Chapter 3. Affected Environment and Environmental Consequences

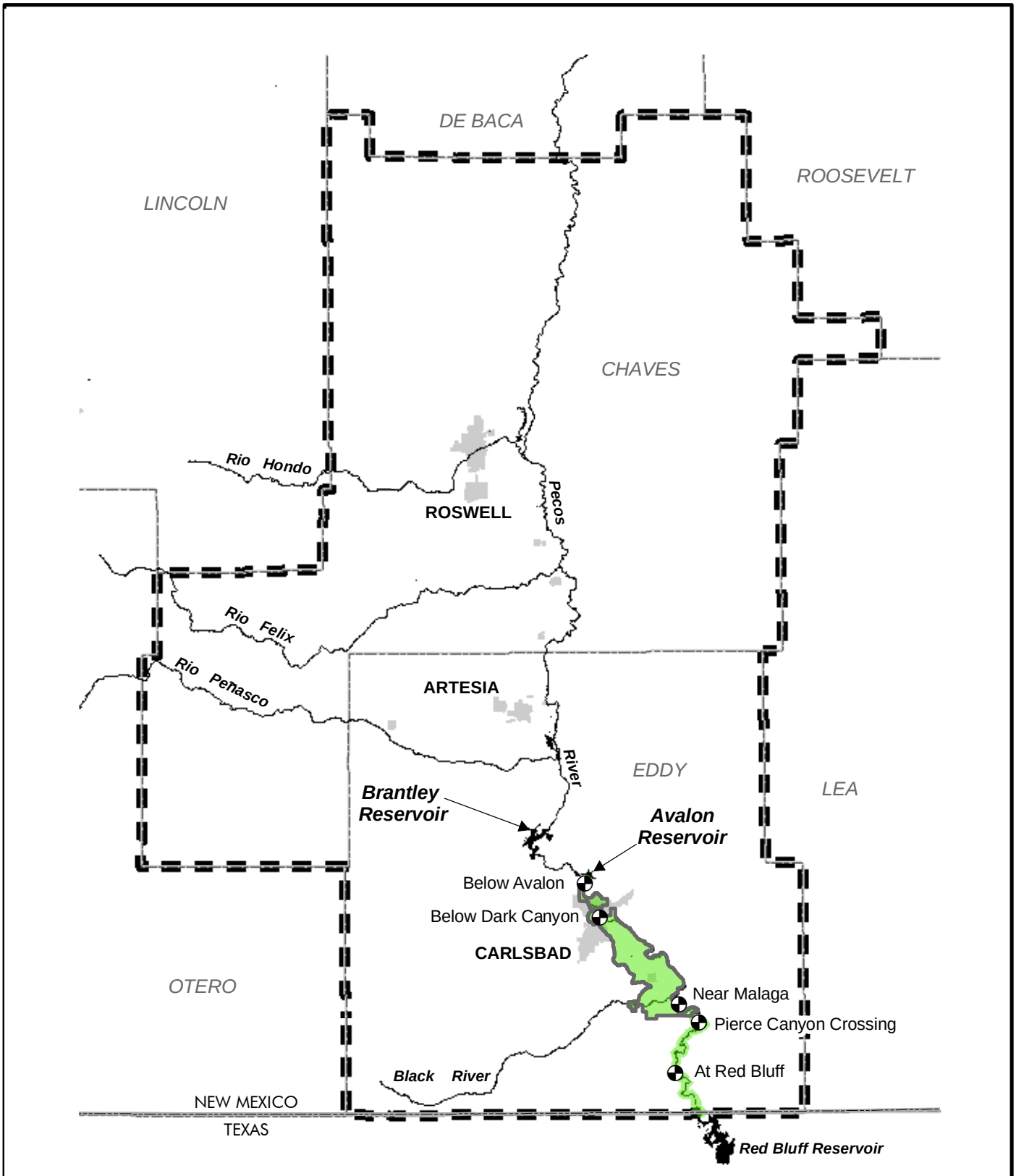
This chapter describes the affected environment and the direct and indirect effects that would be expected to occur as a result of implementing each alternative described in Chapter 2. The affected environment for each resource area is initially discussed, followed by the direct and indirect analysis. In some cases, these discussions follow a brief introduction to the regulatory setting. Potential effects are discussed by alternative, with the No Action Alternative discussed first. In the effects section, potential direct and indirect effects are described. Resource commitments are discussed in Section 3.16.3.

3.1 Terms Used in This Chapter

3.1.1 Effects and Analysis Area

Direct effects are those that would be the direct result of implementing one of the alternatives. For example, a direct effect of the Proposed Action would be any change in flows in the Pecos River that would result from contract execution. An indirect effect (also called secondary effects) would be one induced by the alternative, but would occur later in time or farther removed in physical distance. For example, any change in crop production in the CID, and in Eddy County economic activity as a result of NMISC's continued land fallowing through water right leases or ownership would be an indirect effect.

In this chapter and the subsequent chapter on cumulative effects, two different analysis areas have been defined for the effects analysis. The term "analysis area" refers to the area of potential direct and indirect effect of the Proposed Action. For all resources except socioeconomics, the analysis area for direct and indirect effects is the Pecos River floodplain downstream of Avalon Dam to the state line, and the irrigated lands within the CID. For socioeconomics, the analysis area is Eddy and Chaves Counties (Figure 4).



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Analysis Area for Other Resources

Analysis Area for Socioeconomics

Selected USGS Gauge Sites on Pecos River

1 Inch = 20 Miles

N

Figure 4
Analysis Areas

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A cumulative effect is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Reasonably foreseeable actions are described in detail in Section 4.1. During scoping, several commentors expressed concern about the cumulative effects of NMISC implementing the Settlement Agreement. As Section 4.1 discusses, the Settlement Agreement includes NMISC's acquisition and fallowing of up to 18,000 acres of irrigated lands. Under the Settlement Agreement, NMISC will develop and operate one or more augmentation well fields. Anticipated cumulative effects are disclosed in a separate chapter, Chapter 4–*Cumulative Effects*.

3.1.2 Short-term and Long-term Effects

In the effects section for each resource, effects are described as being either short term or long term. Short-term effects for this project would persist 5 years after execution or review of the contracts in 2006. Because the proposed miscellaneous purpose contract would have a term of 40 years, long-term effects would last until 2046.

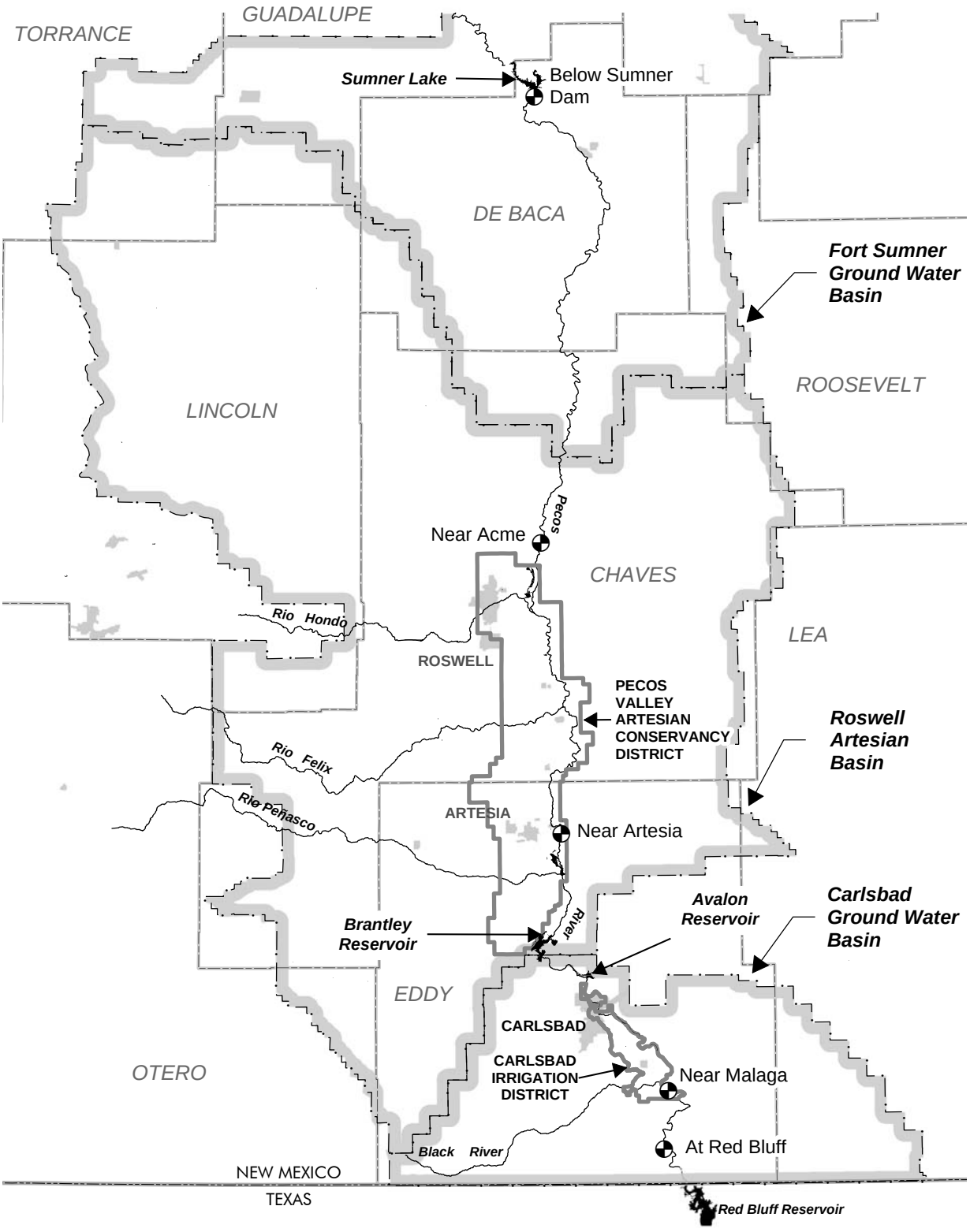
3.2 HYDROLOGY

3.2.1 Background

Surface Water. Flows in the Pecos River through the analysis area are controlled largely by releases from Reclamation's Carlsbad Project storage reservoirs. The Carlsbad Project provides water to the CID, the largest user of surface water in the analysis area. CID can divert up to about 125,200 acre-feet in years with a full supply of water. The flow through river reaches in the analysis area depends on reservoir operations, gains to the reach (including precipitation inflows, ground water inflows (base inflows), and irrigation return flows), and losses from the reach (including diversions for irrigation, seepage, and evaporation/transpiration). The two primary sources of inflow to the Pecos River upstream of the analysis area are: 1) snowfall in the northern headwaters in the Sangre de Cristo Mountains, which provides spring snowmelt runoff; 2) rainfall associated with summer storms that occur across most of the Pecos River basin; and 3) some tributary flows and aquifer recharge from precipitation in the Sacramento Mountains to the west.

Surface water flows in the analysis area are also influenced by ground water inflows from the Roswell and Carlsbad ground water basins. These inflows, in turn, are affected by irrigation practices in those basins. Inflows to the Pecos River from adjacent aquifer systems on average add over 75,000 acre-feet of water annually to the river between Santa Rosa Reservoir and the New Mexico-Texas state line.

The four major reservoirs on the Pecos River in New Mexico are Santa Rosa, Sumner, Brantley and Avalon (Figure 5; Santa Rosa not shown). Only CID and the U.S. (through Reclamation) hold water rights to store water in these reservoirs. The remaining storage space is for flood control. Santa Rosa Reservoir is an Army Corps of Engineers facility north of the town of Santa Rosa in Guadalupe County. Sumner Reservoir is about 49 river miles downstream of Santa Rosa Reservoir, and just upstream of the town of Fort Sumner in De Baca County, and its purposes are flood control and irrigation. Brantley Reservoir is about 230 river miles downstream from Sumner Reservoir, just upstream of the City of Carlsbad in Eddy County. The purposes of Brantley Reservoir also



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Ground Water Basin
Irrigation District
Selected USGS Gauge Sites on Pecos River

1 Inch = 25 Miles

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Figure 5
Pecos River South of Fort Sumner

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are flood control and irrigation. Avalon Reservoir is near Carlsbad, and has very little storage capacity. Avalon Dam serves primarily as an irrigation diversion structure for the CID Main Canal. The volume of surface water stored in these four reservoirs varies annually and seasonally due to precipitation inflows in the basin and storage and releases for irrigation and other purposes.

Aside from CID, there are no other major users of Pecos River surface water in New Mexico below Avalon Dam. Major sources of flow in the river from Avalon Dam to the state line include releases from the dam (flood control, conservation spills, and Project water leased by NMISC or allotted to NMISC-owned lands), flood inflows, base inflows, and irrigation return flows from the Carlsbad area.

Ground Water. A large portion of the analysis area lies within the Carlsbad Ground Water Basin (the "Carlsbad Basin"), a declared ground water basin (Figure 5). Some activities in the Roswell Artesian Basin (RAB) to the north may also contribute to cumulative impacts in the analysis area. The Carlsbad Basin and the RAB each contain two major water-bearing features: a shallow alluvial aquifer and a deep carbonate aquifer.

The Carlsbad Basin extends from below Brantley Dam to south of the New Mexico-Texas state line and is about 90 miles wide at the state line. It contains a shallow alluvial aquifer and a deeper limestone aquifer (the deep aquifer is commonly referred to as the Capitan Reef Aquifer Complex or Capitan Aquifer). The Pecos River and the two Carlsbad Basin aquifers are hydrologically connected. Wells used by the City of Carlsbad and agricultural operations in southeastern New Mexico and west Texas withdraw water from the Capitan Aquifer.

Well data from the Carlsbad area, collected by the NMOSE between 1993 and 1995, indicate depths to ground water in the alluvial aquifer in the range of 7 to 166 feet below ground surface. Depth to ground water in the Capitan Aquifer in 1994 and 1995 ranged from 30 feet to 150 feet below ground surface.

Ground water levels in the alluvial aquifer slope from north to south and from west to east, indicating a southeastward ground water flow toward the Pecos River. Water levels in the alluvial aquifer vary substantially over time, depending on irrigation practices and precipitation patterns. Lower ground water levels correlate with droughts or extended periods of relatively low surface water supply (e.g., the early 1960s and mid-to-late 1970s), during which times irrigation pumping typically increased. During periods of high rainfall (e.g., the mid-1960s, the 1980s, and early 1990s) and abundant surface water availability, irrigation pumping was relatively low and aquifer water levels stabilized or recovered (Barroll et al. 2002).

The RAB is north of the Carlsbad Basin. It straddles the Pecos River, and extends about 25 miles east and 60 miles west of the river (Figure 5). It is generally bounded on the south by Brantley Reservoir and extends upriver to about 25 miles north of the town of Acme. Throughout most of the RAB, the shallow aquifer and the deeper, carbonate aquifer are separated by a semi-confining layer.

The U.S. Geological Survey (USGS) Ground Water Atlas (Robson and Banta 1995) indicates that the flow of water in both Roswell aquifers trends generally to the east and southeast. Water levels dropped significantly after aquifers began to be used for irrigation. Metering of wells, which began in the late 1960s, likely helped spur a

reduction in ground water pumping in the basin. Since that time, water levels have recovered somewhat, although not nearly to pre-development levels. The recovery of ground water levels is attributed in part to NMISC's purchase and retirement of some water rights in the RAB, and the PVACD's water conservation program (Hydrosphere 2003).

CID Operations. CID operations are driven by demands for irrigation water. CID's irrigation season is typically March 1 through October 31. CID holds Project water in the upper basin (Santa Rosa and Sumner Reservoirs) to reduce evaporation and to reserve space in Brantley Reservoir to capture flood inflows. CID stages water in Brantley Reservoir for delivery to irrigators nearby, and delivers water from Brantley Reservoir through Avalon Reservoir to the Main Canal. The Main Canal and a system of lateral canals then deliver water to individual CID irrigators. CID releases water from Avalon Dam directly into the river channel (as opposed to the Main Canal) only if total Carlsbad Project storage is exceeded (termed a "conservation spill"), if the reservoirs are in flood control operations, or if Project water is being delivered to the state line (see below).

The volume of water in Brantley Reservoir decreases as water is delivered to irrigators. CID periodically makes block releases from Sumner Reservoir to refill Brantley. Block releases are high-flow releases of water (typically 1,000 to 1,400 cfs), made over a period of up to three weeks. These block releases minimize the transmission losses incurred in moving water from Sumner Reservoir downstream to Brantley Reservoir.

At the start of each irrigation season, the CID Board sets an allotment for farmers in the district based on the volume of water in Project storage, with consideration for delivery efficiencies to the farm head gates. Within the CID, 25,055 acres of land are authorized for irrigation, with about 70 to 80 percent actively irrigated each year. Because the total amount of water that will be available throughout the irrigation season is not known in March, incremental partial allotment increases may be made throughout the irrigation season. The maximum allotment is 3.697 acre-feet per acre.

About 55 percent of CID's 25,055 acres have permitted supplemental ground water rights in addition to the surface water allotment they receive. These supplemental rights have historically been used in years when the CID allotment was less than 3.0 acre-feet per acre. The effects of surface water irrigation and supplemental well use on flows from the Carlsbad Basin aquifers into the Pecos River below Avalon Dam can be substantial. The NMOSE estimates that a reduction in surface water delivery of 1 acre-foot replaced by supplemental pumping has a 1 acre-foot reduction on flows at the state line (Barroll et al. 2001).

CID Operations Relative to NMISC Use of Project Water. The NMISC has leased Carlsbad Project water since 1992 as part of its Water Resource Conservation Project (see Section 1.3.3 for additional details on the leasing program). Under the existing short-term miscellaneous purposes contract, these leased waters have been released from Avalon Dam to the Pecos River and the state line as partial fulfillment of New Mexico's delivery obligations under the Pecos River Compact and Amended Decree. CID delivers NMISC's leased water to the state line via one or more releases each year. Since 1992, a release almost always has occurred in either October or November (Figure 6). These fall releases account for about 70 percent of NMISC's leased water since 1992. October or November is the most

common time period for these releases because they generally do not interfere with the delivery of irrigation water (which typically ends in mid-October), the total amount of unused allotment water is known, and the NMISC has a better estimate on its state line water delivery obligations (and thus lease requirements) than it does earlier in the year. In some years, CID has also released the leased water to the state line in July and/or December.

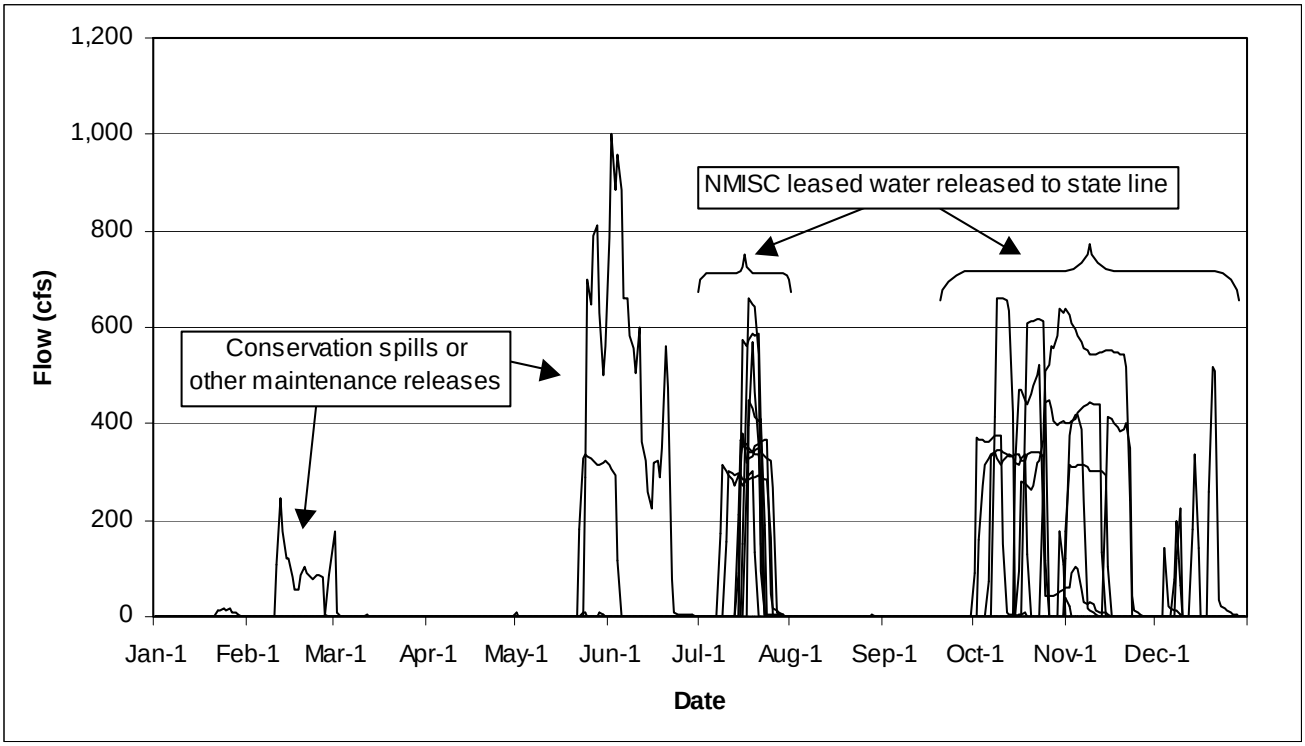
Releases of NMISC's leased water from Avalon Dam are constrained to a maximum of about 600 cfs due to a low-flow culvert near the City of Carlsbad. Actual state line releases of NMISC-leased water have ranged from about 300 cfs to slightly more than 600 cfs (Figure 6).

3.2.2 Affected Environment

Three "resource indicators" are used in the hydrology effects analysis (see Section 3.2.3, *Environmental Consequences*). The indicators are: Pecos River flows downstream of Avalon Dam (below Avalon Dam and at Red Bluff, the delivery gauge for the Pecos River Compact); flows to the CID Main Canal and changes to Project efficiency internal to CID; and base inflows to the Pecos River. The existing and historical condition of these indicators is discussed in the following paragraphs.

Pecos River Flows Downstream of Avalon Dam. Flows downstream of Avalon Dam are evaluated at two locations: the USGS gauges "Pecos River below Avalon Dam" and "Pecos River at Red Bluff" (commonly referred to as "below Avalon" and "Red Bluff", respectively) (Figure 7). Flows downstream of Avalon Dam are a function of CID irrigation returns, ground water inflows from the Carlsbad Basin, storm inflows, and releases from Avalon Dam. Impacts of the alternatives on river flows are presented using flow frequency curves.

Figure 6. Ten years of daily flow data at the USGS gauge "Pecos River below Avalon Dam" (1992-2001).



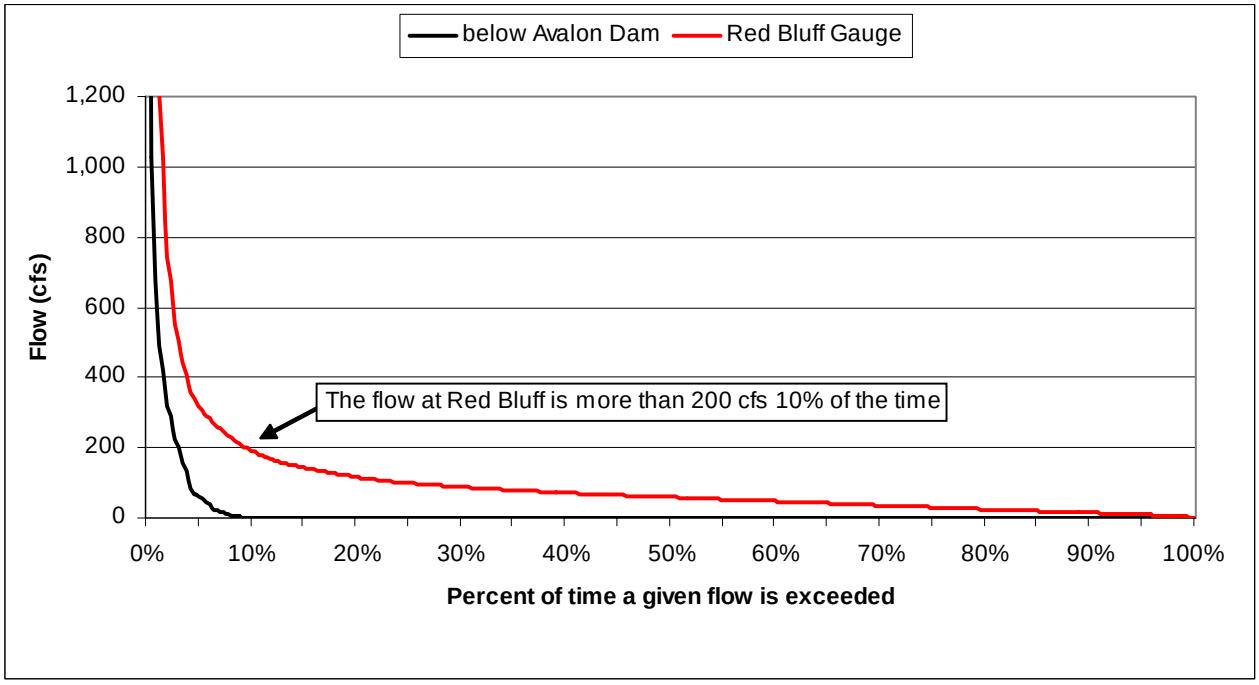
Source: Hydrosphere Resource Consultants 2005a.

A flow frequency curve shows the probability that on any given day the flow at a specific location will exceed a specific flow. For example, the flows at Red Bluff have historically exceeded 200 cfs about 10 percent of the time (Figure 7). Before the NMISC began its leasing program, the only releases from Avalon Dam were due to either conservation spills or flood spills. The Red Bluff flow data include water years 1939 to 2002; below Avalon Dam flow data include water years 1952 to 2002.

Even with the leasing program releases in place, the river below Avalon Dam has no flow about 90 percent of the time. Flows at Red Bluff consist of releases from Avalon Dam, plus base inflows and return flows from the Carlsbad Basin, tributary inflows, and treated effluent from the City of Carlsbad's wastewater treatment plant.

Flows to CID Main Canal and Changes to Project Efficiency. CID may divert up to 125,200 acre-feet per year into the Main Canal. The Carlsbad Project may store up to 176,500 acre-feet in its reservoir system. The average annual diversion by CID over the period 1940 to 2002 was 77,100 acre-feet. In 40 percent of those years, the final allotment was 3.0 acre-feet per acre or higher. The lowest annual allotment in the last 55 years occurred in 1953, when the allotment was 0.4 acre-feet per acre. Although the delivery efficiency of the canal system varies depending on flow rates, CID currently assumes a constant canal transit loss of about 35 percent of the farm headgate delivery requirement for purposes of computing allotments (this is equivalent to a canal transit efficiency of about 74 percent).

Figure 7. Flow frequency at USGS stream gauges at Red Bluff and Below Avalon Dam.



Sources: USGS "Pecos River at Red Bluff" gauge data for water years 1939 to 2002; USGS "Pecos River below Avalon Dam" gauge data for water years 1952 to 2002 (Hydrosphere Resource Consultants 2005a).

Base Inflows to the Pecos River. The primary source of water flowing to the state line is base inflows accruing to the river from the Carlsbad Basin. Changes in surface water supply and irrigation practices impact return flows and supplemental ground water pumping, which in turn impact base inflows to the river. The average base inflow to the Pecos River from the Carlsbad Basin aquifer system during the period 1952-1999 was about 32,000 acre-feet annually (USGS 1996). Base inflows in the reach from Avalon Dam to the New Mexico-Texas state line originate from the Carlsbad Basin aquifers, and are influenced by irrigation return flows, natural recharge from rainfall runoff, and flows from Carlsbad Springs. Return flows from CID directly depend on diversion amounts of available surface water, supplemental pumping, crop irrigation efficiency, and precipitation in the Carlsbad area. These factors influence aquifer storage levels and sub-surface flow to the Pecos River. There would be base inflows without any irrigation activity in and around CID, but the irrigation activities described above significantly modify the natural regime. Flows from Carlsbad Springs (location shown on Figure 1) are believed to be the result of seepage from Lake Avalon (USGS 1996).

3.2.3 Environmental Consequences

Impacts on surface and ground water hydrology are evaluated in the region from Avalon Dam downstream to the Red Bluff gauge. The analyses include evaluation of changes to flow patterns (timing and volume) in the Pecos River as well as changes to patterns of CID diversion, irrigation, and return flow. The results are presented comparatively by resource indicator for the two alternatives (No Action Alternative and Proposed Action).

3.2.3.1 Methods and Assumptions

Except where noted, hydrologic data from the 1952-2001 period were used in the impact analysis. Use of historical hydrologic data to evaluate likely future hydrologic and system operation patterns relies on the assumption that future hydrologic conditions will be similar to those observed in the 1952-2001 period. For the direct and indirect impact analyses, the data were generally separated into two subsets, pre-1992 and 1992-2001.

Pre-1992 data are indicative of CID operations without a leasing program (i.e., No Action operations after the current miscellaneous purposes contract expires in 2009). NMISC began leasing Project water in 1992. 1992-2001 data are reflective of existing conditions (i.e., the current leasing program) with the current short-term miscellaneous purposes contract in place, as well as operations likely to persist under the Proposed Action. Thus, for pre-92 data, estimates of effects of the Proposed Action must be developed, while for the 1992-2001 period, estimates of effects under the No Action Alternative are required.

An estimate of operations under the Proposed Action was developed for the 1952-1991 period using historical CID allotments. These approximate operations for the 1952-1991 period involved superimposing the NMISC releases onto historical release data, and estimating impacts of the reduced CID Main Canal deliveries and return flows. Likely CID operations under a No Action Alternative using the 1992-2001 hydrology data subset were estimated by removing state line releases of leased water from the 1992-2001 historical data, and estimating likely additional CID Main Canal deliveries and irrigation return flows.

The results of these analyses are approximations of hydrologic conditions over the entire 1952-2001

period that would result from either the No Action Alternative or the Proposed Action. These results are not predictions of hydrologic conditions over the life of the Proposed Action, but *are* indicative of likely *patterns* of water operations and hydrology assuming no major changes occur relative to historical hydrologic patterns.

CID Operations Relative to NMISC Use of Project Water. A description of current CID operations, including those related to the NMISC leasing program, was discussed previously (see Section 3.2.1). Determination of CID allotments and irrigation water deliveries will continue to be made in accordance with CID bylaws, New Mexico water law, and historical practices. Under the Proposed Action, future operations probably would be the same as under the current NMISC leasing program. Operations probably would include:

- Releases of Project water either leased or allotted to NMISC-owned lands from Avalon Dam to the state line one or more times annually, with the majority of these releases occurring in October or November, and less frequently in mid-summer and/or December, depending on Project water supply and Pecos River Compact delivery obligations
- CID operations upstream of Avalon Dam (e.g., block releases from Sumner Dam) consistent with current and future operational guidelines as described in Biological Opinions, the Carlsbad Project Water Operations and Water Supply Conservation EIS, and other documents. Historical patterns of block release variability would be likely to continue regardless of the outcome of this EIS.
- Releases to the state line under the current leasing program and the short-term miscellaneous purposes contract typically occur in the fall. This has allowed CID to conduct its irrigation deliveries unencumbered by any potential operational issues related to making both CID Main Canal and state line deliveries simultaneously. Subject to the constraints mentioned above, this practice is likely to continue.

For purposes of these analyses, several simplifying assumptions are made with respect to CID operations:

- Neither the Proposed Action nor No Action would affect the manner in which CID operates Sumner or Santa Rosa Reservoirs. CID would make block releases from Sumner Dam in anticipation of water delivery requirements to CID irrigators and/or the state line for NMISC. No single CID member can cause CID to initiate a block release. All CID operations are conducted to meet the demands of the Project as a whole. While the volume of specific block releases may be increased or decreased depending on NMISC requests under the miscellaneous purposes contract, these variations are not likely to be greater than the variations resulting from changing irrigation demands and allotment volumes. In the 13 years since NMISC began leasing Project water for state line deliveries, there has only been one block release (in 2005) specifically intended to meet NMISC leasing requirements. Another block release in 1991 was made with the specific objective of meeting Compact obligations, but it was not associated with the lease program. With the exception of the 2005 block release, CID has always been able to combine block release requirements of the lease program with water delivery requests from other CID irrigators (Davis 2005).
- Deliveries to the state line require releases from both Brantley and Avalon Reservoirs, because Avalon Reservoir is not large enough to store all the water required to meet most state line delivery requirements. The release of water from Brantley Reservoir to Avalon Reservoir for state line deliveries is no different in terms of

operational constraints than any other CID releases from Brantley Reservoir for irrigation purposes, except that some of the releases may occur later in the year than they would for irrigation. For this reason, the flows in the river between Brantley Reservoir and Avalon Reservoir in this analysis are not considered in the analysis.

- Because operation of Project reservoirs is the responsibility of the CID and Reclamation, there would be no direct or indirect effects of either alternative on evaporative losses from Project reservoirs.

To analyze the Proposed Action, it is assumed that the pattern of water leasing since 1992 (existing conditions) continues into the future. A value of 3,416 acres (the amount of land fallowed by NMISC leasing in 1999) is used to estimate the changes to CID diversions, canal efficiency, irrigation return flow, and base inflows to the Pecos River. In a full allotment year, leased water allotted to 3,416 acres plus the water allotted to the 164 acres owned by the NMISC, plus an average lease of 5,170 acre-feet of undelivered allotment water would result in releases to the state line of nearly 21,600 acre-feet (3,580 acres x 3.697 acre-feet per acre x 1.176 adjustment for losses not incurred + 5,170 acre-feet of undelivered allotment water x 1.176 adjustment for losses). The Proposed Action would allow use of up to 50,000 acre-feet of water annually, near the historical maximum of 44,800 acre-feet leased water and about 2.5 times the current average volume used by NMISC. For state line deliveries of 50,000 acre-feet, releases from Avalon Dam totaling 42 days at 600 cfs would be required.

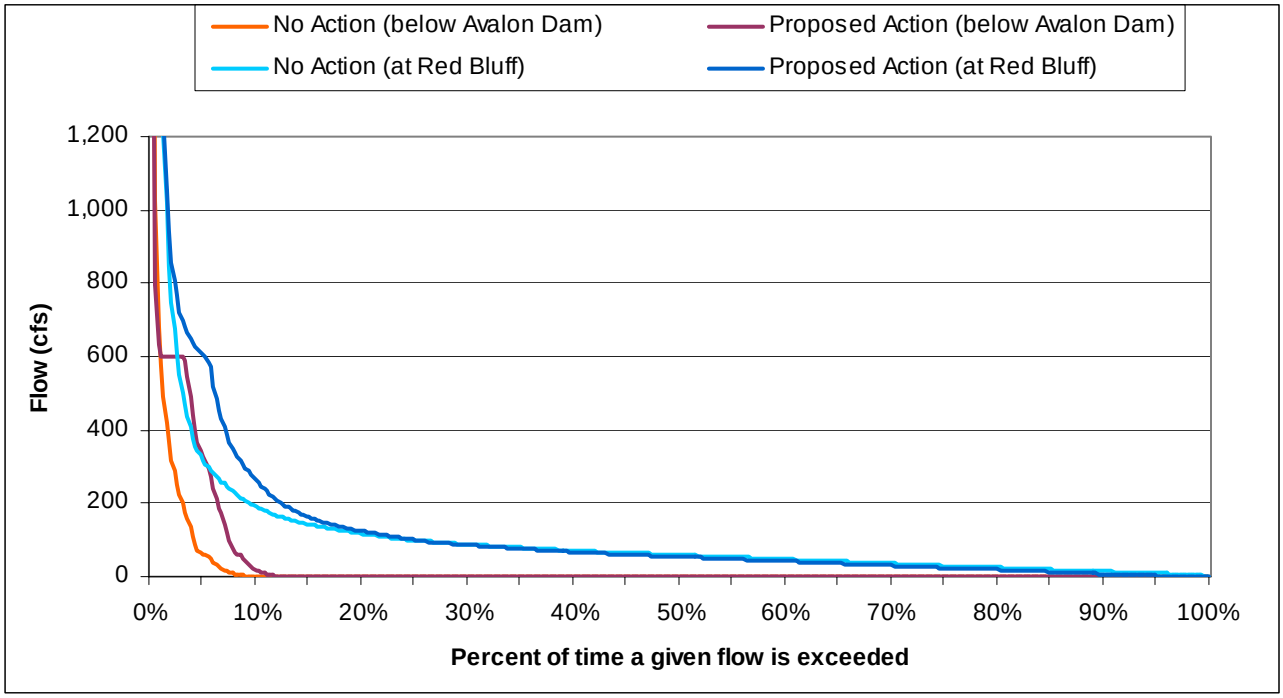
3.2.3.2 Direct and Indirect Effects

Pecos River Flows below Avalon Dam. Under the No Action Alternative, releases from Avalon Dam and flows from the dam to the state line would continue through 2009 in much the same pattern as they currently occur under the existing short-term miscellaneous purposes contract. Once the short-term contract expires, releases from Avalon Dam would only be made in the event of conservation spill or flood control spills. Below Avalon Dam, the No Action Alternative would reduce the frequency of flows less than 600 cfs by up to 18 fewer days compared to the Proposed Action (Figure 8). The flows in the river immediately below Avalon Dam would be zero slightly less than 90 percent of the time, slightly less than the Proposed Action. Flow frequency data at Red Bluff and below Avalon Dam would exhibit similar patterns, with a small percentage of very high flows and high frequency of lower flows. However, flows at Red Bluff would also include base inflow from the Carlsbad Basin aquifers that generally prevents the flows at Red Bluff from being zero (the long-term average flow at Red Bluff is 60 cfs, and the flow exceeds 15 cfs 90 percent of the time).

The Proposed Action would be a continuation of existing conditions; the patterns of releases from Avalon Dam and flows at Red Bluff would not change significantly from existing conditions. The flows in the river immediately below Avalon Dam would be zero about 90 percent of the time, slightly more than the No Action Alternative.

Compared to the No Action Alternative, the Proposed Action would have up to 18 more days with flows above 600 cfs below Avalon Dam (Figure 8). At the Red Bluff gauge, the 600 cfs release from Avalon Dam would mix with base inflows from the Carlsbad Basin aquifers and periodically with tributary inflows from rainfall events. As a result, flow frequencies at the Red Bluff gauge under the Proposed Action would be greater than 600 cfs more than the No Action Alternative, although the magnitude of the change

Figure 8. Effect of alternatives on flows below Avalon Dam (releases) and at Red Bluff.



Source: Hydrosphere Resource Consultants 2005a.

in flow (compared to the No Action Alternative) would still not exceed 600 cfs on any given day. The addition of 600 cfs releases would also slightly reduce the frequency of flows less than 100 cfs at Red Bluff (compared to No Action) because those 100 cfs or less flows would be replaced by the releases of 600 cfs.

The proposed long-term miscellaneous purposes contract would allow use for purposes other than irrigation and the subsequent release from Avalon Dam of up to 50,000 acre-feet of Project water annually. While releases of larger volumes up to 50,000 acre-feet may be possible, it is highly unlikely that they would occur on a regular basis. If they did occur, it is likely that the current pattern of releases in July and again in October or November would continue, but with significantly larger volumes in both periods (the percentage of days with 600 cfs releases from Avalon Dam would approximately triple).

Flows in the Pecos River at Red Bluff would also be affected by changes in base inflows from the Carlsbad Basin. These effects are discussed below under "Base Inflows to the Pecos River."

Flows to CID Main Canal and Project Efficiency. CID Main and lateral canal efficiency is primarily a function of the total volume of water delivered from Avalon Dam into the CID canal system. Regression analysis of CID headgate delivery and transit loss data was used to derive efficiency values at different delivery rates. The existing short-term miscellaneous purposes contract operating agreement between NMISC and CID includes a provision requiring NMISC to leave 17.6 percent of its total leased water entitlement (allotment plus transmission losses in the Main

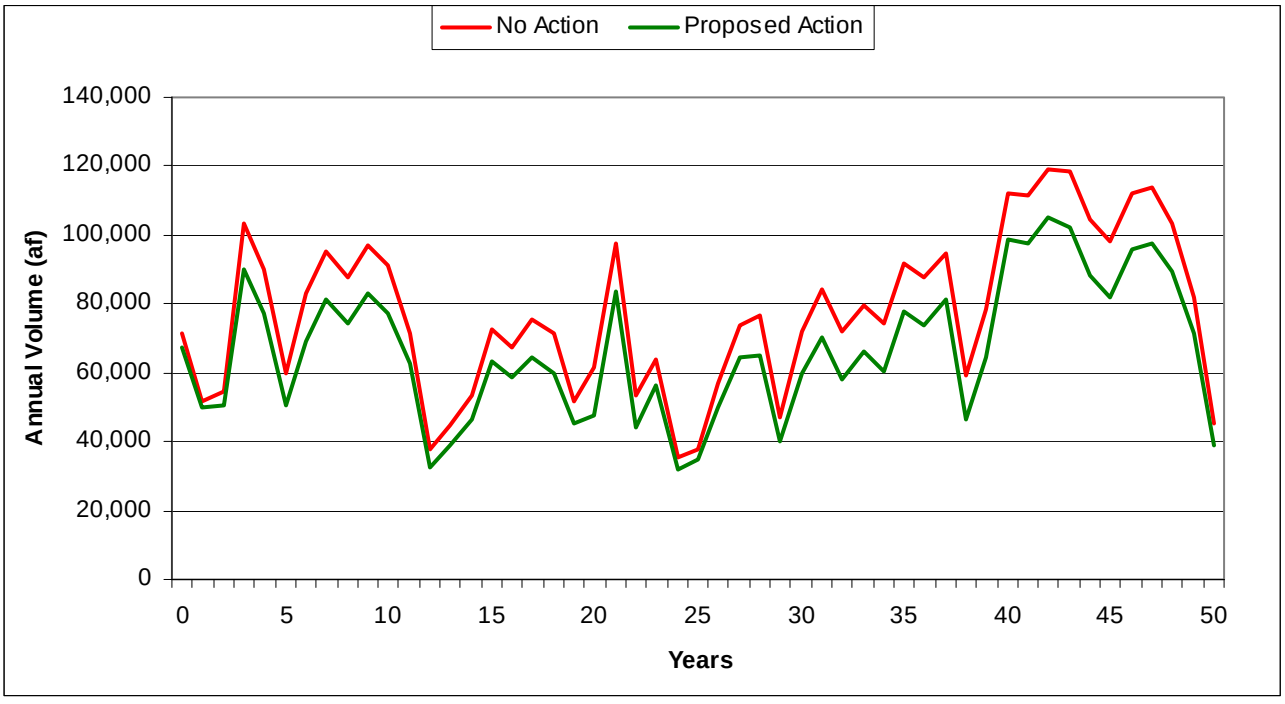
Canal) in storage, in part to compensate for the possibility of lowered transmission efficiencies within the CID canal system. The value of 17.6 percent is about half of the estimated transmission losses incurred in delivering water from Avalon Dam to farm headgates, and was agreed to as part of the existing leasing program.

Diversions to the CID Main Canal would increase under the No Action Alternative after 2009 (Figure 9). The No Action Alternative would result in annual diversion volumes similar to those before NMISC leasing began in 1992. Canal efficiency would increase slightly under the No Action Alternative, as the current land fallowing would cease and total deliveries into the Main Canal would increase. As the average volume of water delivered to farm headgates increases, so does the overall canal efficiency.

Hydrologic data from 1992-2001 are indicative of likely future operations under the Proposed Action. Generally, diversions into the CID Main Canal under the Proposed Action would remain the same as existing conditions and would be lower than the No Action Alternative after 2009. In the Proposed Action, the NMISC would continue using Project water either leased or allotted to NMISC-owned lands for state line deliveries.

Based on empirical data, the difference in transit efficiency between historical (pre-1992) conditions and existing conditions is less than five percent. Under an average allotment year, the Project transmission efficiency is estimated to be about two percent less in the Proposed Action compared to the No Action Alternative. These changes would not be statistically significant, and would be less than the magnitude of the errors associated with observations of the efficiency data itself. Compared to current operations with the existing NMISC leasing program, there would be no change

Figure 9. Comparison of annual diversions to the CID Main Canal.



Source: Hydrosphere Resource Consultants 2005a.

from existing efficiencies in implementing the Proposed Action (Hydrosphere Resource Consultants 2005a).

Base Inflows to the Pecos River. Base inflows to the Pecos River below Avalon Dam come from the Carlsbad Basin aquifers. Natural base inflow patterns are influenced by irrigation return flows and supplemental well pumping in CID. In general, irrigation return flows are reduced by the ongoing NMISC leasing program as compared to pre-1992 conditions. These reductions in irrigation return flows tend to reduce base inflows to the Pecos River.

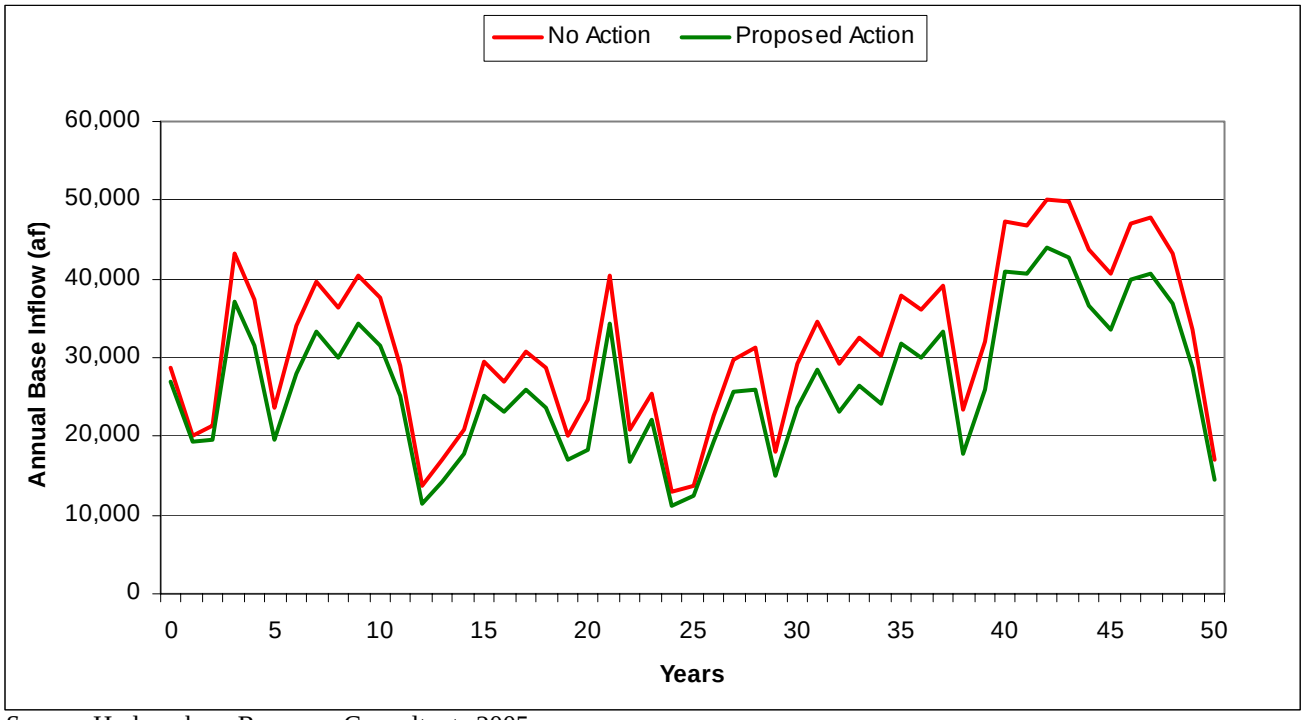
Base inflows would be on average about 5,000 acre-feet per year greater under the No Action Alternative than with the Proposed Action (Figure 10). A 5,000 acre-foot per year increase in base inflows is equivalent to a constant seven cfs flow increase throughout the year. The increased flow under the No Action Alternative would affect flows in the river beginning just downstream of the City of Carlsbad and that change would continue downstream to the Red Bluff gauge. Even though base flows may be less in the Proposed Action, the net flows at the state line are considerably greater than with the No Action Alternative.

3.3 Water Quality

3.3.1 Affected Environment

The New Mexico Water Quality Control Commission (NMWQCC) sets water quality classifications and standards to protect beneficial uses of water bodies in the state. The New Mexico Environment Department (NMED) assesses and reports on the attainment of standards. If water quality data indicate that a standard is exceeded, the lake or stream segment is declared as being impaired and not supporting of the designated use

Figure 10. Estimated base inflows to the Pecos River between Avalon Dam and Malaga.



Source: Hydrosphere Resource Consultants 2005a.

for which the standard was set. This information is summarized in the State's Integrated §303(d)/ §305(b) Report (NMWQCC 2004).

Within the analysis area, the NMWQCC has defined four separate segments on the Pecos River (Table 6). Each segment is listed in the §303(d)/§305(b) Report as not supporting the "warm water fishery" designated use. The segments and probable causes and sources of water quality impairment are listed in Table 6. Of the three probable causes of water quality impairment, two of them could be affected by changes in water operations: low flow alterations and sedimentation/ siltation. Low flow alterations were discussed previously in Section 3.2.3.2. Sedimentation and siltation are addressed in the subsequent *Geomorphology* Section (Section 3.4).

Apart from the NMWQCC impairment issues identified in Table 6, elevated salinity concentrations are of concern. Although salinity is relatively high in the Pecos River downstream of Avalon Dam, the corresponding NMWQCC standards are also high because those concentrations are considered to be naturally occurring. Water quality standards in the analysis area related to salinity are currently not exceeded (NMWQCC 2004).

Water containing high concentrations of salts can hinder irrigation and adversely affect community water supplies. The use of water for irrigation purposes is severely restricted when total dissolved solids (a measure of salinity) rises above 2,000 mg/L (Ayers and Westcot 1985). This is approximately equivalent to a specific conductance of 2,500 µS/cm on the lower Pecos River. Because salinity is of concern to the agricultural community and is often readily affected by changes in water operations, it is the focus of the water quality analysis. Specific conductance is often used as a measure of salinity (as salinity increases, so does specific conductance) and, therefore, is used as the resource indicator.

The USGS maintains four water quality stations below Avalon Dam in the Pecos River. The four stations are Below Dark Canyon, near Malaga, Pierce Canyon Crossing, and Red Bluff (Figure 4). Specific conductance at the Below Dark Canyon gauge is relatively low and shows little variation within any particular year (Figure 11). Flow at this location is predominately due to base inflow from

Table 6. Probable causes and sources of water quality impairment in Pecos River below Avalon Dam.

Pecos River Segment	Probable Cause of Impairment	Probable Source of Impairment
Avalon Dam to Tansill Dam	Low flow alterations	Usually dry
Tansill Dam (Lake Carlsbad)	Mercury in Fish Tissue	Atmospheric deposition
Tansill Dam to Black River	Sedimentation / siltation	• Irrigated crop production • Loss of riparian habitat • Rangeland grazing • Streambank modifications/ destabilization
Black River to the state line	Sedimentation / siltation	• Flow alterations from water diversions • Habitat modification • Loss of riparian habitat • Natural sources • Rangeland grazing

Source: NMWQCC 2004.

Carlsbad Basin aquifers. Specific conductance increases in the downstream direction, primarily due to irrigation return flows from CID.

The greatest increase in specific conductance occurs downstream of Malaga Bend (Malaga Bend is located between the "near Malaga" gauge and the Pierce Canyon Crossing gauge; see Figure 2). At Malaga Bend, a saline geologic formation adds considerable salt loads to the river (NMWQCC 1998). A salinity control project, called the Malaga Bend Salinity Alleviation Project, is designed to reduce natural loadings from a saline geologic formation that discharges into the Pecos River at Malaga Bend. In addition, a number of potash mining operations are in the basin. These operations may contribute saline loads to the ground water system and increase salinity in area surface waters (NMWQCC 1998).

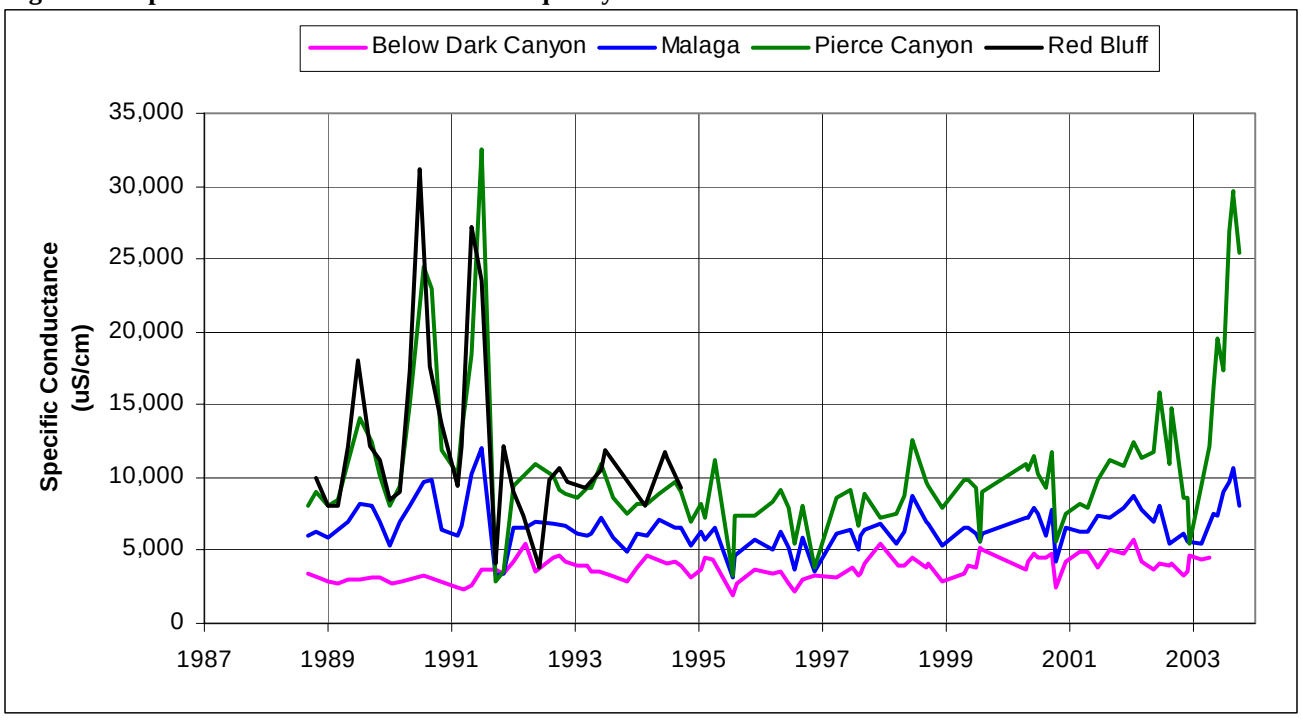
Variability in salinity concentrations at the Red Bluff and Pierce Canyon Crossing gauges decreased in late 1991. The NMISC leasing program started for state line deliveries in 1992. The change in Avalon Dam operations to accommodate state line deliveries may be a cause of the reduced variability of salinity, although there is not enough data to establish this relationship conclusively.

3.3.2 Environmental Consequences

As described in Section 3.3, the resource indicator for the water quality analysis is salinity as measured by specific conductance. As salinity increases, so does specific conductance. Estimated impacts at the four USGS water quality stations in the analysis area are described below. Additional details can be found in the Water Quality Technical Report (Hydrosphere Resource Consultants 2005b).

Effects of the No Action Alternative. In the No

Figure 11. Specific conductance at four water quality stations.



Source: USGS 2005.

Action Alternative, NMISC would continue leasing and using Project water for state line delivery until 2009. After 2009, leasing and using Project water for state line delivery would cease, and land currently fallowed as a result of leasing would return to being irrigated. The discussion below describes anticipated conditions after 2009.

The No Action Alternative would result in an increase in specific conductance at most locations below Avalon Reservoir (Table 7). Water would only be released from Avalon Dam to the river under spill conditions. Specific conductance at the below Dark Canyon gauge would likely decrease because flow would be composed more of ground water discharges, which have lower salinity than water stored upstream in the Pecos River. Between the below Dark Canyon and Red Bluff gauges, the increase in specific conductance would be associated with increased irrigation return flows from CID.

The values listed in Table 7 reflect the average salinity over a period of several years. Inter-annual variations in specific conductance are not reflected in these values. In general, it is estimated that salinity for the No Action Alternative would be less variable over the course of a year than the existing conditions at the below Dark Canyon gauge. It is estimated that the other three gauges would have greater variability. These patterns are evident from Figure 11 where operations prior to 1992 (no leasing or state line deliveries) are indicative of future operations under the No Action Alternative.

Effects of the Proposed Action. Operations most likely to occur under the Proposed Action are assumed to be the same as those seen under the current NMISC leasing program (1992-present). Therefore, specific conductance is unlikely to change from existing conditions (Table 7).

Table 7. Estimated changes in specific conductance from the No Action Alternative.

Station	Specific Conductance (µS/cm)		
	Existing Conditions	No Action	Change
Below Dark Canyon	3,900	2,900	-1,000
Near Malaga	6,200	7,400	+1,200
At Pierce Canyon Crossing	9,200	12,600	+3,400
At Red Bluff	NED	13,400	NED

The No Action Alternative was estimated using historical data between August 1988 and September 1991. Existing conditions were estimated using historical data between September 1991 and October 2002.

NED = Not Enough Data to quantify

Source: Hydrosphere Resource Consultants 2005b.

If NMISC would lease additional Project water and release the full 50,000 acre-feet to the state line allowed by the long-term contract, minor changes in specific conductance would occur during July and November (Table 8). This analysis assumes that increased releases from Avalon Dam to the state line in July and November would not affect the subsequent release concentrations from Brantley Reservoir.

In addition, the specific conductance of the water flowing into the analysis area is generally increasing (Hydrosphere Resource Consultants 2005b). The reason for this trend has not been determined although it has been determined the cause is not due to flow variations. The water quality analysis for the FEIS is based on average historical concentrations flowing into the analysis area, and does not account for the recently-observed upward trend in salinity.

Table 8. Estimated changes in specific conductance under the Proposed Action for years when 50,000 acre-feet would be released.

Station	Specific Conductance (µS/cm) July			Specific Conductance (µS/cm) November		
	Proposed Action	Full 50,000 AF Discharge	Change	Proposed Action	Full 50,000 AF Discharge	Change
Below Dark Canyon	3,900	4,000	+100	4,000	4,000	0
Near Malaga	4,200	4,100	-100	4,600	4,200	-400
At Pierce Canyon Crossing	4,200	4,100	-100	5,300	4,500	-800

Source: Hydrosphere Resource Consultants 2005b. Note that there is insufficient data at the Red Bluff gauge to estimate change in specific conductance.

3.4 GEOMORPHOLOGY

3.4.1 Affected Environment

The riverbed sediment of the Pecos River in the analysis area is composed predominantly of fine-grained sands and silts, with an armoring of larger gravels and cobbles common near bridges, dams, and underpasses. In most cases, both banks of the river channel are defined by thick stands of salt cedar that come down to the water's edge, resulting in deep U-shaped channels. Due to the substantial root system of the salt cedars, the overall shape of the river channel is quite stabilized and unlikely to vary significantly with minor increases or decreases in flow rate. In some locations, salt cedar appears to have been removed by controlled burns, leaving steep, sandy banks along the river's edge (Hydrosphere Resource Consultants 2005c). Geomorphology and riparian and wetland habitat width, health, and stability are interrelated. Additional information regarding these related topics is in Section 3.2 and Section 3.6.

Within the City of Carlsbad, the flow of the Pecos River is controlled by Tansill Dam to form Lake Carlsbad. The river along this reach is designated for recreational uses such as boating and swimming, and the river banks are composed of maintained grass lawns with paved walkways along the river's edge. In places where the river is wide enough (such as under large bridges), the stream bed becomes braided with vegetation growing in small islands.

As discussed in the Geomorphology Technical Report (Hydrosphere Resource Consultants 2005c), no obvious areas of instability, down cutting, or of sediment deposition were observed during a 2005 field inspection of the river morphology. Aerial photos from 1940, 1970, and 1996 similarly indicate no geomorphologic instability. The aerial photos show a steady increase in salt cedar stands along the river banks over the years. The high, steep banks that salt cedar stands create usually prevent the river from changing course, and maintain overall channel geometry except under extreme flood conditions such as in 2004, 1985, 1966 and earlier. An interview with a river gauging specialist with a long observation history of the Avalon to state line reach confirmed these observations of stable geomorphology (Todd 2005).

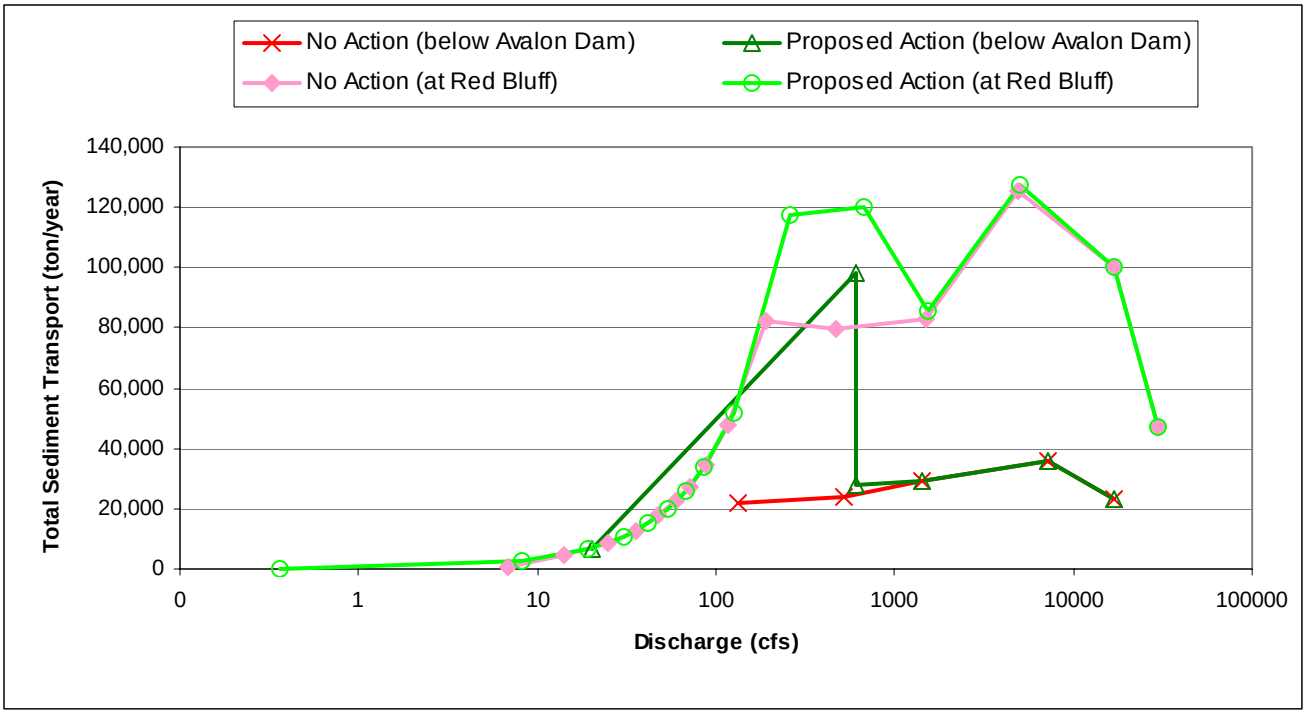
3.4.2 Environmental Consequences

A sediment transport analysis was conducted to assess likely changes in geomorphology. The total sediment transported in the river channel was calculated for each alternative using the flow frequency data for the Avalon and Red Bluff gauges (Hydrosphere Resource Consultants 2005a). Details of this analysis are presented in the Geomorphology Technical Report (Hydrosphere Resource Consultants 2005c).

Figure 12 shows the calculated annual sediment transport pattern for the No Action Alternative and the Proposed Action at the Avalon and Red Bluff gauges. Under both alternatives, flows at the Red Bluff gauge have a higher total sediment load than flows at the below Avalon Dam gauge. This is primarily due to the slightly higher flow rates at this gauge compared to the Avalon gauge. The curves for the Avalon gauge calculations are incomplete at lower flows because the flow at the Avalon gauge is 0 cfs 90 percent of the time.

At both gauge locations, estimated sediment transport would be greater with the Proposed Action than with the No Action Alternative; however, there likely would be no change in channel morphology, downstream sedimentation, or bank erosion. Sediment loads under the Proposed Action would be similar to those seen since 1992, under the existing operational conditions. The No Action Alternative would result in reduced sediment load relative to existing conditions. The difference between the two alternatives is most pronounced at flows around 600 cfs, which would be the dominant discharge rate associated with releases from Avalon Dam to the state line. At the below Avalon gauge, the Proposed Action would transport roughly 65 percent more sediment than the No Action Alternative, and at the Red Bluff gauge the

Figure 12. Estimated total sediment transport in the Pecos River under both alternatives.



Source: Hydrosphere Resource Consultants 2005c.

Proposed Action would transport about 10 percent more sediment than the No Action Alternative.

3.5 WETLANDS

3.5.1 Regulatory Overview

The proposed contracts and resulting activities would not involve the discharge of fill material or excavation in wetlands or waters of the U.S. Consequently, the U.S. Army Corps of Engineers (Corps) does not have any permitting responsibilities under Section 404 of the Clean Water Act. Reclamation, however, has responsibilities to avoid, minimize, and mitigate unavoidable impacts to wetlands under Executive Order (EO) 11990. EO 11990 requires Reclamation to "consider factors relevant to a proposal's effect on the survival and quality of the wetlands." EO 11990 requires that adverse effects on wetlands and other waters of the U.S. be avoided where possible in implementing federal actions.

In this FEIS, wetlands are defined using the Corps' definition (33 CFR 323.2[c]), which is:

> "…those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wetlands are transitional areas between terrestrial and aquatic systems that are saturated by surface or ground water for a significant percentage of the growing season in order to support hydrophytic (moisture-loving) vegetation. The U.S. Army Corps of Engineers 1987 Manual defines wetlands as areas containing all three following characteristics: the presence of hydrophytic vegetation, hydric (wet) soil characteristics, and wetland hydrology (Environmental Laboratory 1987). Wetlands are important natural systems that provide stormwater attenuation and retention, wildlife habitat, and commonly contain distinct vegetation species from adjacent upland areas.

For waters (including wetlands) to fall under the jurisdiction of the Corps, they must be hydrologically connected to a navigable water of the U.S. As such, stock tanks, wetland areas, and other waters isolated from any hydrologic connection to a main waterway do not fall under the jurisdiction of the Corps.

Riparian areas are the zones of vegetation that link terrestrial and aquatic ecosystems, and are found bordering lakes, ponds, reservoirs, estuaries, and ephemeral, intermittent, or perennial streams. Riparian areas do not meet the Corps criteria for wetland soils or wetland hydrology and frequently occur in locations transitional between jurisdictional wetlands and adjoining uplands. The Corps does not regulate placement of fill in riparian areas.

3.5.2 Affected Environment

The U.S. Fish and Wildlife Service (USFWS) developed a national classification system for wetlands so the extent and status of wetland types can be addressed on a national level (Cowardin et al. 1979). The Cowardin classification system describes a hierarchy of wetland systems and classes of wetlands and other waters. The USFWS' National Wetland Inventory (NWI) was used as the primary resource to determine the extent of wetlands in the analysis area. A field reconnaissance of the analysis area took place in August 2004 (ACI Consulting 2004). Along with the NWI maps, USGS topographic maps, floodplain maps, vegetation, and soils maps were used to aid in wetland identification. Aerial

photography also was used to identify potential wetlands in the analysis area.

Wetlands are distributed throughout the analysis area with a concentration along the Pecos River corridor. Riverine, palustrine, and lacustrine, wetlands are found in the analysis area and are defined by Cowardin et al. (1979) as:

- Riverine – all freshwater habitats contained within a channel, including springs, streams, and /or rivers, except those dominated by trees, shrubs, or persistent emergent vegetation
- Palustrine – habitats dominated by emergent vegetation, or small (less than 20 acres), shallow (less than 6.6 feet in depth) bodies of water without shoreline features dominated by bedrock or wave action
- Lacustrine – habitats situated within a topographic depression or dammed river channel that contain less than 30 percent areal coverage of trees, shrubs, and emergent vegetation

Riverine Wetlands. About 80.5 linear miles of riverine wetlands lie within the analysis area (Table 9). According to USFWS National Wetland Inventory maps (USFWS 1990), these wetlands include the Pecos River and its natural and man-made tributaries, including: Delaware River, Bluff Draw, Salt Draw, Pickett Draw, Wood Draw, Livingston Canal, Harroun Canal, Black River, Brushy Draw, Cass Draw, Esperanza Draw, Dark Canyon Draw, Southern Canal and East Canal. These riverine systems are primarily of the lower perennial subsystem, in which the gradient is low and water velocity is slow, and of the unconsolidated bottom or unconsolidated shore classes. Less commonly found in the analysis area are riverine systems of the intermittent subsystem and streambed class. Riverine wetlands within the analysis area are classified within the permanently, temporarily, seasonally, and intermittently flooded regimes (USFWS 1990).

Palustrine Wetlands. About 23.6 linear miles of palustrine wetlands occur within the analysis area (Table 9). These areas are predominantly located along the Pecos River, its tributaries and within the floodplain adjacent to riverine wetlands. Palustrine systems include vegetated wetlands such as marshes, swamps, bogs, fens, and wet meadows. While these wetlands are not assigned to a subsystem, they may be characterized by the emergent class, with erect, rooted, herbaceous hydrophytes (excluding moss and lichens); the scrub-shrub class, with woody vegetation less than 20 feet in height; and the unconsolidated shore.

Table 9. Wetlands in the analysis area.

Wetland Type	Approximate Length Along Pecos River
Riverine	80.5 miles
Palustrine	23.6 miles
Lacustrine	7.5 miles

Source: Lengths estimated from USFWS NWI Maps (USFWS 1990).

Lacustrine Wetlands. About 7.5 linear miles of linear lacustrine wetlands occur within the analysis area (Table 9). These wetland areas are typically along the perimeter and within lake and impoundment systems within the analysis area. These include: Lake Carlsbad, areas south of Telltale Bluff, along Culebra Bluff northeast of Loving, and the upper extent of Red Bluff Reservoir. Lacustrine wetlands in the analysis area are either littoral subsystems (wetland habitats extending from shoreline to a water depth of about 6.6 feet) or limnetic subsystems (deepwater habitats).

3.5.3 Environmental Consequences

3.5.3.1 Effects of the No Action Alternative

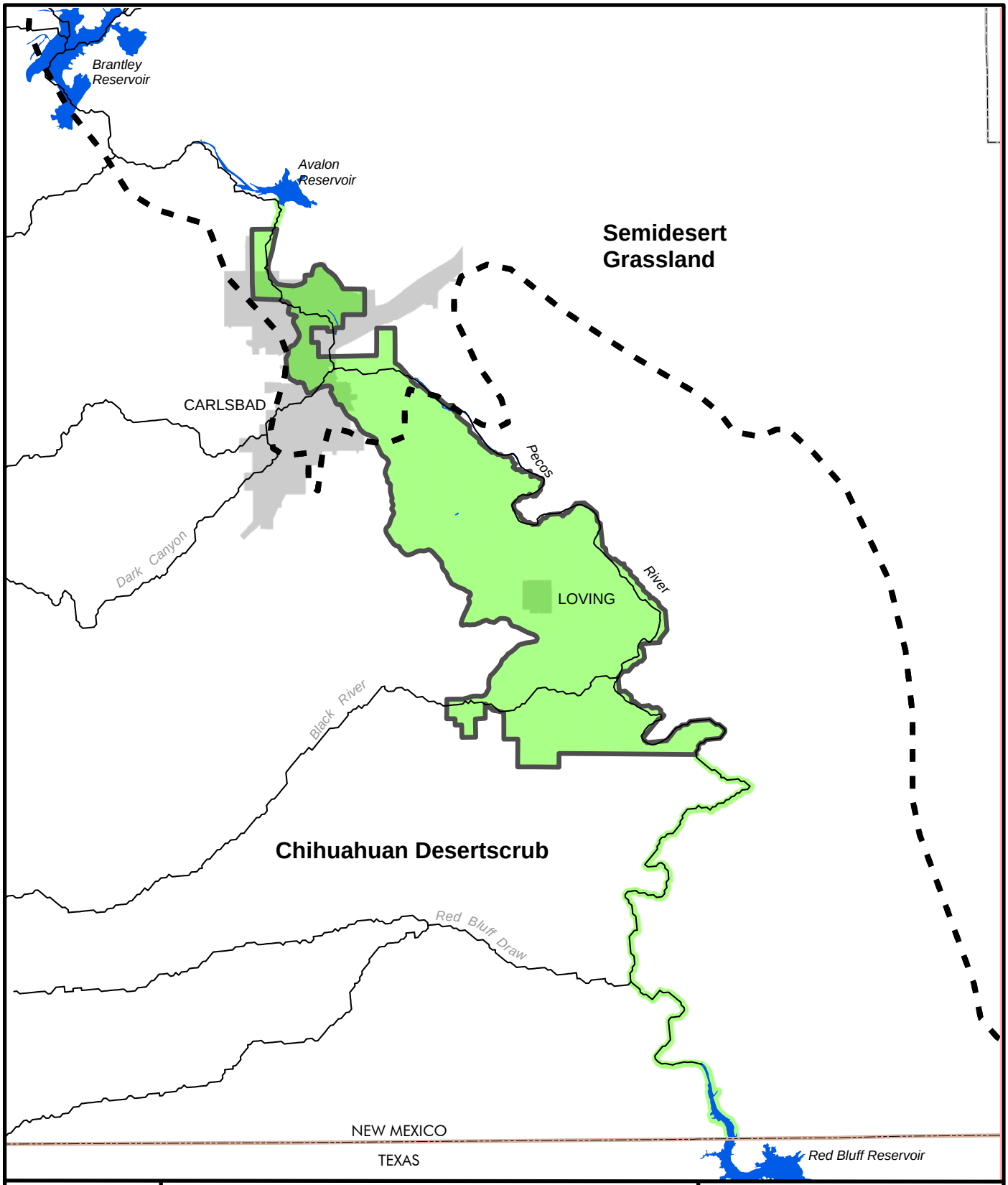
Under the No Action Alternative, the discontinuation of state line releases would decrease the available water below Avalon Dam by about 21,600 acre-feet per year in full allotment years. The water from the fall releases would not be available for wetlands immediately adjacent to and within the Pecos River below the dam over the long term. Baseflow below CID would increase by 5,000 acre-feet (Hydrosphere Resource Consultants 2005a) generally during and after the irrigation season and could benefit wetlands along the Pecos River and drainages hydrologically below CID leading to the Pecos River. The additional baseflow may slightly promote wetland (hydrophytic) vegetation along the Pecos River. The 5,000 acre-feet of baseflow would arrive at the river over a longer time period than the leased water deliveries, which generally occur over short (1-2 week) periods in the summer and fall. The baseflow may provide additional supportive hydrology over a larger percentage of the growing season and increase the saturation of wetlands within and along the Pecos River channel.

3.5.3.2 Effects of the Proposed Action

Under the Proposed Action, long-term flow below Avalon Dam would occur in essentially the same manner as under current conditions. Current releases from Avalon Dam to the state line would continue into the long-term at 600 cfs during October/November and possibly July and December. The Proposed Action would not affect existing wetlands within the analysis area. Current trends in wetland development and recession would continue as they have since 1992. Benefits to wetlands that occur from state line deliveries would continue. These releases would continue to provide supportive hydrology for soil saturation within the Pecos River floodplain. That is, the breadth of the Pecos River at 600 cfs would continue to remain saturated over the long term. The releases would continue to promote wetland vegetation growth and dispersal during the fall release periods. The releases would also provide the supportive hydrology necessary for development of hydric, saturated soils.

3.6 VEGETATION

The analysis area lies on the northern edge of the Chihuahuan Desert Ecological Region (ecoregion) (EPA 2004). The Chihuahuan Desert ecoregion extends from southeastern Arizona to the Edwards Plateau region in central Texas. The topography of this ecoregion is defined by broad basins and valleys surrounded by alluvial fans and terraces. Isolated mesas and mountains are interspersed throughout the central and western portions of the ecoregion. Vegetation within the Chihuahuan Desert ecoregion consists primarily of arid grasslands and shrublands. Specifically, three vegetation communities are found within the analysis area: semidesert grassland, Chihuahuan desertscrub, and riparian scrublands (Figure 13). Threatened and endangered plant species are discussed in Section 3.8, *Threatened and Endangered Species.*



ERO Resources Corp.
1842 Clarkson Street
Denver, CO 80218
(303) 830-1188
Fax: 830-1199

Analysis Area

Vegetation Community (Riparian areas and wetlands not shown at map scale)

Carlsbad Irrigation District

1 Inch = 5 Miles

N

Figure 13
Vegetation Types in Analysis Area

File: 2300-veg_community.mxd (JP)
Date: November 21, 2005

3.6.1 Affected Environment

Semidesert Grassland. Semidesert grassland characterizes the analysis area between Avalon Dam and just southeast of Carlsbad, New Mexico (Brown and Lowe 1980). Grasses in semidesert grassland regions include: black grama (*Bouteloua eriopoda*), slender grama (*Bouteloua filiformis*), chino grama (*Bouteloua breviseta*), spruce top grama (*Bouteloua chondrosoides*), bushy muhly (*Muhlenbergia porteri*), three-awns (*Aristida* spp.), Arizona cottontop (*Trichachne californica*), slim tridens (*Tridens muticus*), pappusgrass (*Pappophorum vaginatum*), tanglehead grass (*Heteropogon contortus*), and vine mesquite grass (*Panicum obtusum*) (Brown 1994). Sotols (*Dasylirion* spp.), beargrasses (*Nolina* spp.), agaves (*Agave* sp.), and yuccas (*Yucca* sp.) are also common in this region. Other scrub-shrub species that may dominate the semidesert grassland region include mesquite (*Prosopis glandulosa, P. juliflora*), one-seed juniper (*Juniperus monosperma*), lotebush (*Ziziphus obtusifolia, Condalia spathulata*), allthorn (*Koeberlinia spinosa*), mimosa (*Mimosa* spp.), Wright's lippia (*Aloysia wrightii*), catclaw acacia (*Acacia greggii*), littleleaf sumac (*Rhus microphylla*), desert hackberry (*Celtis pallida*), and ocotillo (*Fouquieria splendens*).

Cactus species, which are well represented in semidesert grassland communities, may include barrel cactus (*Ferocactus wislizenii*), Turk's head (*Echinocactus horizonthalonius*), cane cholla (*Opuntia imbricata, O. spinosior*), the prickly pears (*Opuntia* spp.), the hedgehogs (*Echinocereus* spp.), and the pincushions (*Mammillaria* spp.). Additional semidesert grassland species include false broomweed (*Haploesthes greggii*), viscid acacia (*Acacia neovernicosa*), cowpen daisy (*Verbesina encelioides*), wild zinnia (*Zinnia grandiflora*), plains bristle grass (*Setaria leucopila*), purple nightshade (*Solanum elaeagnifolium*), leatherweed (*Croton pottsi*), desert seepweed (*Suaeda suffrutescens*), and dove weed (*Croton texensis*) (Brown 1994).

Hildebrandt and Ohmart (1982) conducted a biological resource inventory of the Pecos River basin in New Mexico and Texas. Transect LV-02, which was located in the vicinity of Loving, New Mexico, was a salt cedar-dominated community, and contained vegetation typical of semidesert grassland within the analysis area. The vegetation inventoried in that transect included: iodine bush *(Allenrolfea occidentalis),* baccharis *(Baccharis salicina),* salt cedar *(Tamarix chinensis),* inland salt grass *(Distichlis spicata* and *D. stricta),* alkali sacaton *(Sporobolus airoides),* tansy mustard *(Descurainia pinnata),* snakeweed *(Grindelia* spp.*),* rayless goldenrod *(Haplopappus heterophyllus),* mountain pepperweed *(Lepidium montanum* and *L. oblongum),* and threeseed phlox *(Phacelia* spp.*)* (Hildebrandt and Ohmart 1982).

Chihuahuan Desertscrub. The southern section of the analysis area, from just southeast of Carlsbad to the Red Bluff gauging station, has vegetation characteristic of the Chihuahuan desertscrub biotic community (Brown and Lowe 1980). This region contains fairly homogeneous vegetation types throughout its expanse and is dominated primarily by creosotebush (*Larrea tridentata*).

Two species, tarbush (*Flourensia cernua*) and whitethorn acacia (*Acacia constricta*), occasionally share dominance with creosotebush in the Chihuahuan desertscrub community. Ocotillos, allthorn, mesquite, agaves (especially *Agave lechuguilla*), yuccas, sotols, and beargrasses are also well represented in vegetative communities in the Chihuahuan desertscrub. Understory species may include mariola (*Parthenium incanum*),

guayule (*P. argentatum*), goldeneye (*Viguiera stenoloba*), desert zinnia (*Zinnia acerosa, Z. grandiflora*), dogweeds (*Dyssoida* spp.), and cacti (Brown 1994).

A transect by Hildebrandt and Ohmart (1982) in the vicinity of Pecos, Texas had vegetation that may be typical of Chihuahuan desertscrub within the analysis area. The vegetation inventoried in that transect included: whitethorn acacia, catclaw acacia, iodine bush *(Atriplex canescens)*, creosotebush (*Larrea divaricata and L. tridentate)*, buckhorn cholla *(Opuntia acanthocarpa)*, Engelmann prickly pear *(Opuntia engelmannii)*, honey mesquite *(Prosopis glandulosa)*, lotebush, and snakeweed *(Xanthocephalum sarothrae*) (Hildebrandt and Ohmart 1982).

Riparian Scrublands. Floodplains and stream channels throughout the analysis area has vegetation characteristic of the riparian scrublands community (Brown 1994). This community typically has saltcedar along with a diverse range of species. Two structural types described by Hildebrandt and Ohmart (1982) within the analysis area contain: (1) little foliage volume above 15 feet above ground, dense between 4.9 and 15 feet above ground, and (2) little foliage volume above 9.8 feet above ground, generally sparse, with open areas between trees or groups of trees.

According to Brown (1994) and field observations, species that may occur in riparian scrublands include aster (*Aster spinosus*), desert broom (*Baccharis sarthroides*), horsetails (*Equisetum* spp.), heliotrope (*Heliotropium curassavicum*), burrobrushes (*Hymenoclea* spp.), camphor-weed (*Pluchea camphorata*), cowpen daisy, honey mesquite (*Prosopis glandulosa*), screwbean mesquite (*P. pubescens*), catclaw, black-brush (*Acacia rigidula*), viscid acacia, huisache (*Acacia farnesiana*), desert-willow (*Chilopsis linearis*), tree tobacco (*Nicotiana glauca*), common buttonbush (*Cephalanthus occidentalis*), Texas paloverde (*Cercidium texanum*), Bermuda grass (*Cynodon dactylon*), cocklebur (*Xanthium spinosum*), Canadian wildrye (*Elymus canadensis*), Johnson grass (*Sorghum halepense*), western goldenrod (*Solidago occidentalis*), Quinine bush (*Allenrolfea occidentalis*), curlycup gumweed (*Grindelia squarrosa*), prostrate pigweed (*Amaranthus blitoides*), marsh fleabane (*Pluchea purpurascens*), buffalo gourd (*Cucurbita foetidissima*), and green bristle grass (*Setaria viridis*). Aquatic habitats that are more protected from the main stream channel, such as cut-off ponds, may contain cattail (*Typha* spp.), American three-square sedge (*Schoenoplectus americanus*), sandmat (*Chamaesyce prostrate*), other sedges, common reed (*Phragmites australis*), curly dock (*Rumex crispus*), and other emergent marshland species.

Noxious Weeds. One noxious weed species and five invasive weed species have been documented within the analysis area (Thomas et al. 2003; Table 10). All these species may be found in fallowed lands within CID. Field bindweed is the most widespread statewide and potentially the most easily distributed to fallowed areas.

Table 10. Noxious weed species in the analysis area.

Common Name	Scientific Name
African rue	*Peganum harmala*
Field bindweed	*Convolvulus arvensis*
Malta starthistle	*Centaurea melitensis*
Russian knapweed	*Acroptilon repens*
Scotch thistle	*Onopordum acanthium*
Yellow starthistle	*Centaurea solstitialis*

Source: Southwest Exotic Plant Clearinghouse 2004; Lee 1999.

3.6.2 Environmental Consequences

3.6.2.1 Effects of the No Action Alternative

Impacts to vegetation in the No Action Alternative would include decreased available water for plant uptake and possible decrease in water-borne seed dispersal during the fall (and less frequent summer) releases. Effects to vegetation would occur within and adjacent to the Pecos River immediately downstream from the Avalon Dam because this area would see the largest hydrologic change within the analysis area. Vegetation within the floodplain that depends less on the water associated with state line deliveries for uptake and reproduction/dispersal would be less affected than those more hydrologically dependent on the system. This may include noxious weeds listed in Table 10.

A slight increase in baseflow would be expected adjacent to and downgradient from CID under the No Action Alternative. The approximate 5,000 acre-foot increase in baseflow would affect vegetation more substantially during dry years (during which irrigation occurs) than wet years with conservation spills and other additional water in the system. Negative impacts to vegetation from the decrease in annual flow would be partially offset by additional inflow from CID irrigation return flows. Some vegetation along the Pecos River may increase in number and density from the slight increase in base inflow during the growing season. These plant species would most likely include emergent, annual vegetation that is less dependent on water in the fall and winter.

3.6.2.2 Effects of the Proposed Action

The Proposed Action would not affect vegetation communities or the amount and distribution of noxious weeds. The 600 cfs releases to the state line would continue to provide water for vegetation communities along the Pecos River for a period of several days most commonly in October/November and less commonly in July or December. Vegetation specifically dependent on these fall releases for water uptake, reproduction or seed dispersal would continue to receive water in a manner similar to historical patterns. Compared to existing conditions, the Proposed Action would not increase land fallowing or noxious weed distribution. Compared to the No Action Alternative, however, the Proposed Action would likely result in 3,416 fewer irrigated acres after 2009. More land fallowing would result in a greater risk of noxious weed infestations. Maintenance of fallowed land would remain the responsibility of the individual members from whom water is leased, as described in the individual member contracts between the CID and the member.

3.7 WILDLIFE

Each vegetation community supports different types, diversities, and densities of wildlife within the analysis area. The wildlife species typically found in each community are discussed in the following sections. General threats to wildlife include displacement, habitat modification and loss, prey base decline, and competition. Threatened and endangered wildlife species are discussed in Section 3.8, *Threatened and Endangered Species.*

3.7.1 Affected Environment

Semidesert Grassland Habitat. This section summarizes the common wildlife resources within the semidesert grassland region of the analysis area, between Avalon Reservoir and just southeast of Carlsbad, New Mexico.

Mammals that are commonly found in the semidesert grassland community include the black-tailed jackrabbit (*Lepus californicus*), spotted ground squirrel (*Spermophilus spilosoma*), hispid pocket mouse (*Perognathus hispidus*), kangaroo rats (*Dipodomys* spp.), white-footed mouse (*Permyscus leucopus*), cotton rats (*Sigmodon* spp.), southern grasshopper mouse (*Onyshomys torridus*), southern plains wood rat (*Neotoma micropus*), white-throated wood rat (*N. albigula*), badger (*Taxidea taxus*), and coyote (*Canis latrans*) (Brown 1994).

Bird species that are well represented in this region include Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), American kestrel (*F. sparverius*), mourning dove (*Zenaida macroura*), scaled quail (*Callipela squamata*), greater roadrunner (*Geococcyx californianus*), burrowing owl (*Athene cunicularia*), common poorwill (*Phalaenoptilus nuttallii*), ladder-backed woodpecker (*Picoides scalaris*), western kingbird (*Tyrannus verticalis*), ash-throated flycatcher (*Myiarchus cinerascens*), Say's phoebe (*Sayornis saya*), barn swallow (*Hirundo rustica*), verdin (*Auriparus flaviceps*), cactus wren (*Campylorhynchus brunneicapillus*), northern mockingbird (*Mimus polyglottos*), loggerhead shrike (*Lanius ludovicianus*), Scott's oriole (*Icterus parisorum*), and Cassin's sparrow (*Aimophila cassinii*) (Brown 1994).

Amphibians and reptiles common in this region include western green toad (*Bufo debilis insidior*), desert grassland whiptail (*Cnemidophorus uniparens*), western hooknose snake (*Ficimia cana*), Mexican hognose snake (*Heterodon nasicus kennerlyi*), southwestern earless lizard (*Holbrookia texana scitula*), and desert box turtle (*Terrapene ornate luteola*) (Brown 1994).

Chihuahuan Desertscrub Habitat. The Chihuahuan desertscrub community is found in the southern section of the analysis area, from just southeast of Carlsbad to the Red Bluff gauge.

Mammals commonly found in the Chihuahuan desertscrub community include the Texas antelope ground squirrel (*Ammospermophilus interpres*), kangaroo rat, desert pocket gopher (*Geomys arenarius*), Goldman's woodrat (*Neotoma goldmani*), desert shrew (*Notiosorex crawfordi*), desert mule deer (*Odocoileus hemionus crooki*), southern grasshopper mouse, desert bighorn sheep (*Ovis canadensis mexicana*), yellow-faced pocket gopher (*Pappogeomys castanops*), desert pocket mouse (*Perognathus pencillatus*), Nelson's pocket mouse (*P. nelsoni*), and desert cottontail (*Sylvilagus auduboni*) (Brown 1994).

Bird species characteristic of this region include the scaled quail and Chihuahuan raven (*Corvus cryptoleucus*). Other birds that are less abundant, but still represented in the region, include mourning dove, greater roadrunner, lesser nighthawk (*Chordeiles acutipennis*), Scott's oriole, cactus wren, curve-billed thrasher (*Toxostoma curvirostre*), and black-throated sparrow (*Amphispiza bilineata*) (Brown 1994).

Amphibians and reptiles common in this region include the whiptails (*Cnemidophorus* spp.), western diamondback rattlesnake (*Crotalus atrox*), Mohave rattlesnake (*C. scutulatus*), Texas banded gecko (*Coleonyx brevis*), greater earless lizard (*Cophosaurus texanus*), bolson tortoise (*Gopherus flavomarginatus*), striped whipsnake (*Masticophis taeniatus*), roundtail horned lizard (*Phrynosoma modestum*), Mexican blackhead snake (*Tantilla atriceps*), Trans-Pecos ratsnake (*Elaphe subocularis*), Merriam's canyon lizard (*Sceloporus merriami*), and other *Sceloporus* spp. (Brown 1994).

Riparian Scrublands Habitat. Riparian scrublands traverse the analysis area along the floodplain of the Pecos River and some of its tributaries. Because riparian areas commonly contain greater available surface and ground water than adjacent upland areas, greater densities and diversity of vegetation are frequently found.

Mammals commonly found in the riparian shrublands include cotton rat (*Sigmodon hispidus*), white-footed mouse (*Peromyscus leucopus*), desert pocket mouse, beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and bats (Brown 1994).

Birds commonly associated with this community include crissal thrasher (*Toxostoma dorsale*), verdin (*Auriparus flaviceps*), black-tailed gnatcatcher (*Polioptila melanura*), phainopepla (*Phainopepla nitens*), black phoebe (*Sayornis nigricans*), and Lucy's warbler (*Vermivora luciae*) (Brown 1994).

Amphibians and reptiles common in riparian scrublands include western spadefoot (*Scaphiopus hammondii*), red-spotted toad (*Bufo punctatus*), side-blotched lizard (*Uta stansburiana*), spiny softshelled turtle (*Trionyx spiniferus emoryi*), and pond slider (*Chrysemys scripta*). Fishes that may occur adjacent to this community include speckled chub (*Hybopsis aestivalis*), blue sucker (*Cycleptus elongatus*), river carpsucker (*Carpiodes carpio*), buffalofishes (*Ictiobus* spp.), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), red shiner (*Notropis lutrensis*), Conchos pupfish (*Cyprinodon eximius*), Mexican tetra (*Astyanax mexicanus*), mosquitofish (*Gambusia affinis*), roundnose minnow (*Dionda episcopa*), Tamaulipas shiner (*Notropis braytoni*), fathead minnow (*Pimephales promelas*), longnose gar (*Lepisosteus osseus*), gizzard shad (*Dorosoma cepedianum*), gray redhorse (*Scartomyzon congestus*), flathead catfish (*Pylodictis olivaris*), Pecos gambusia (*Gambusia nobilis*), warmouth (*Lepomis gulosus*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), and largemouth bass (*Micropterus salmoides*) (Brown 1994, Hoagstrom 2000).

3.7.2 Environmental Consequences

The effects analysis for wildlife focuses on the potential for hydrologic change from existing conditions, the estimated direct effects on wildlife, and the indirect effects due to impacts to the vegetation communities on which wildlife depend on for habitat. The effects analysis is most applicable within the riparian scrubland along the Pecos River floodplain in the analysis area from Avalon Dam downstream to the state line.

3.7.2.1 Effects of the No Action Alternative

Wildlife within the analysis area would be affected by a decrease in baseflow most significantly in the area immediately downstream of the Avalon Dam as a result of the No Action Alternative. Effects to wildlife would not only include the direct loss of water within the system, but may also include indirect effects such as change or loss of food source, change or loss of nesting and resting habitat, and possible change of prey base. Any potential effect would more likely affect less mobile wildlife species that depend more on the riparian corridor for habitat and food sources. For example, small, less mobile reptiles and amphibians may perceive a greater effect than migratory birds that could seek adjacent habitat more easily. The loss of water delivery volumes below Avalon Dam would be partially offset by increased baseflows from CID return flows. This would benefit wildlife most during dry years.

3.7.2.2 Effects of the Proposed Action

The Proposed Action would not affect wildlife or wildlife habitat. Any current trend or change in wildlife carrying capacity or diversity would likely continue into the long-term future. Accordingly, development or recession of vegetation communities along the Pecos River and upland areas would continue in a manner similar to current patterns. Wildlife species' carrying capacity based on current conditions would continue indefinitely as it relates to the Proposed Action.

3.8 Threatened and Endangered Species

This section describes the regulations associated with the protection of federally listed and state-listed threatened and endangered species. Each threatened and endangered species with the potential to occur within the analysis areas is described, and a brief description of the range and habitat of those species is provided.

The USFWS provided a list of all federally listed and candidate species potentially occurring within Eddy County, New Mexico (USFWS 2004). The NMDGF provided a similar list of species of concern for the State of New Mexico (NMDGF 2004). Those species provided on the lists not included in the assessment due to lack of range and habitat within the analysis areas are not listed in Table 11).

3.8.1 Listing and Monitoring Process

The Endangered Species Act (ESA) gives the USFWS the authority to list and regulate the protection of threatened and endangered species. The USFWS can provide protection to species at several levels based on the best scientific data available at the time. Species listed as endangered (E) and threatened (T) by the USFWS are fully protected under the ESA. Proposed and candidate species are informally referred to as "Species of Concern." Non-essential experimental species (EXPN) are species for which a population has been artificially established in the wild that is not essential to the survival of the species in the wild. The ESA and related regulations allow for the states to implement individual protection and management systems for threatened and endangered species.

New Mexico passed the New Mexico Wildlife Conservation Act in 1974, and the New Mexico Endangered Plant Species Act in 1978. Sections 17-2-37 through 17-2-46 of the New Mexico Statutes Annotated (NMSA, "Statutes") authorize the NMDGF to develop lists of fish and wildlife species considered to be threatened and endangered within the state. The authority to list plant species as threatened or endangered was added in 1978 under NMSA §75-6-1; the collection and sale of listed plant species without a permit is now prohibited.

NMDGF enforces the regulations prohibiting the unlawful taking of threatened and endangered species. "Take" is defined in the state Statutes as "to harass, hunt, capture, or kill any wildlife or attempt to do so" (NMSA §17-2-38). However, the NMDGF is not granted the authority to regulate indirect take of species in the form of habitat modification or degradation. In order to direct State recovery efforts, the NMDGF is required to develop recovery plans for all listed species within 2 years of state listing and to prepare biennial reviews documenting the status of all State-listed species.

Table 11. Threatened, endangered and other species of concern.

Common Name	Scientific Name	Status	
		USFWS	NMDGF
Fish			
Mexican tetra	*Astyanax mexicanus*		T
Blue sucker	*Cycleptus elongatus*		E
Gray redhorse	*Moxostoma congestum*		T
Pecos pupfish	*Cyprinodon pecosensis*		T
Greenthroat darter	*Etheostoma lepidum*		T
Bigscale logperch	*Percina macrolepida*		T
Amphibians/Reptiles			
Western river cooter	*Pseudemys gorzugi*		T
Plainbelly water snake	*Nerodia erythrogaster*		E
Western ribbon snake	*Thamnophis proximus*		T
Birds			
Brown pelican	*Pelecanus occidentalis*	E*	E
Neotropic cormorant	*Phalacrocorax brasilianus*		T
American peregrine falcon	*Falco peregrinus anatum*		T
Piping plover	*Charadrius melodus*	T*	E
Interior least tern	*Sterna antillarum*	E	E
Common ground-dove	*Columbina passerina*		E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E*	E
Bell's vireo	*Vireo bellii*		T
Baird's sparrow	*Ammodramus bairdii*		T
Mammals			
Least shrew	*Cryptotis parva*		T
Black-footed ferret	*Mustela nigripes*	E, EXPN	
Plants			
Gypsum wild buckwheat	*Eriogonum gypsophilum*	T	E

E=Endangered; E*=Listed as endangered by USFWS, but not listed as occurring within Eddy County; T=Threatened; T*=Listed as threatened by USFWS, but not listed as occurring within Eddy County; EXPN=Experimental population.

Source: USFWS 2004; NMDGF 2004a.

3.8.2 Affected Environment

3.8.2.1 Fish

Mexican Tetra (T-NM). NMDGF listed the Mexican tetra (*Astyanax mexicanus*) as threatened in 1976; the USFWS has not listed the species. In New Mexico, the Mexican tetra is known to occur in the Pecos River drainage system within the analysis area. Although the species is rare in mainstream Pecos River habitats, it is more common in low-velocity pool habitats in small springs and off-channel habitats including Lea Lake in the Bottomless Lakes State Park, Blue Spring, and a spring in the upper Carlsbad Municipal Reservoir (Propst 1999).

Current conservation efforts are concentrated on maintenance of natural flows in known habitat including Blue Springs, Cottonwood Creek, and Delaware River (Propst 1999). The primary threat to this species is loss of habitat due to ground water depletion and diversion of flows from small streams (NMDGF 2000).

Blue Sucker (E-NM). NMDGF listed the blue sucker (*Cycleptus elongatus*) as endangered in 1976; the USFWS has not listed the species. The blue sucker occurs from the Missouri River west to the Gulf coast drainage systems (Gilbert 1980). The blue sucker's New Mexico range is limited to the Pecos River between Brantley Dam and Avalon Reservoir, the lower reaches of the Black River, and seasonally the larger irrigation canals within the CID (pers. comm. J.E. Brooks in Propst 1999). The greatest density of the species occurs within the Pecos River between Brantley Dam and the Avalon Reservoir (Propst 1999). The species has been extirpated from the Rio Grande basin in New Mexico, but remains in the Pecos River basin within Texas and Mexico (Sublette et al. 1990). The species typically prefers streams with moderately fast flowing water and deep pools with strong current in the chutes of medium to large rivers (Lawrence and Burr 1991).

Current conservation measures concentrate on the flow maintenance within the Pecos River and rescue of fish from the CID canals (Propst 1999). According to the NMDGF, in 2000 the primary threats to this species include range fragmentation due to dams, loss of high-velocity water habitats, pollutants, and stranding in canals (NMDGF 2000).

Gray Redhorse (T-NM). NMDGF listed the gray redhorse (*Moxostoma congestum*) as threatened in 1976. The USFWS has not listed the species.

The species' range extends from the Brazos River to the Rio Grande River in Texas and farther south to the Rio Soto la Marina drainage in Mexico (Lawrence and Burr 1991). This species typically prefers deep, slow-velocity water over a variety of substrates including silt and limestone (NMDGF 2000; Propst 1999). The species is most commonly found downstream of Brantley Reservoir within the Carlsbad Municipal Reservoir, the confluence of the Pecos and Black Rivers, the main stem of the Black River, and Six-Mile and Ten-Mile Reservoirs.

No known conservation measures are currently underway. Primary threats to this species include range fragmentation due to dams, stream dewatering, and pollutants (NMDGF 2000).

Pecos Pupfish (T-NM). The Pecos pupfish (*Cyprinodon pecosensis*) was proposed for federal listing as endangered in 1996, but the proposed rule to list this species was withdrawn by the USFWS in 2000. It was listed as threatened by NMDGF in 1988. The fish historically was found within the Pecos River drainage in New Mexico and Texas (Lawrence and Burr 1991). In New Mexico, the Pecos pupfish is found in habitats within the Pecos River basin from as far downstream as Malaga,

pools within Bottomless Lakes State Park, and possibly Laguna Grande (Hoagstrom and Brooks 1995); it is infrequently found in the main stem Pecos River. This species typically prefers low- to moderate-velocity run and pool habitats in streams, springs, and gypsum sinkholes (Echelle and Echelle 1978 and Hoagstrom and Brooks 1999).

The primary threat to this species is the non-native sheepshead minnow, which hybridizes with the pupfish. The Pecos pupfish has been extirpated from its range within Texas due to hybridization since the introduction of the sheepshead minnow in early 1980s (Hoagstrom and Brooks 1995). Hybridization progressively continued upstream into New Mexico and no non-hybridized Pecos pupfish have been found where sheepshead minnow or hybrids occur (Propst 1999). This hybridization has not occurred in isolated populations that currently constitute the remaining pure populations. Current conservation efforts include the continued isolation of existing population from sheepshead minnow hybridization. Preventative management measures to ensure the continued isolation of the fish populations are being taken. Ground water depletion and stream dewatering, which modify habitats, also pose threats to this species (NMDGF 2000).

Greenthroat Darter (T-NM). NMDGF listed the greenthroat darter (*Etheostoma lepidum*) as threatened in 1975; the USFWS has not listed the species. In New Mexico, the greenthroat darter is known to occur in the mainstream and tributaries of the Pecos River within the analysis area. This species typically prefers small stream and spring habitats with clear waters, dense aquatic vegetation, and clean gravel and cobble substrates (Sublette et al. 1990). The species' range extends from the Pecos River basin in New Mexico to the Edwards plateau in Texas, with common occurrence on the Edwards plateau (Lawrence and Burr 1991). In New Mexico, the greenthroat darter primarily occurs in Bitter Lake National Wildlife Refuge, Cottonwood Creek, Blue Spring, and Rattlesnake Spring (Propst 1999). The species is commonly found with Pecos gambusia, Mexican tetra, and roundnose minnow (Propst 1999).

Primary threats to this species include ground water depletion, spring run diversion, and above-average sedimentation (Propst 1999). Conservation measures include the introduction of the species to Rattlesnake Springs near Carlsbad Caverns National Park (Propst 1999).

Bigscale Logperch (T-NM). NMDGF listed the bigscale logperch (*Percina macrolepida*) as threatened in 1975; the USFWS has not listed the species. The species' range extends from the Red River of Texas and Oklahoma, through the drainage systems of Texas, to the Pecos and Rio Grande (Sublette et al. 1991); the species has also been introduced into the Sacramento-San Joaquin River basin, California (Lawrence and Burr 1990). In New Mexico, the bigscale logperch is known to occur in the Pecos River from Santa Rosa to Fort Sumner and near Carlsbad, as well as the Black River and Santa Rosa, Sumner, and Brantley reservoirs. This species typically prefers high-velocity, non-turbulent, moderately deep water habitats with cobble substrates (Stevenson 1971 in Propst 1999). Sublette et al. (1991) suggest the main constraint on widespread and common occurrence in New Mexico is lack of preferred habitat, deep rivers with strong current and rubble-gravel substrate.

No known conservation measures are currently underway in New Mexico. Primary threats to this species include flow reduction, lower velocity flows due to stream diversion, and modification of habitat (Propst 1999).

Limited information on range and population size provides little assistance in the determination of necessary conservation measures; as such further research is the primary conservation goal at this time (Propst 1999). Additional threats to this species include ground water depletion, spring run diversion, and above-average sedimentation (Propst 1999). Habitat desiccation and habitat fragmentation are also probable threats (NMDGF 2000).

3.8.2.2 Reptiles and Amphibians

Western River Cooter (T-NM). The western river cooter (*Pseudemys gorzugi*) was state-listed as threatened in 1975. The range for this species includes the lower Rio Grande and Pecos River drainages, extending from northern Mexico through Texas and New Mexico. In New Mexico, the species is known to occur in the Pecos River drainage downstream of Brantley Dam, including the Black and Delaware rivers (Degenhardt et al. 1996).

This large turtle typically avoids riffles and prefers river systems with deep pools and aquatic vegetation for foraging and cover. This species can often be observed basking on logs, vegetation at the water's surface, or muddy banks (Degenhardt et al. 1996). The primary threats to this species include recreational practices, especially fishermen using it as bait (NMDGF 2000).

Plainbelly Water Snake (E-NM). The plainbelly water snake (*Nerodia erythrogaster)* was state-listed as threatened in 1975 and was uplisted to endangered in 1996. The range for this species extends from Michigan and Delaware southward to Mexico and westward to New Mexico. In New Mexico, this species is known to occur in the lower Pecos River drainage, including the Black and Delaware Rivers (Degenhardt et al 1996).

Typical habitat can be found in rivers, main irrigation diversion drains, or intermittent streams that contain large, deep, permanent pools. It has also been reported in marshes, streams, and springs in northeastern New Mexico. This aggressive snake feeds on fish and frogs (Degenhardt et al 1996).

Numerous surveys of this region since 1988 have located fewer than 10 individuals of this species. Primary threats to this species include direct take, habitat destruction, and alteration of water use practices (NMDGF 2000).

Western Ribbon Snake (T-NM). The western ribbon snake (*Thamnophis proximus*) was state-listed as threatened in 1975. Its range extends from Wisconsin southward to Mexico and Costa Rica, and from New Mexico eastward to the Mississippi River (Degenhardt et al. 1996). In New Mexico, the western ribbon snake is known to occur mostly east of the Pecos River and is uncommon within its New Mexico range with exception of Spring River in Roswell and Bitter Lake National Wildlife Refuge (NMDGF 2000).

Typical habitat for this semi-aquatic species includes areas where permanent water is present; in New Mexico, this includes habitat along the Canadian River at Mills Canyon and the lower Pecos River drainage. The western ribbon snake is known to inhabit rivers and streams, irrigation canals, stock tanks, intermittent creeks that contain large deep pools, and areas of dense streamside vegetation (Degenhardt et al. 1996).

Studies of this species at the Bitter Lake National Wildlife Refuge reveal sizable populations within the refuge. The primary threats to this species include habitat alteration or destruction due to changes in water use practices and illegal take (NMDGF 2000).

3.8.2.3 Birds

Brown Pelican (E*, E-NM). The brown pelican (*Pelecanus occidentalis*) was listed as endangered by the USFWS in 1970 and was state-listed as endangered in 1983. Although this species has been delisted by USFWS (that is, removed from the list of endangered and threatened species) in the southeastern U.S., it is still considered endangered throughout the rest of its range. The range for this species includes the California and mid-Atlantic coasts, the entire Gulf of Mexico coastline, and southward to South America. In New Mexico, the brown pelican can be found seasonally (usually during the summer-fall period) along large lakes or major rivers, including the Pecos River drainage. Two were detected in 2001 in Eddy County.

The brown pelican is the smallest of the world's pelicans (Alsop 2001). This species scoops fish near the surface of the water by plunge-diving from mid-air. Typical nesting habitat includes coastline vegetation 6 to 20 feet high or on the ground built up about 4 to 10 inches.

Primary threats to this species include pesticide contamination of food sources, loss of breeding habitat, and illegal take (NMDGF 2000). The brown pelican population neared extinction in the 1960s and 1970s due to high pesticide and hydrocarbon presence in its food sources, which led to thin eggshells and reproductive failure.

Neotropic Cormorant (T-NM). The neotropic cormorant (*Phalacrocorax brasilianus*) was state-listed as threatened in 1975. The range of this species includes Central and South America; New Mexico is in the northernmost reaches of this species' breeding limits. In New Mexico, the neotropic cormorant is known to occur in the middle Rio Grande Valley, Gila Valley, lower Pecos Valley, Elephant Butte Lake, and Caballo Lake areas (NMDGF 2000).

The neotropic cormorant is a waterbird and can swim and dive well to hunt for fish, amphibians, and crustaceans. This species is known to inhabit areas near freshwater, saltwater, or brackish water and typically prefers stands of trees or shrubs that are in or near water.

No more than 50 nests have been identified in any season since the first documented nest was recorded in 1972. Primary threats to this species include habitat disturbance or degradation and food supply (fish) fluctuations (NMDGF 2000).

American Peregrine Falcon (T-NM). The American peregrine falcon (*Falco peregrinus anatum*) was federally delisted in 1999. It was downlisted by NMDGF in 1996 from endangered status; currently, it is state-listed as threatened. The range for this species extends almost worldwide. In New Mexico, the peregrine falcon can be found throughout the state and typically occurs in mountains and river canyons (NMDGF 2000).

The American peregrine falcon, one of the fastest birds in the world, can reach flying speeds greater than 175 mph. This species can typically be found in open rangeland and tropical savanna habitat types; the peregrine falcon prefers open terrain, often near water, with scattered trees, relatively low ground cover, and many small- to medium-sized birds.

Although the peregrine falcon population suffered severe losses in the 1960s and 1970s due to the widespread use of the pesticide DDT, its numbers appear to be increasing. The continued threats to this species include continued environmental contamination and illegal take (NMDGF 2000).

Piping Plover (T*, E-NM). The piping plover (*Charadrius melodus*) was federally listed as endangered in the Great Lakes region and as

threatened in other regions, including New Mexico, in 1985. This species was also state-listed as endangered in 1988. The range for the piping plover includes the northern Great Plains, Great Lakes region, and the Gulf of Mexico and Atlantic coastal areas of the U.S. In New Mexico, it is a rare migrant and has been reported in the state on only seven occasions (NMDGF 2000).

This migratory shorebird feeds on fly larvae, beetles, crustaceans, and marine worms. Typical habitat includes coastal beaches, wetland areas, portions of rivers, and inland lakes and reservoirs. In New Mexico, this species has been known to occur in wetlands of Colfax, Guadalupe, Socorro, Chaves, and Eddy counties (NMDGF 2000).

The piping plover population has been declining in many portions of its range, especially in the Midwest and Great Lakes regions (Alsop 2001). Primary threats to this species include habitat loss or degradation due to development, traffic, human disturbance, and impoundments and/or irregular water releases in river systems (NMDGF 2000). Critical habitat for this species has been designated, but no areas in New Mexico are included in this designation.

Interior Least Tern (E, E-NM). The least tern (*Sterna antillarum*) was federally listed as endangered in 1985 and state-listed as endangered in 1976. The breeding range for this species extends from California, the Dakotas, and Maine southward to Latin America. Interior populations breed primarily in the Mississippi River basin. In New Mexico, the least tern nests historically only at or near Bitter Lake National Wildlife Refuge, and is known to be a regular migrant through Eddy County (NMDGF 2000).

The least tern feeds on small fish, crustaceans, and sand eels; it catches its prey by hovering and plunge diving to the surface. Typical nesting habitat for this species includes rivers or the barren flats of saline lakes and ponds. The least tern is known to occasionally occur in wetland areas throughout New Mexico in at least 15 counties, including Eddy County (NMDGF 2000).

Over the past 50 years, the breeding population of least terns in New Mexico has rarely exceeded 16 breeding adults. Between 1990 and 1999, five or six breeding pairs were present within New Mexico annually (NMDGF 2000). In 2004, Reclamation documented a nesting and breeding colony of interior least terns at Brantley Reservoir (Reclamation 2004d). Reclamation biologists documented 14 adult terns and estimated seven nests (Reclamation 2005). In 2005, no least terns were found to have nested at Brantley Reservoir. However, a small number of adults and sub-adults were present at the reservoir all summer (Doster, pers. comm. 2006). Primary threats to this species include loss of river habitats due to inundation, channelization, and altered flow regimes in river systems, human disturbance of flats and beaches, and pesticide and chemical contamination of environment and food sources (NMDGF 2000).

Common Ground-Dove (E-NM). The common ground-dove (*Columbina passerina*) was listed as endangered by NMDGF in 1983. The range for this species extends from the southern U.S. into Latin America. In New Mexico, the common ground-dove occurs in the southernmost portion of the state.

This species feeds on seeds of grasses and weeds, insects, and berries, particularly in riparian native shrubland habitat. Between 1990 and 1999, four to five common ground-doves were reported annually within New Mexico (NMDGF 2000). The primary threat to this species is loss of habitat, particularly aquatic habitats.

Southwestern Willow Flycatcher (E*, E-NM). The southwestern willow flycatcher (*Empidonax traillii extimus*) was federally listed as endangered in 1995. The bird was listed as threatened by New Mexico in 1988 and was reclassified as endangered in 1996. The range of this species extends from southern Canada southward through the U.S., Mexico, and Panama. The range of the southwestern subspecies is restricted to New Mexico, Arizona, and southern California. In New Mexico, the largest population occurs in the Cliff-Gila Valley.

Typical habitat can be found in areas of dense streamside vegetation such as willow, cottonwood, and buttonbush. Historically, this habitat type was sparse and has become even less common in recent years.

In New Mexico, about 300 breeding territories have been recorded in about 32 locations statewide between 1993 and 2001. The Cliff-Gila Valley population experienced a decline of about 45 percent in 2000 and 2001 (NMDGF 2000). Primary threats to this species include habitat loss, alteration, or fragmentation due to factors such as invasion by exotic species, water manipulation, livestock grazing, and predation.

Bell's Vireo (T-NM). Bell's vireo (*Vireo bellii*) was state-listed as threatened in 1975. This species breeds in the central and southwestern U.S. and northern Mexico and winters in central and southern Mexico. In New Mexico, the species occurs in the southern regions of the state, especially in the Gila Valley, Guadalupe Canyon, the lower Rio Grande Valley, and the lower Pecos Valley.

This neotropical migratory species feeds on insects, fruits, and berries. This species typically prefers scrubby riparian vegetation that is dense and low in arid and semi-arid landscapes.

In New Mexico, reports reveal that fewer than 100 breeding pairs may occur within the state. The primary threat to this species is riparian habitat loss and habitat fragmentation due to urbanization, agriculture, grazing, flood control, and reservoir construction, as well as parasitism by the brown-headed cowbird (NMDGF 2000).

Baird's Sparrow (T-NM). Baird's sparrow (*Ammodramus bairdii*) was state-listed as threatened in 1975. The breeding range for this species includes the northern Great Plains, from the Canadian prairie southward to Montana, the Dakotas, and Minnesota. It winters primarily in north-central Mexico. In New Mexico, Baird's sparrow may be found primarily as a migrant through the state, although it may winter in some locations (NMDGF 2000).

Typical habitat includes short-grass prairie and grasslands; in New Mexico, Baird's sparrow typically occurs in the eastern plains and southern lowlands. This neotropical migrant was one of the most abundant prairie birds in the 1870s, but its population has experienced significant declines with the loss of prairie habitat in more recent years. The primary threat to this species is loss of native grassland habitat, especially due to excessive livestock grazing (NMDGF 2000).

3.8.2.4 Mammals

Least Shrew (T-NM). The least shrew (*Cryptotis parva*) was state-listed as threatened in 1985. The range of this species includes much of the eastern U.S., from Colorado eastward, and from the Gulf Coast northward to the Canadian border. New Mexico is within the western edges of the range for the least shrew. Small numbers of this species can be found at restricted sites in the state, primarily in the eastern portion of the state, including the Bitter Lake National Wildlife Refuge (NMDGF 2000).

This species feeds on insects and other small animals and often builds nests under debris or underground. Typical habitat for the least shrew includes open grassy areas with scattered brush and marshes (Burt and Grossenheider 1952). In New Mexico, this species can be found in moist areas with dense grass cover and vegetation such as willow trees, cattails, alkali sacaton, grama, and forbs (NMDGF 2000).

Primary threats to this species include habitat loss due to water diversion, agriculture, and grazing (NMDGF 2000).

Black-footed Ferret (E, EXPN). The black-footed ferret (*Mustela nigripes*) was federally listed as endangered in 1967. Historically, the range for this species included the Great Plains, extending from the Rocky Mountains east and south through the Dakotas, Nebraska, Kansas, Oklahoma, Texas, New Mexico, and Arizona (USFWS 1998). Currently, this species is known to occur in Arizona, Colorado, Montana, South Dakota, Utah, Wyoming, and parts of Mexico, due to the establishment of non-essential experimental populations in these states.

This species typically occurs in mixed shrub habitats where prairie dogs are also present; prairie dogs are the primary food source of the black-footed ferret. The decline of prairie dog populations has contributed significantly to the decline of ferret populations (Burt and Grossenheider 1952).

The primary contributors to the population decline of this species include habitat loss due to conversion to agricultural land and elimination of prairie dog populations due in part to sylvatic plague (USFWS 1998).

3.8.2.5 Plants

Gypsum Wild Buckwheat (T, E-NM). The gypsum wild buckwheat (*Eriogonum gypsophilum*) was federally listed as threatened in 1981 is state listed as endangered. Its known range includes three locations within Eddy County, New Mexico: Seven River Hills north of Carlsbad, south of Black River Village, and in the drainages of Ben Slaughter Draw and Hay Hollow (NMRPTC 1999). This species occurs in semi-arid areas with gypsum soils.

Critical habitat was designated at the time of listing for gypsum wild buckwheat; 130 acres of public land in Eddy County administered by the Bureau of Land Management was originally designated as critical habitat for this species. Primary threats to this species include habitat loss and degradation, trampling by grazing livestock, and mortality due to off-road vehicles.

3.8.3 Environmental Consequences

3.8.3.1 Effects of the No Action Alternative

All of the federally and state listed species within the analysis area are wildlife with the exception of one plant, the gypsum wild buckwheat. Accordingly, the general wildlife effects described under the No Action Alternative pertain to listed species within the analysis area as well.

For the purposes of the NEPA effects analysis, listed species are grouped according to general type. Additional analysis is provided for federal species in the Biological Evaluation attached as Appendix C.

Fish. Six state-listed fish are found within Eddy County, New Mexico, the analysis area county. The No Action Alternative would affect the hydrology of the area immediately downstream

from Avalon Dam. In general under the No Action Alternative, this area would contain base inflow 10 percent of the year and flows below 600 cfs would decrease from 6 percent to 2 percent annually. The impact to fish (including listed species) would be minimal because the species are not likely to regularly use that particular stretch of the Pecos River. Further discussion on federally listed species is included in the Biological Evaluation attached as Appendix C.

Reptiles and Amphibians. Three state-listed threatened or endangered reptiles (western river cooter, plainbelly water snake, and western ribbon snake) are found within Eddy County, New Mexico, the analysis area county. The three species are known to inhabit the Pecos River within the analysis area. The western ribbon snake is the least likely to occur within the analysis area and is more likely to occur north of the analysis area. Under the No Action Alternative, these species would experience the same decrease in base flow from Avalon Dam attributed to the discontinuation of state line deliveries. As described in Section 3.8.2.2, literature suggests the western river cooter and the plainbelly water snake are most likely to inhabit deep pools and aquatic habitat. Under the No Action Alternative, the segment of the Pecos River immediately downstream from Avalon Reservoir is the area most hydrologically affected by the discontinuation of the releases, and this area does not contain a base flow 90 percent of the year. Therefore, the effects are anticipated to be minimal and would be mitigated by the potential for slight increases in base flow attributed to the use of water for irrigation within the CID.

Birds. One federally listed endangered bird (interior least tern) is found within Eddy County, New Mexico. Known nesting locations, north of the analysis area, would not be affected by the No Action Alternative. Under the No Action Alternative, listed birds would be subject to decreased annual base flow below Avalon Dam due to the discontinuation of state line deliveries. The hydrological effects are anticipated to be minimal and would be mitigated by the potential for slight increases in base flow attributed to the use of water for irrigation within the CID. The impact may be more minimal to birds than other species due to their mobility and accessibility to select adjacent habitat, provided such habitat is available.

Mammals. The federally listed endangered black-footed ferret is reported to have an experimental population within Eddy County, and the state-listed threatened least shrew is documented in Eddy County as well. Both these mammals could be affected by the small decrease in base flow and potential small increase in base inflow in the long-term after 2009. The black-footed ferret is commonly associated with upland prairie dog colonies, and therefore the minimal hydrologic effect is not anticipated to significantly affect any experimental populations within the analysis area. The least shrew is found in moist areas, which may include portions of the Pecos River within the analysis area. However, the Pecos River immediately downstream from the Avalon Dam is the least mesic or moist habitat along the stretch and is the area most impacted by the discontinuation of the state line releases after 2009. The decrease in base flow within sections of the Pecos River farther downgradient and adjacent to the CID would be mitigated, to a fractional extent, by the minimal increases in base flow during the irrigation season.

Invertebrates. One federal candidate/state-listed endangered invertebrate (Texas hornshell) is known to occur within the analysis area county, Eddy County, New Mexico. According to NMDGF (2000), the only population of Texas

hornshell within Eddy County is in the Middle Black River south and downstream of Avalon Reservoir and CID. Under the No Action Alternative, the discontinuation of state line deliveries after 2009 is not anticipated to have a negative effect on the artesian flow of Blue Spring (a source of water for the Black River) because the alluvial aquifer that feeds Blue Spring is hydrologically isolated from the Carlsbad area and the Pecos River alluvial aquifer (Barroll 2005). Therefore, no direct effects to the invertebrate species are anticipated.

Plants. Federally threatened gypsum wild buckwheat is known to occur within Eddy County (NMRPTC 1999). However, each of these areas is located more than 8 miles west of the analysis area, and are hydrologically isolated from the Pecos River. Therefore, no direct effects to gypsum wild buckwheat locations are anticipated from the hydrologic changes anticipated under the No Action Alternative.

3.8.3.2 Effects of the Proposed Action

Under the Proposed Action, releases from Avalon Dam would continue in essentially the same manner as current releases into the long-term future. The Proposed Action would not affect any threatened or endangered species. Current trends related to endangered and threatened species within the analysis area would likely continue into the long-term future. Accordingly, development or recession of vegetation communities along the Pecos River and upland areas would continue similarly to current patterns. This is detailed in the Biological Evaluation attached as Appendix C.

3.9 Soils

3.9.1 Affected Environment

The landscape of the Pecos River basin is characterized in the analysis area and cumulative effect analysis area as a broad floodplain lined with alluvial terraces sloping up in elevation to mountains in the west, and plains in the east. Soils in the floodplain formed from alluvial deposits, while upland benches are dominated by soils derived from parent material.

Soil uses in the analysis area and cumulative effects analysis area include farmland, rangeland and wildlife habitat. Many soils in the analysis area and cumulative effects analysis area are prime farmlands when irrigated, or farmland of statewide importance. All information about the soils was compiled from soil surveys completed by the Soil Conservation Service (USDA 1971; USDA 1983).

Irrigated Soils within the CID. Soils within the CID potentially affected by alternatives are either currently irrigated, or formerly irrigated. Within the CID, numerous different soil types, or series, are irrigated. The dominant irrigated soils are the Reagan, Harkey, Karro, and Anthony soils. These soils are briefly described in the following sections.

The Reagan series consists of very deep (more than 60 inches deep), well-drained, soils that formed from calcareous loamy materials. These soils are on nearly level to gently sloping broad flats, filled valleys and fans. Reagan soils are moderately fine textured, and generally have subsoils high in calcium carbonates. The soils are highly erodible.

The Harkey series consists of very deep, well-drained soils that formed in calcareous mixed alluvial sediments. Harkey soils are on nearly level floodplains and stream terraces. Harkey soils are moderately coarse textured, and are highly erodible.

The Karro series consists of very deep, well-drained soils that formed in mixed alluvium. The soils are on alluvial fans and valley plains. Karro soils are moderately fine textured, and generally have subsoils high in calcium carbonates. The soils are highly erodible.

The Anthony series consists of very deep, well-drained soils formed in stratified alluvium. Anthony soils are on alluvial fans and floodplains. Anthony soils are moderately coarse textured, and are highly erodible.

Soils Along the Pecos River Floodplain. A wide range of soils are found along the Pecos River floodplain. The Pajarito, Arno, Anthony, Harkey, Dev, and Pima series are the dominant soils. The Anthony and Harkey soils were described previously. The Pajarito, Arno, Dev, and Pima are described briefly in the following sections.

The Pajarito series consists of very deep, and well-drained soils that formed in sandy sediments from mixed sources. These soils are typically on plains and alluvial fans. Pajarito soils are moderately coarse textured, and are highly erodible.

The Arno series consists of very deep, moderately well drained, very slowly permeable soils formed in clayey alluvium. These soils are on nearly level floodplains. They have clayey textures and subsoils high in salts. The Arno soils are highly erodible.

The Dev series consists of very deep, well drained, moderately rapidly permeable soils that formed in gravelly alluvium. The soils are on nearly level floodplains. Dev soils are moderately fine textured, and generally have subsoils high in rock fragments. Dev soils are highly erodible.

Pima soils are deep, well drained soils formed in stream alluvium on alluvial fans and flood plains. Pima soils are moderately coarse textured, and are highly erodible.

Prime Farmland and Farmland of Statewide Importance. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable climate and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding (7 CFR 657.5). If a soil is prime farmland only under certain conditions, the USDA provides a qualifier stating those conditions. Four soil map units in Eddy County are prime farmland only when irrigated. The five prime farmland map units are:

- Harkey very fine sandy loam, 0 to 1 percent slopes
- Pima silt loam, 0 to 1 percent slopes
- Pima clay loam, gray variant, 0 to 1 percent slopes
- Reagan loam, 1 to 3 percent slopes

Farmland of Statewide Importance is land other than Prime Farmland that has a good combination of physical and chemical characteristics for the production of crops. It must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. Most of the irrigated lands in the CID are either

Prime Farmland or Farmland of Statewide Importance.

3.9.2 Environmental Consequences

3.9.2.1 Effects of the No Action Alternative

The No Action Alternative would increase irrigated soils within the CID after 2009, when the existing short-term miscellaneous purposes contract expires. Without a long-term miscellaneous purposes contract, the NMISC would no longer lease water and fallow irrigated lands. It is assumed irrigation and production would resume on all lands currently fallowed by water leases (about 3,416 acres annually). The 164 acres currently owned by the NMISC would likely remain fallowed. It is likely that some of the leased agricultural lands are classified as prime if they are irrigated; irrigation of these lands would resume their status as prime farmlands.

The No Action Alternative would reduce wind and water erosion and decrease noxious weed density. Irrigated soils would be less likely to erode by either wind or water. Farmlands are also less likely to support high densities of weeds, including noxious weeds.

3.9.2.2 Effects of the Proposed Action

The number of acres irrigated would remain at about 19,456 acres in CID under the Proposed Action. The NMISC would continue to lease water and fallow about 3,416 acres; fallowing of the 164 acres owned by the NMISC would not change. Under the Proposed Action, soil erosion and noxious weed cover would not change from current conditions. Land fallowed by NMISC's water leases has no land maintenance requirements, but land maintenance may be required through the CID. Because the water could be leased annually, and fallowed lands potentially subject to irrigation the following year, maintenance of the fallowed land would be the responsibility of the individual members from whom water is leased, as described in the individual member contracts between the CID and the member. The maximum number of acres that the NMISC could fallow under the long-term miscellaneous purposes contract would be about 11,336 acres (in addition to the 164 acres it owns), which would amount to 50,000 acre-feet of water under a full allotment year, factoring in the NMISC credit for farm losses not incurred. Because water leases and land fallowing would be temporary, there would be no impact to the prime farmland designation. Soil erosion and weed infestations under maximum leasing levels would vary annually. (Also see the land management discussion under the Settlement Agreement on page 91.)

3.10 Land Use

3.10.1 Affected Environment

Lands in the analysis area are managed by Reclamation, U.S. Army Corps of Engineers, BLM, U.S. Fish and Wildlife Service, the State of New Mexico (including State Parks and New Mexico Department of Game and Fish), and private companies and individuals. Use of these lands varies considerably and includes agriculture, recreation, wildlife habitat management, and mineral/oil and gas extraction, (Reclamation 2003a).

Agricultural Uses. Two main types of agricultural uses occur within the analysis area: ranching and livestock operations and farming (irrigated agriculture). Agricultural uses are summarized in the following paragraphs, and are described in greater detail in the *Socioeconomic* Section. Cattle, calves, goats, and sheep are the primary livestock

operations, including production of milk, cheese, and wool. Grazing allotments for cows and calves are available on Reclamation, BLM, and state owned lands (Reclamation 2003a).

Irrigated agriculture occurs on private lands throughout the analysis area and cumulative effects analysis area. Much of the cropped land in the lower Pecos River valley is within one of three irrigations districts: Carlsbad Irrigation District, Pecos Valley Artesian Conservancy District, or Fort Sumner Irrigation District. The most common crops in the analysis area include forage crops (hay, silage), cereals (wheat, corn, oats, and sorghum), and nursery and greenhouse crops (USDA 1997). The USDA reports prime farmland and farmland of statewide importance in the Pecos River valley (USDA 1971; USDA 1983). Additional information regarding farmland soils can be found in the *Soils* section (Section 3.9).

Recreation. The primary purpose of most reservoirs in the analysis area and cumulative effects analysis area is to provide water storage for irrigation, but most also provide recreational benefits. Fishing, boating, water skiing, and swimming are popular recreational activities at area lakes and reservoirs. Carlsbad Lake (also called Tansill Lake) is the only lake within the analysis area. Brantley and Avalon Lakes are within the cumulative effects analysis area. The Pecos River and adjacent floodplain areas are also used for recreation, including boating, fishing, and hunting. See the *Recreation* section for additional information (Section 3.11).

Wildlife Habitat. No lands within the analysis area are managed specifically as wildlife habitat. The riparian and wetland zone along the Pecos River provide areas of wildlife concentration that are not specifically managed for that purpose.

Mineral/Oil and Gas Extraction. The BLM manages portions of its land holdings within the analysis area for mineral and oil and gas extraction. Mineral leasing on Reclamation lands is administered by the BLM. In addition, leases and mineral extraction occur on private lands (Reclamation 2003a).

3.10.2 Environmental Consequences

3.10.2.1 Effects of the No Action Alternative

Under the No Action Alternative, NMISC's leasing program would continue until 2009 and then cease. Agricultural land use would change from fallowed to irrigated because NMISC would no longer lease water rights. Agricultural production within CID would likely resume on 3,416 acres, while the 164 acres owned by NMISC likely would remain fallow.

The No Action Alternative would have a considerably higher risk of a priority call, which would potentially affect agricultural production in the entire Pecos Basin. The effect of a priority call is discussed in greater detail in the *Socioeconomics* section (Section 3.12.2.3).

Effects on recreation are discussed in the *Recreation* section (Section 3.11.2), and effects on wildlife habitat are in the *Wildlife* section (Section 3.7.2).

3.10.2.2 Effects of the Proposed Action

Under the Proposed Action, the amount of irrigated and fallowed lands would continue to fluctuate annually. For example, the amount of land fallowed due to water leases has varied from 0 acres in 2004 to 5,133 acres in 1993. The maximum amount of water that could be used for miscellaneous purposes with the proposed long-term miscellaneous purposes contract (50,000 acre-

feet/year) would be similar to the maximum amount of water that NMISC has used for miscellaneous purposes under the existing short-term miscellaneous purposes contract. In years with a full farm allotment, 11,336 acres of land associated with water leases and 164 acres of NMISC-owned lands could be fallowed if 50,000 acre-feet of water from fallowed land leases is used for state line delivery. As Section 3.2.3.2 discusses, it is highly unlikely that leases of 50,000 acre-feet would occur on a regular basis.

Compared to the No Action Alternative after 2009, the Proposed Action (either most likely or potential range) would result in more fallowed agricultural land. Within the CID, it is assumed 3,416 more acres would be fallowed in the Proposed Action than the No Action Alternative. An additional effect of the Proposed Action would be a considerably low risk of a priority call. See the *Socioeconomics* section for additional analysis of land fallowing (Section 3.12.2.3).

Under the Proposed Action, NMISC's leasing program would continue, and it is likely that Avalon Reservoir water levels and Pecos River channel volumes would remain the same. No impacts to recreation uses are anticipated under the Proposed Action.

The Proposed Action would result in a continuation in the current volume of water in the Pecos River channel below Avalon Dam. No impacts to wildlife are anticipated. Wildlife impacts are discussed in great detail in the *Wildlife* section (Section 3.7.2). The Proposed Action would not affect lands currently used for oil and gas operations.

3.11 Recreation

The following includes a brief discussion of recreation in the analysis area. Recreation opportunities are provided at area reservoirs and lakes, and along the Pecos River corridor.

3.11.1 Affected Environment

Reservoirs and Lakes. Reservoirs and lakes offer many different recreation opportunities at a single location, and therefore are popular destinations. Three reservoir recreation areas are within the analysis area. The recent drought has negatively affected lake levels, and may be responsible for decreased annual visitation at reservoirs throughout the affects area and cumulative effects analysis area.

Avalon Reservoir is on the Pecos River, about 3 miles north of Carlsbad. The CID manages recreation activities there under an agreement with Reclamation. Aside from a primitive unpaved parking area and boat launch area, Avalon Reservoir has no developed recreation facilities (Reclamation 2003a).

Recreational use of Avalon Reservoir is minimal and consists primarily of day-use shoreline fishing and some primitive dispersed camping. Motorized boating is not allowed. CID does not collect visitor use records for Avalon Reservoir.

Carlsbad Lake (also called Tansill Lake) is on the Pecos River within the city limits of Carlsbad. Summer activities include swimming, boating, water-skiing, jet skiing, fishing, and picnicking. Boating activity is generally greatest along the Pecos River from November 27 to December 31. During this time, the Carlsbad Chamber of Commerce offers evening boat tour rides to local residents and visitors that showcase Christmas lights decorating over 100 homes along the river. The Carlsbad Chamber of Commerce provides four boats for the tours, and as many as 15,000 people participate in the boat rides each year (New Mexico Department of Tourism 2004).

Brantley Reservoir is on the Pecos River, 13 miles upstream from Carlsbad. Surrounding the reservoir is Brantley Lake State Park, managed by the New Mexico State Division of Parks and Recreation under agreement with Reclamation. Brantley Reservoir is outside of the analysis area.

River Recreation. Recreation on the Pecos River downstream of Brantley Reservoir to the state line consists primarily of boating and fishing. These activities primarily depend on the availability of water and public access. In terms of boating, small watercraft and other flotation devices can be used on the Pecos River when flows are sufficient.

Limited fishing is available on the Pecos River for small bass and catfish. Public access is available at State and county highway bridges and across public land managed by the Bureau of Land Management (BLM). No specific information regarding recreation and angler use on the Pecos River is currently available.

Hunting is popular at several state wildlife areas outside of the analysis area. No specific information regarding hunting along the Pecos River below Avalon Dam is available. It is assumed that such use is limited.

3.11.2 Environmental Consequences

3.11.2.1 Effects of the No Action Alternative

Under the No Action Alternative, NMISC's leasing program would continue until 2009 and then cease. Because more water would be diverted in the Carlsbad Main Canal for irrigation purposes than under existing conditions, the Pecos River channel between Avalon Dam and where irrigation return flows enter the channel would have slightly less water. Reduced flow may have a slight adverse impact on recreation in and along the river, including fishing, hunting on private lands, and picnicking. Most recreation uses, however, such as waterfowl hunting and reservoir fishing, are upstream of Avalon Reservoir and would not be affected. No changes in reservoir levels, including Carlsbad Lake, would occur under the No Action Alternative.

3.11.2.2 Effects of the Proposed Action

Under the Proposed Action, NMISC's leasing program would continue, and it is likely that Avalon Reservoir water levels and Pecos River channel volumes would remain the same as existing conditions. No impacts to recreation uses are anticipated under the Proposed Action. The long-term miscellaneous purposes contract would allow an annual maximum of 50,000 acre-feet of Project water to be used for meeting state line delivery needs, which is similar to the maximum volume released to the state line under existing conditions. Below Avalon Dam, the pattern, volume, and seasonal timing of water releases would not change from existing conditions. As discussed under the No Action Alternative, most recreation activity takes place upstream of Avalon Dam, and no impact to reservoir- or river-based recreation is anticipated.

3.12 Socioeconomics

3.12.1 Affected Environment

The direct socioeconomic effects of the proposed action are likely to occur in the CID and Eddy County, New Mexico. Indirect effects are likely to also occur in Chaves County. Consequently, the analysis area for direct and indirect effects includes both Eddy and Chaves counties. In this section, information on the affected environment for both counties is provided for comparison and ease of reference. Socioeconomic data in this section

includes population, employment and industry, income and earnings, race and ethnicity, and agriculture. Included in the *Agriculture* section is a detailed description of socioeconomic data related to farming, ranching, and cropping patterns in both Eddy and Chaves counties.

3.12.1.1 Regional Context

Carlsbad is the county seat for Eddy County, and includes the towns of Artesia, Loving, and Malaga. Carlsbad Caverns National Park, southwest of Carlsbad, attracts many tourists to the area each year. Chaves County includes Roswell as the county seat and the towns of Dexter, Hagerman, and Lake Arthur. The largest sectors of the regional economy are government, retail trade, and agriculture. Most agricultural production is associated with irrigated land near the Pecos River.

3.12.1.2 Population

The population of the analysis area in 2002 was 111,316 people, about 6 percent of New Mexico's total population. Between 1992 and 2002, the population of Eddy County grew by less than 0.1 percent, and Chaves County grew by 2.6 percent. By 2020, the population of Eddy County is projected to grow to 58,514 people (14.4 percent); Chaves County is projected to grow to 67,591 people (12.3 percent) (UNM 2002).

Much of the population lives in the cities of Roswell and Carlsbad, which are the largest urban areas in the analysis area. In 2001, Roswell accounted for 74 percent of Chaves County's total population while Carlsbad accounted for 49 percent of Eddy County's total population (New Mexico Economic Development Department 2004).

3.12.1.3 Employment and Industry

In 2003, Eddy and Chaves counties accounted for about 5.8 percent of New Mexico's total labor force. Unemployment rates in 2003 were 6.8 percent for Eddy County, and 8.6 percent for Chaves County, compared to 6.4 percent for New Mexico and 6.0 percent nationwide (Table 12). Since 1990, unemployment rates in the analysis area have typically been higher and had more variation than the state and national averages.

The economies of Eddy and Chaves counties have historically been based on agriculture, and the discovery of oil and gas in the mid-1920s had a significant impact on the regional economy. Over time, the local economies have gradually become more diversified. Currently, the three largest economic sectors in the region are: 1) educational, health, and social services; 2) retail trade; and 3) agriculture, forestry, fishing, hunting and mining.

3.12.1.4 Income and Earnings

Per capita personal income in Eddy and Chaves counties ranged from 90 percent to 98 percent of the state average in 2001 (New Mexico Department of Labor 2004). While these percentages indicate that personal income was relatively close to the state average of $23,081, New Mexico ranked 47th

Table 12. Average labor force statistics for Eddy and Chaves counties (2003).

County	Civilian Labor Force	Total Employed	Total Unemployed	Unemployment Rate (%)
Eddy	24,263	22,604	1,659	6.8
Chaves	26,014	23,776	2,238	8.6
New Mexico	896,867	839,667	57,200	6.4

Source: New Mexico Department of Labor 2004.

in national per capita personal income that year. Per capita personal income in Eddy County increased from $15,456 to $22,637 between 1991 and 2001, an average annual growth rate of about 3.9 percent. The 2001 per capita personal income ranked 6th in the state and was 98 percent of the state average, and 74 percent of the national average (New Mexico Department of Labor 2004). In Chaves County, per capita personal income increased from $14,278 to $20,769 between 1991 and 2001, an average annual growth rate of about 3.8 percent. The 2001 per capita personal income ranked 11th in the state and was 90 percent of the state average, and 68 percent of the national average of $30,413 (New Mexico Department of Labor 2004).

Total earnings in 1999 were over $699 million in Eddy County and over $771 million in Chaves County. Total earnings for New Mexico were over $26 billion in 1999. The top five contributors to earnings in each county are provided in Table 13. Mining, services, and government were the most important economic sectors in Eddy County, accounting for about 57.2 percent of earnings in 1999. In Chaves County, government, services, and farming accounted for about 57.7 percent of earnings. Farming was considerably more important in Chaves County than in Eddy County, where only 3.8 percent of earnings were related to farming. In New Mexico, government, services, and retail accounted for 65.6 percent of all earnings (New Mexico Department of Labor 2004).

3.12.1.5 Agriculture

In 2001, farm income accounted for 2.2 percent of all personal income in Eddy County, and 12.3 percent in Chaves County. Between 1997 and 2002, the number of farms in Eddy County increased from 467 to 510 and increased from 562 to 604 in Chaves County. Statewide, the number of farms decreased from 15,500 to 15,170 over the same time period (USDA 1997; USDA 2002).

Including ranching, Eddy County had 1,183,073 acres in agricultural production in 2002, less than Chaves County, which had 2,515,660 acres in agricultural production. Added together, Eddy and Chaves counties accounted for 11.4 percent of all agricultural land in New Mexico (USDA 1997; USDA 2002).

Numbers and acreages of farms under irrigation are substantially smaller than the numbers provided above. The number of farms with irrigated land and total irrigated acreages in each county is provided in Table 14. Eddy County's market value of agricultural products sold totaled $82,211,000 in 2002. Chaves County's market value of agricultural products sold was $283,949,000 (USDA 2002).

Table 13. Industry earnings leaders (1999).

Eddy County		Chaves County	
Industry	**% Earnings**	**Industry**	**% Earnings**
Mining	20.8	Government	19.6
Services	18.4	Services	19.2
Government	17.3	Farming	18.9
Transportation and Utilities	11.8	Retail Trade	10.1
Retail Trade	9.5	Manufacturing	9.6

Source: New Mexico Department of Labor 2004.

Table 14. Selected agricultural production statistics for Eddy and Chaves Counties.

	Eddy County	Chaves County
Acres in Agricultural Production	1,183,073	2,515,660
Total Irrigated Land Acreage	45,489	69,789
Number of Farms with Irrigated Land	344	327

Source: USDA 2002.

Ranching and Livestock. Cattle, calves, and sheep are important commodities in Eddy and Chaves counties. According to the 2002 Agricultural Census, livestock production was the predominant agricultural activity in the analysis area, accounting for 70 percent of the market value of agricultural products sold in Eddy County, and 90 percent of the market value of agricultural products sold in Chaves County (USDA 2002). The sheep and goat industry also is particularly important to Chaves County. More wool is sold from Roswell than from any other single community in the United States. Chaves County also ranks as the top milk producing county in the state and 10th in the nation. Dairy products account for the single largest agricultural commodity in Chaves County, with over 906,000 tons of milk produced in 2002 (USDA 2004).

Farming. A long growing season, good soil, favorable markets, and irrigation facilities make intensive, diversified farming practices attractive and profitable in much of Eddy and Chaves counties. In 2002, Eddy County had 45,041 acres of harvested cropland, and Chaves County had 61,308 acres of harvested cropland (USDA 2002).

Crops, including nursery and greenhouse production, accounted for 15 percent of the value of agricultural products sold in the analysis area in 2002. Forage crops (such as alfalfa hay) and cotton are the principal crops grown in Eddy County. In Chaves County, forage crops and corn for silage were the principal crops. Wheat, oats, and vegetables were also produced in significant amounts in both counties (USDA 2002).

In recent years, drought and decreases in the price of major crops such as cotton have had a negative impact on farming in Eddy and Chaves counties. Many medium-sized farms are increasingly being bought out and consolidated into larger farms, and some farmers have removed land from production (Davis 2004).

County Data. Detailed county crop data for Eddy and Chaves counties were available from the U.S. Department of Agriculture (USDA 2002; USDA 2004) and the NMOSE (Wilson et al. 2003). The NMOSE compiled crop data from federal agencies, irrigation districts, county extension agents, hydrographic surveys, and other sources of information for a report on irrigated acreage and water use in New Mexico counties in 2000 (Wilson et al. 2003).

Cropping patterns for principal crops in Eddy and Chaves Counties between 1992 and 2003 are provided in Table 15. USDA data from 1992 to 2000 is limited to hay and corn silage, some grains (wheat, corn for grain, and sorghum for grain), and cotton. Recently, the New Mexico Agricultural Statistics Service (in coordination with the USDA) began documenting data for additional crops grown in the counties including irrigated pasture, barley, oats, vegetables, seeds, and pecans.

Table 15. Eddy and Chaves County cropping patterns for principal crops (1992 – 2003 acreage harvested).

Year	Hay and Corn Silage	Wheat, Corn and Sorghum For Grain	Cotton	Total
Eddy County				
1992	33,600	2,250	8,650	45,500
1993	35,300	700	10,600	46,600
1994	36,500	400	8,650	45,550
1995	34,900	100	9,600	44,600
1996	34,900	400	10,300	45,600
1997	33,600	550	10,600	44,750
1998	37,100	500	10,750	48,350
1999	40,000	500	10,200	50,700
2000	39,700	200	7,300	47,200
2001	32,800	700	7,300	40,800
2002	33,600	100	5,000	38,700
2003	35,600	0	4,800	40,400
Average	35,633	533	8,646	44,896
Chaves County				
1992	61,250	1,150	8,700	71,000
1993	61,700	250	11,650	73,600
1994	56,100	700	8,650	65,450
1995	47,300	550	9,500	57,350
1996	44,300	2,000	9,300	55,600
1997	48,100	4,000	7,000	59,100
1998	56,800	2,300	5,200	64,300
1999	67,500	1,600	6,200	75,300
2000	70,000	2,150	4,300	76,450
2001	64,000	3,300	2,800	70,100
2002	68,900	2,300	1,700	72,900
2003	54,500	0	1,900	56,400
Average	58,371	1,692	6,408	66,463

Source: USDA 2004.

The NMOSE reports additional detailed crop data for Eddy and Chaves Counties, identified by the source of irrigation water used in each area (NMOSE 2004, unpublished). The most recent NMOSE data are available for 1999 and are depicted in Table 16 and Table 17. The NMOSE crop data for Eddy County is divided into areas using five sources of water: the Carlsbad Irrigation District (CID), the southern part of RAB, Black

River, the Carlsbad Ground Water Basin, and Rio Peñasco (NMOSE 2004, unpublished).

3.12.1.6 Carlsbad Irrigation District and Roswell Artesian Basin Cropping Patterns

As indicated by the total crop acreage shown in Table 16 and Table 17, much of the farming activity in Eddy and Chaves Counties occurs in the CID and RAB. More detailed crop data for these areas were collected from Reclamation (Reclamation 2003b) and the CID (Bailey 2004).

Carlsbad Irrigation District. The CID is in the southernmost portion of the analysis area between Avalon Dam on the north and just downstream of the mouth of the Black River near Malaga. The CID serves more than 1,121 persons on 235 farms, and includes 25,055 acres of irrigable land, or about 55 percent of Eddy County's total irrigable land (Reclamation 2004b). From 1992 to 2001, the CID had an average of 18,922 acres being irrigated, which accounted for about 41 percent of all irrigated lands in Eddy County (Bailey 2004). As a federal Reclamation project, the CID reports crop information to Reclamation annually. Crop information reported by the CID is detailed and is organized into several categories, including forage (alfalfa hay, other hay, irrigated pasture, and silage/ensilage), grains (barley, corn, oats, sorghum, and wheat), cotton, vegetables (melons, peppers, and family gardens), miscellaneous field crops (alfalfa seed), and pecans. CID crop data for 1992-2001 are summarized in Table 18.

Table 19 summarizes the 1999 CID crop data reported by NMOSE. The crop data reported by the NMOSE for CID in Table 19 is the same as the data reported by CID in Table 17 except: 1) sorghum is listed as silage rather than grain; 2) there are 80 additional acres of pecans; and 3) there are 5 acres of pistachios. The NMOSE data are used in this analysis to be consistent with the detailed data for the RAB.

Roswell Artesian Basin. The RAB is the southern portion of Chaves County and northern portion of Eddy County (Figure 1). Unlike the CID, RAB farmers are not required to report crop information to Reclamation and cropping data are limited. For this reason, NMOSE cropping data for the RAB is used in this analysis (Table 20).

3.12.2 Environmental Consequences

The direct and indirect socioeconomic effects of the No Action and Proposed Action alternatives are described in this section. A brief discussion of analysis methods is provided, followed by descriptions of the effects of each alternative.

3.12.2.1 Analysis Methods

Both quantitative and qualitative approaches are used in the socioeconomic analysis. The focus of the analysis is on crop production impacts because the primary difference between the alternatives would involve the amount of water used for crop irrigation.

Effects of the No Action and Proposed Action alternatives are the estimated change of socioeconomic indicators from existing conditions. For this socioeconomