations to benefit the shiner would deplete the Carlsbad Project water supply. Section 8 provides a discussion of the evaluation criteria, analysis, and ranking of CPWA options; section 9 provides a detailed description of the CPWA options.

The water offset options group was later directed to explore options, called AWA options, for acquiring additional water for the river reaches where the shiner is found. This water would be used when changes in Carlsbad Project operations would not provide adequate flows to meet target flows, avoid intermittency at gaged sites, or, at a minimum, maintain flows in the critical habitat stream reach. A distinction is made between the two sets of water acquisition options. CPWA options are focused on providing replacement water for delivery and irrigation use in the CID, whereas the AWA options are focused on meeting the needs of the shiner upstream. The options are not necessarily mutually exclusive; for example, some AWA option supplies may reach Brantley Reservoir and become available for use as Carlsbad Project water supply. Section 10 provides a discussion of the AWA evaluation criteria, analysis, and ranking; section 11 provides a detailed description of the AWA options.

These water acquisition options were developed without seeking a definitive determination of the authority of Reclamation or other agencies for their implementation. Reclamation is limited to implementing actions that are within its authority. NEPA, however, requires consideration of all reasonable alternatives within or outside the jurisdiction of the Federal agency. New authorities could be sought or other entities may be able to acquire water using options analyzed here. ESA does not provide Reclamation additional authority to meet its obligations under the Act.

8. CPWA Options Development Process

8.1 Evaluation Criteria, Analysis, and Ranking of CPWA Options

The water offset options group identified 26 options (designated A-Z), which were assigned to various group members for evaluation of the probable amount of water supplied, location of the supply, general cost of the water supply, and other pertinent attributes of the option. Group members documented their understanding of the water supply attributes of each option in technical reports that were reviewed by group members. During the review process, many of the original options were expanded into subcategories that further defined or delineated the option. For example, the water right purchase and retirement option was redefined into several options, depending on the location of the water

Quantitative	Qualitative
<ul style="list-style-type: none"> • Location • Amount of water potential • Cost • Time needed to implement • Time needed to realize water for the Carlsbad water supply • Effect on State-line deliveries 	<ul style="list-style-type: none"> • Sustainability • Political risk to implement • Risk that the option would actually realize the water supply • Flexibility in diverting the supply

right within the basin and by estimates of historic or escalated costs to acquire the right. Subcategories were evaluated as separate water acquisition options and were identified by a letter corresponding to the original 26 options, followed by a number in sequence for each subcategory of that option. For example, the water right purchase and retirement option was designated as

“option D.” The subcategories of this option were designated D-1 for surface water rights, D-2 for shallow ground water rights, and D-3 for artesian ground water rights. D-1A indicated surface rights in FSID, D-1B indicated surface rights in the Roswell area, and D-1C indicated surface rights in CID. The “X” designation on some of these options indicated an option identical to the option without the “X,” except for a 40-percent increase in the option’s water right cost attributable to the 2003 Settlement Agreement and NMISC’s ongoing purchases of water rights in the basin. With subcategories, there were a total of 80 options. However, 10 of the original options or their subcategories were eliminated without further analysis as options for obtaining water already implemented, options with little or no potential, or as options that duplicated other options.

Options were analyzed to determine their effectiveness in providing additional water for the Carlsbad Project water supply. Water offset options group members estimated quantitative properties of the options, including location, amount, cost of the option, time to implement the option, and time to realize water from the option. Group members, as a whole, reviewed and, in some cases, modified these quantitative properties. Four additional qualitative criteria were developed to evaluate the more subjective properties of the water acquisition options, including

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sustainability of the option, political risk to implement, the relative risk that the option would actually realize the water supply, and flexibility in diverting the supply. These quantitative and qualitative properties of water acquisition options were used as ranking criteria for further analysis. In addition, a final criterion was added that evaluated the effect of the options on State-line flows.

What is Equivalent Uniform Annual Cost?

Equivalent Uniform Annual Cost is the unit annual cost in dollars per acre-foot for developing a water resource, considering capital, operation and maintenance costs, project life, and the time value of money as the Reclamation annual planning rate of 5.875 percent.

Each ranking criterion was assessed for performance levels, and each performance level was assigned a ranking value of 0 to 5, with 5 being the most desirable. Care was taken to develop costs for all water acquisition options on an equivalent basis. Equivalent uniform annual costs (EUAC) were developed for each option by computing the present value of the capital and operation and maintenance costs of the water

acquisition options and then converting that amount into a series of annual costs using a Federal project development rate of 5.875 percent. Two ranking officers selected by the workgroup prepared complete rankings for each option, by criteria. These ranking officers worked independently of each other during the initial ranking of each water acquisition option and compared differences once the initial ranking was complete. The numeric ranking for each of the 10 criterion was summed by water acquisition option, with larger numeric values indicating preferred options. The best possible score assigned by each ranking officer was 5, multiplied by the number of criteria, 10, for a total of 50. Each officer's total rank was then added to represent the total average score, with preference to higher scores and a possible perfect score of 100.

As part of the ranking process, the water offset options group also considered prioritization of certain criteria to replace net depletions on an average basis or to replace maximum depletions. Results of the ranking options to meet average and maximum depletions through the use of weighted criteria are included in the water offset options group documentation report (appendix 2).

8.2 CPWA "A" List Options

At the request of the management team, the water offset options group developed "A" and "B" lists to focus the impact analysis on those CPWA options that could be implemented in the near term. The "A" and "B" lists were developed to reduce the number of options to be analyzed in detail. The criteria for developing these lists were the time it would take to implement the option and time to access the water. For "A" list options, the combination of time to implement the option and time to realize water in the river was limited to a maximum of 3 years. The "B" lists included options that required extensive planning beyond the scope of this NEPA process. "B" list options may still be developed in the future, but as part of a longer-term strategy, and they are not analyzed in this EIS. Details on

CPWA Options Development Process

development of these lists can be reviewed in the water offset options group documentation report (appendix 2).

Table 2.4 presents the “A” list of 16 CPWA options resulting from the use of unweighted criteria. The “A” list is further refined by recognition that the amount of water generated by the option would not be fully effective in replacing depletions to the Carlsbad Project water supply. For example, the purchase and retirement of FSID water rights make water available far upstream of the Carlsbad Project, and less than the full amount of water generated at FSID would be available farther downstream because of conveyance losses. Chapter 4 provides further information on the development of the offset efficiency factors.

Table 2.4 "A" list: equally weighted ranking of CPWA options

Rank	Designation ¹	Option name/description	Reclamation authority	Amount available (consumptive acre-feet/year) ²	Average CPWA efficiency to CID ³	Average effective CPWA (acre-feet/year)	Combined total score (no units)	Adjusted EUAC ⁴ (\$/acre-feet/year)
1	Q1-SR	Develop well field: Seven Rivers	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	10,000	67%	6,700	77.0	433
2	Q1-BV	Develop well field: Buffalo Valley	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	10,000	58%	5,800	76.0	455
3	D-1B	Surface water right purchase: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	74.0	180
4	E-1B	Surface water right lease: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	73.0	165
5	D-1A	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	72.0	431
6	D-1BX	Surface water right purchase: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	72.0	252
7	L-3	Changes to cropping patterns: (CID) ⁵ (very low water use crop)	Yes – for Carlsbad Project uses	10,500	100%	10,500	71.5	182
8	E-1A	Surface water right lease: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	71.0	396

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Table 2.4 "A" list: equally weighted ranking of CPWA options

Rank	Designation ¹	Option name/description	Reclamation authority	Amount available (consumptive acre-feet/year) ²	Average CPWA efficiency to CID ³	Average effective CPWA (acre-feet/year)	Combined total score (no units)	Adjusted EUAC ⁴ (\$/acre-foot/year)
9	D-1C	Surface water right purchase: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	71.0	99
10	E-1C	Surface water right lease: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	70.0	91
11	D-1AX	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	70.0	603
12	D-1CX	Surface water right purchase: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	69.0	139
13	L-2	Changes to cropping patterns: (CID) ⁵ (low water use crop)	Yes – for Carlsbad Project uses	8,800	100%	8,800	66.5	249
14	L-1	Changes to cropping patterns: (CID) ⁵ (average of all water use amounts)	Yes – for Carlsbad Project uses	8,900	100%	8,900	65.5	206
15	L-4	Changes to cropping patterns (CID) ⁵ (medium water use crop)	Yes – for Carlsbad Project uses	6,000	100%	6,000	64.5	209
16	U	FSID gravel pit pumping	Unknown – construction may be considered operations and maintenance, but do have the authority to acquire water for the Carlsbad Project	300	74%	222	62.0	13

¹ Options designated with an "X" represent the option with the same designation but with an escalated cost of 40% to account for market pressures.

² Amount presented for all water rights acquisition options is the consumptive irrigation requirement (CIR). The CIR is the amount of irrigation water, exclusive of precipitation, stored soil moisture or ground water needed consumptively for crop production.

³ Note that "amount available" column multiplied by efficiency in this column does not yield effective offset. Only diverted amounts (convert from CIR amount by multiplying by 3 acre-feet/acre and dividing by 2.1 acre-feet/acre) can be multiplied by efficiencies in this column to determine effective offset.

⁴ EUAC was "adjusted" to account for CPWA option efficiencies.

⁵ The changes to cropping patterns were based on conversion of 5,000 acres of alfalfa to the crops with the indicated level of water.

9. Detailed Description of CPWA Options

Each CPWA “A” list option is discussed in the following five general categories: water right purchase and land retirement, water right lease and land fallowing, change cropping patterns, well field development, and FSID gravel pit pumping. Additional NEPA analysis may be required for some options and may include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some options, resource specific field studies (cultural and biological resource studies) may be conducted.

9.1 Water Right Purchase and Land Retirement

Water right purchase and land retirement options include D1-A, D1-AX, D1-B, D1-BX, D-1C, and D-1CX. Water rights are real property rights for which ownership can be transferred, much like land. The water right holder can apply to NMOSE for a change in point of diversion, place, and purpose of use of the water right, as long as doing so would not impair other appropriators, the transfer is not contrary to conservation of water in the State, or the transfer is not detrimental to the public welfare of the State.

Because water rights are transferable, a market exists for their sale and purchase. For agricultural water use, the value may be the difference in the price of farmland with and without irrigation water rights attached to the land. For municipal, commercial, industrial, and institutional water use, the market is usually for water rights alone, separate from the land.

Under these CPWA options, Reclamation would purchase surface water rights from willing sellers at market rates. These rights would be permanently retired in place, and this water would remain in the Pecos River and would not be diverted. A reduction in the quantity of the right sometimes occurs when a water right is transferred. Because the objective is to replace new depletions to the river, the source should reduce existing depletions or the consumptive portion of a water right. These options would not require changes to infrastructure, but precise locations of the retired land cannot be predicted. Six CPWA “A” list options are in this category; three of these options differ only in that they anticipate higher costs of acquiring water rights. NMISC is purchasing substantial quantities of land with surface water and ground water rights for implementing the Settlement Agreement. The market has changed as a result of this and other anticipated future activity. (See chapter 1, section 6.4.1.). However, NMISC has received offers in excess of its needs, and the price of purchasing or leasing water rights can only be estimated until offers are received.

Under CPWA options D-1A and D-1AX, Reclamation would seek to acquire surface water rights to approximately 1,000 acre-feet per year and permanently retire approximately 490 acres in the FSID. Under CPWA options D-1B and D-1BX, Reclamation would seek to acquire water rights to 1,600 acre-feet per year and permanently retire approximately 750 acres in the vicinity of Roswell.

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Under CPWA options D-1C and D-1CX, Reclamation would seek to acquire water rights to 3,150 acre-feet per year and permanently retire approximately 1,500 acres within CID. Reclamation would not purchase the land associated with the water right. Reclamation has the authority to acquire water for the Carlsbad Project.

9.2 Water Right Lease and Land Fallowing

Water right lease and land fallowing options include E1-A, E1-B, and E-1C. Under these CPWA options, Reclamation would lease surface water rights from willing parties and then would fallow the acreage. Annual water allotments would remain in the Pecos River or the aquifer for the term of the lease, typically 5 years. Under State law, the lease term is limited to 10 years. The landowner would retain the water rights and would be free to use or transfer them at the end of the lease (Water-Use Leasing Act, sections 72-6-1 through 72-6-7, New Mexico Statutes Annotated, 1978).

These CPWA options would not require changes to infrastructure. Exact locations of land with water rights available for lease and fallowing cannot be predicted.

Three CPWA “A” list options involve leasing and fallowing. Acres leased for CPWA purposes are independent of acres purchased for CPWA purposes, even though they may be from the same source. Under option E-1A, Reclamation would seek to lease consumptive surface water rights to approximately 1,000 acre-feet per year and would temporarily fallow approximately 490 acres in FSID. Under CPWA option E-1B, Reclamation would seek to lease water rights to 1,600 acre-feet per year and would fallow approximately 750 acres in the vicinity of Roswell. Under CPWA option E-1C, Reclamation would seek to acquire water rights to 3,150 acre-feet per year and would temporarily fallow approximately 1,500 acres within CID. Reclamation has the authority to acquire water for the Carlsbad Project.

9.3. Changes to Cropping Patterns

Options to change cropping patterns include L-1, L-2, L-3, and L-4. Alfalfa is the predominant crop within CID. An acre of alfalfa requires approximately 4.5 acre-feet per year of water, including a leaching requirement of about 0.9 acre-foot per year because of soil salinity (Brummer, 2001). When less water is applied, yields are reduced. Under these options, Reclamation would encourage farmers to plant crops that require less irrigation water, such as cotton, small grains, and corn. Because these crops are less profitable than alfalfa, the farmers would need to be reimbursed for the loss in profit. CID and/or individual farmers also would have to agree to release the water saved because of the lower water consumption and from growing lower value crops. These options would not require changes to infrastructure, and exact locations of cropland conversion cannot be predicted.

In developing these options and estimating costs, Reclamation made the following assumptions:

- L-1: Reclamation assumed a program in which 5,000 acres would be converted from alfalfa to a mix of very low, low, and medium water use crops in equal amounts.
- L-2: Reclamation assumed a program in which 5,000 acres would be converted from alfalfa to a low water use crop.
- L-3: Reclamation assumed a program in which 5,000 acres would be converted from alfalfa to very low water use crops.
- L-4: Reclamation anticipates a program in which 5,000 acres would be converted from alfalfa to a medium water use crop.
- Saved water would remain in the Pecos River system.

Reclamation has the authority to implement these options if the water is saved for the Carlsbad Project water supply.

9.4 Well Field Development

Well field development options include Q1-SR and Q1-BV. Under these CPWA options, Reclamation would use, purchase, or lease water rights and transfer them to well fields to be developed at the Seven Rivers or Buffalo Valley areas. Ground water would be pumped from these wells and piped into the Pecos River for delivery to Brantley Reservoir when operations to benefit the shiner cause additional depletions. The number, exact locations, depths, and distance from the river of new wells have not been determined. Under CPWA option Q1-SR, Reclamation would develop a well field at Seven Rivers near river mile 479. Under option Q1-BV, Reclamation would develop a well field at Buffalo Valley. Each option could provide 10,000 acre-feet of water per year. Reclamation does not currently have the authority to construct new facilities but does have the authority to acquire water for the Carlsbad Project from this source.

9.5 FSID Gravel Pit Pumping

Under CPWA option U, water from an abandoned gravel pit on the south side of Fort Sumner would be pumped to the Pecos River through an irrigation drain. A total of 300 acre-feet per year is available, but the pit is connected to an aquifer upon which domestic wells depend. Minimal infrastructure would be required, resulting in low unit water costs. Water quality is unknown. The authority for Reclamation to implement this option is unknown. Reclamation has the authority to acquire water for the Carlsbad Project, but construction of a pipeline may exceed its authority.

10. AWA Options

10.1 Evaluation Criteria, Analysis, and Ranking of AWA Options

Additional water acquisition is defined as new water added to the Pecos River system for the purpose of providing flows for the shiner. The water offset options group formulated AWA options by revisiting the list of CPWA options and determining which of these could be applied upstream of the shiner critical habitat. Group members added other potential AWA options, including some in areas upstream of Santa Rosa. Options north of Santa Rosa may be viable for acquiring water, but these options were not included in the initial scoping and affected environment for this EIS and would require additional analysis and public involvement activities. Ten sources for AWA were identified and were divided into subcategories or variations that are associated with the option. These were developed into 47 proposals that were evaluated by the water offset options group (appendix 2). AWA options were assigned their own designations, which differ from the CPWA options.

AWA options were evaluated using similar methods, including development of a list of possible supplies, defining the water supply attributes of those options, developing criteria for ranking the options, and summarizing the findings. Many of the AWA options were derived from similar CPWA options and used the same analytical information. However, some of the criteria for ranking the AWA options were altered to reflect the changed circumstances for use of the water. Criteria for ranking the “location” of the additional water supplies were changed to reflect the need to supply water to the upper critical habitat of the shiner rather than the Carlsbad Project location. Further, the “amount available” ranking criterion was reduced to reflect the smaller supplies available for additional water acquisition. Finally, the “flexibility of supply” ranking criterion was adjusted for seasonal timing needs of the water supply for the shiner. At the conclusion of the ranking of the AWA options, the options were again assigned to an “A” or “B” list, depending on the ability of the option to provide water within 3 years of selection and whether extensive additional NEPA analysis would be required. These results and the “B” list can be reviewed in appendix 2.

10.2 “A” List AWA Options

Table 2.5 presents the “A” list of AWA options. The table includes the final combined total score, the amount of potentially available water, and the projected cost. The table describes the AWA options that could be implemented to provide water within 3 years. Additional NEPA analysis may be required for some options and may include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some options, resource specific field studies (cultural and biological resource studies) may be conducted.

AWA Options

Table 2.5 “A” list AWA options

Designation¹	Option name	Reclamation authority	Combined total score	Amount available (consumptive acre-feet/year)	EUAC (\$/acre-feet/year)
A-1	Surface water right purchase: CID	Yes – for Carlsbad Project uses	75.5	3,150	99
A-2	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	73.5	1,000	99
A-1X	Surface water right purchase: CID (additional 40-percent inflation)	Yes – for Carlsbad Project uses	73.5	3,150	139
B-1	Surface water right lease: CID	Yes – for Carlsbad Project uses	72.5	3,150	91
A-2X	Surface water right purchase: FSID (additional 40-percent inflation)	Yes – for Carlsbad Project uses	71.5	1,000	139
B-2	Surface water right lease: FSID	Yes – for Carlsbad Project uses	70.5	1,000	91
I	FSID gravel pit pumping	Unknown – construction may be considered operations and maintenance, but do have the authority to acquire water for the Carlsbad Project	63.5	300	10
J-2	Fort Sumner area large-capacity well field	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	62.0	1,384	150
J-1	Fort Sumner area small-capacity well field	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	61.0	500	164
D-1C	Changes to cropping patterns: CID (very low water use crop)	Yes – for Carlsbad Project uses	60.0	10,500	128
D-1A	Changes to cropping patterns: CID (average of all water use amounts crop)	Yes – for Carlsbad Project uses	60.0	8,900	144
D-1D	Changes to cropping patterns: CID (medium water use crop)	Yes – for Carlsbad Project uses	60.0	6,000	147
D-1B	Changes to cropping patterns: CID (low water use crop)	Yes – for Carlsbad Project uses	60.0	8,800	175
D-2	Changes to cropping patterns: FSID (small grain)	Yes – for Carlsbad Project uses	59.0	3,375	158
A-4	Surface water right purchase: Puerto de Luna area	Yes – for Carlsbad Project uses	57.5	110	99
A-4X	Surface water right purchase: Puerto de Luna area (additional 40-percent inflation)	Yes – for Carlsbad Project uses	55.5	110	139
B-4	Surface water right lease: Puerto de Luna area	Yes – for Carlsbad Project uses	54.5	110	91
D-4	Changes to cropping patterns: Puerto de Luna area (very low water use crop)	Yes – for Carlsbad Project uses	47.5	360	168

¹ Options designated with an "X" represent the option with the same designation but with an escalated cost of 40 percent to account for market pressures.

11. Detailed Description of AWA Options

Each “A” list AWA option is discussed in the following five general categories: water right purchase and land retirement, water right lease and land fallowing, change cropping patterns, well field development, and FSID gravel pit pumping. Additional NEPA analysis may be required for some options and may include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some options, resource specific field studies (cultural and biological resource studies) may be conducted.

11.1 Water Right Purchase and Land Retirement

Water right purchase and land retirement options include A-1, A-1X, A-2, A-2X, A-4, and A-4X. Under these AWA options, Reclamation would purchase surface water rights from willing sellers at market rates. These rights would be permanently retired in place, and this water would remain in the Pecos River and would not be diverted. These AWA options would not require changes to infrastructure, and precise locations of the retired land cannot be predicted. Six “A” list AWA options are in this category; three of these options differ only in that they anticipate higher costs of acquiring water rights. NMISC is purchasing substantial quantities of land with surface water and ground water rights for implementing the Settlement Agreement. The market has changed as a result of this and other anticipated future activity. (See chapter 1, section 6.4.1.). However, NMISC has received offers in excess of its needs, and the price of purchasing or leasing water rights can only be estimated until offers are received.

Under AWA options A-1 and A-1X, Reclamation would seek to acquire water rights to 3,150 acre-feet per year and would permanently retire approximately 1,500 acres within CID. Because these water rights would be retired downstream from where the additional water would be needed, they would be exchanged for the release of surface water stored in Sumner Lake or Santa Rosa Reservoir. The portion of the water reaching CID would need to be accounted for in the exchange.

Under AWA options A-2 and A-2X, Reclamation would seek to acquire surface water rights to approximately 1,000 acre-feet per year and would permanently retire approximately 490 acres within FSID. Under AWA options A-4 and A-4X, Reclamation would seek to acquire water rights to 110 acre-feet per year and would permanently retire approximately 52 acres in the vicinity of the village of Puerto de Luna, south of Santa Rosa. Reclamation has the authority to acquire water for Carlsbad Project uses.

11.2 Water Right Lease and Land Fallowing

Water right lease and land fallowing options include B-1, B-2, and B-4. Under these AWA options, Reclamation would lease surface water rights from willing parties and would fallow acreage. Annual water allotments would remain in the Pecos River for the term of the lease, typically 5 years. Under State law, the lease

term is limited to 10 years (Water-Use Leasing Act). The landowner would retain the water rights and would be free to use or transfer them at the end of the lease. These AWA options would not require changes to infrastructure, but exact locations of land with water rights available for lease and fallowing cannot be predicted.

Three “A” list AWA options involve leasing and fallowing. Under AWA option B-1, Reclamation would seek to acquire water rights to 3,150 acre-feet per year and would temporarily fallow approximately 1,500 acres within CID. Under AWA option B-2, Reclamation would seek to lease surface water rights to approximately 1,000 acre-feet per year and would temporarily fallow approximately 476 acres within FSID. Under AWA option B-4, Reclamation would seek to lease water rights to 110 acre-feet per year and would fallow approximately 52 acres in the vicinity of the village of Puerto de Luna, south of Santa Rosa. Reclamation has the authority to acquire water for Carlsbad Project uses.

11.3 Changes to Cropping Patterns

Options to change cropping patterns include D-1A, D-1B, D-1C, D-1D, D-2, and D-4. Under these AWA options, Reclamation would encourage farmers to plant crops that require less irrigation water, such as cotton, small grains, and corn. Because these crops are less profitable than alfalfa, the farmers would have to be reimbursed for the loss in profit. The irrigation districts and/or individual farmers would also have to agree to release the water saved because of lower water consumption and from growing lower value crops. The point of diversion or place of storage for water saved by CID will have to be transferred or exchanged upstream of Sumner Dam. These AWA options would not require changes to infrastructure, and exact locations of cropland conversion cannot be predicted.

In developing these options and estimating costs, Reclamation made the following assumptions:

- D-1A: 5,000 acres within CID would be converted from alfalfa to a mix of very low, low, and medium water use crops in equal amounts.
- D-1B: 5,000 acres within CID would be converted from alfalfa to low water use crops.
- D-1C: 5,000 acres within CID would be converted from alfalfa to very low water use crops.
- D-1D: 5,000 acres within CID would be converted from alfalfa to medium water use crops.

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- D-2: 1,125 acres within FSID would be converted from alfalfa to very low water use crops
- D-4: 120 acres near the village of Puerto de Luna would be converted from alfalfa to very low water use crops.
- Saved water would remain in the Pecos River system.

Reclamation has the authority to implement these options if the water is saved for the Carlsbad Project water supply.

11.4 Well Field Development

Under these AWA options, a well field would be developed in the vicinity of Fort Sumner. Ground water would be pumped from these wells and piped into the Pecos River to provide direct flows for shiner conservation in the upper critical habitat. Purchased or leased water rights would be transferred to the well field. The number, precise locations, depths, and distance from the river of new wells have not been determined. Under AWA option J-1, a small-capacity well field was assumed which could provide up to 500 acre-feet per year of supplemental water to the Pecos River. Under AWA option J-2, a large-capacity well field was assumed which could provide up to 1,384 acre-feet per year of supplemental water. Reclamation does not currently have the authority to construct new facilities, but it does have the authority to acquire water for the Carlsbad Project from this source.

11.5 FSID Gravel Pit Pumping

Under AWA option I, water from an abandoned gravel pit on the south side of Fort Sumner would be pumped to the Pecos River through an irrigation drain. A total of 300 acre-feet per year is potentially available, but the pit is connected to an aquifer upon which domestic wells depend. Minimal infrastructure would be required as long as the water quality is acceptable, and this water could be provided to augment flows at a low cost. The authority for Reclamation to implement this option is unknown. Reclamation has the authority to acquire water for the Carlsbad Project, but construction of a pipeline may exceed its authority.

12. Summary of Impacts Table

Table 2.6 summarizes the impacts of the alternatives on the resource indicators analyzed in this EIS.

Table 2.6 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Water Resources						
Difference in percent of time modeled flows of 10 cfs at the Near Acme gage are exceeded	10 percent more frequently than under pre-1991 baseline	3 percent less frequently than under No Action	3 percent less to 4 percent more frequently than under No Action	7 percent more frequently than under No Action	5 percent more frequently than under No Action	2 percent less frequently than under No Action
Difference in percent of time modeled flows of 20 cfs at the Near Acme gage are exceeded	19 percent more frequently than under pre-1991 baseline	10 percent less frequently than under No Action	8 to 9 percent less frequently than under No Action.	10 percent more frequently than under No Action	3 percent more frequently than under No Action	6 percent less frequently than under No Action
Difference in percent of time modeled flows of 30 cfs at the Near Acme gage are exceeded	24 percent more frequently than under pre-1991 baseline	23 percent less frequently than under No Action	23 percent less frequently than under No Action.	8 percent more frequently than under No Action	0.6 percent more frequently than under No Action	23 percent less frequently than under No Action
Difference in frequency of modeled intermittency at the Near Acme gage	0.3 percent less frequently than under pre-1991 baseline	0.04 percent less frequently than under No Action	0.08 to 0.3 percent less frequently than under No Action	0.3 percent less frequently than under No Action	0.3 percent less frequently than under No Action	0.1 percent more frequently than under No Action
Additional water needed to meet target flows	Average of 2,900 acre-feet per year more than under pre-1991 baseline	Average of 720 acre-feet per year more than under pre-1991 baseline	Average of 1,400 to 4,200 acre-feet per year more than under pre-1991 baseline	Average of 9,500 acre-feet per year more than under pre-1991 baseline	Average of 5,300 acre-feet per year more than under pre-1991 baseline	Average of 620 acre-feet per year more than under pre-1991 baseline
Modeled average annual depletion (net depletions) to Carlsbad Project water supply	Average of 1,600 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 to 1,700 acre-feet per year greater than under pre-1991 baseline	Average of 3,900 acre-feet per year greater than under pre-1991 baseline	Average of 3,000 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 acre-feet per year greater than under pre-1991 baseline
Modeled average annual flows at the New-Mexico State line	1,200 acre-feet per year lower than under pre-1991 baseline	440 acre-feet per year lower than under pre-1991 baseline	690 to 1,600 acre-feet per year lower than under pre-1991 baseline	2,100 acre-feet per year lower than under pre-1991 baseline	1,600 acre-feet per year lower than under pre-1991 baseline	530 acre-feet per year lower than under pre-1991 baseline

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Table 2.6 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Water Quality						
EC	EC as much as 900 μ S/cm higher in Brantley Reservoir and more than 300 μ S/cm higher in CID; higher EC in all year types, but highest in dry year, lowest in wet year. Impacts would be moderate, localized, and long-term.	Slightly higher EC in wet year, but higher than under No Action in other year types. Impacts would be minor, localized, and long-term.	Higher EC in dry years and lower EC in normal and wet years at high and intermediate target flows; lower EC in wet years and higher EC in normal and dry years at lowest target flows. Impacts would vary with target flows, but overall would be minor, localized, and long-term.	Lower EC in normal and dry years, but higher in wet years when EC is generally lower. Impacts would be moderate, localized, and long-term.	No change in EC in wet year, but lower EC in normal and dry years, highest EC in dry years. Impacts would be moderate, localized, and long-term.	Higher EC in all year types, Impacts would be minor, localized, and long-term.
Agricultural Soil and Land Resources						
Overall resource	Minor localized adverse impacts to agricultural soil and land resources compared to pre-1991 baseline	Minor adverse impacts compared to No Action	Minor adverse impacts compared to No Action	Minor adverse impacts compared to No Action, mainly because of greater land retirement	Minor adverse impacts compared to No Action	Minor, mitigatable impacts compared to No Action
Biological Resources						
Terrestrial and flood plain ecosystem components	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverine aquatic ecosystem components: Santa Rosa Reservoir to Sumner Lake	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	No change The lack of AWA options and adaptive management guidelines would not provide the management flexibility necessary to offset these potential impacts.	With bypass flows only: Total amount of inter-mittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action.	With bypass flows only: Total amount of inter-mittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action.	With bypass flows only: Total amount of inter-mittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action.	With bypass flows only: Total amount of inter-mittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action.	With bypass flows only: Total amount of inter-mittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action.

Summary of Impacts Table

Table 2.6 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
		With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	Same as No Action. AWA/AWN options would not reduce or eliminate intermittency as under other action alternatives.
Riverine aquatic ecosystem components: Brantley Dam to New Mexico-Texas State line	No change	Same as No Action	Same as No Action			
Reservoir aquatic ecosystem components	No change	Same as No Action	Same as No Action			
Pecos bluntnose shiner	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as impacts presented for Riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir
Interior least tern	No change	No significant change from No Action	No significant change from No Action			
Regional Economy						
Change in annual value of regional output (\$)	- 350,000 to - 2,165,000	+ 88,000 to + 525,000	+ 88,000 to + 525,000 to - 22,000- 131,000	- 504,000 to - 3,149,000	- 307,000 to - 1,902,000	+ 88,000 to +525,000
Change in annual regional income (\$)	- 27,000 to - 871,000	+ 7,000 to + 211,000	+ 7,000 to + 211,000 to -2,000 to + 53,000	- 39,000 to - 1,267,000	- 24,000 to - 766,000	+ 7,000 to - 211,000
Change in regional employment (jobs)	-0.3 to -28.1	+0.1 to +6.8	+0.1 to +6.8 to 0.0 to -1.7	- 0.5 to -40.8	- 0.3 to -24.7	+0.1 to +6.8

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Table 2.6 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Recreation						
Reservoir recreation and impacts	No change	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action
River recreation and impacts	No change	Less recreation use implies less recreation related spending and lower net benefits than No Action	Less recreation use implies less recreation related spending and lower net benefits than No Action	More recreation use implies more recreation related spending and higher net benefits than No Action	More recreation use implies more recreation related spending and higher net benefits than No Action	Approximately the same recreation use implies approximately the same recreation related spending and approximately the same net benefits as No Action
Cultural Resources						
Presence or potential for significant cultural resources	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverflow and reservoir storage levels and fluctuation where resources could be disturbed	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Ground-disturbing activities, modification, loss, or abandonment of historic structures	No change	Unknown. Low AWN. Lower potential to exercise water acquisition options which could affect cultural resources.	Unknown. Low AWN. Lower potential to exercise water acquisition options which could affect cultural resources.	Unknown. Most AWN. Highest potential to exercise water acquisition options which could affect cultural resources.	Unknown. High AWN. Higher potential to exercise water acquisition options which could affect cultural resources.	Unknown. Least amount of AWN. Lower potential to exercise water acquisition options which could affect cultural resources.
Indian Trust and Treaty Assets						
Potential to affect Indian real property, physical assets, or intangible property rights	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Environmental Justice						
The proportion of physical or economic impacts compared to the distribution of specific population characteristics	No change	Negligibly higher potential than No Action	Negligibly higher potential than No Action	Higher potential than No Action	Higher potential than No Action	Similar potential as No Action

EC = specific electrical conductance, AWN = additional water needed, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter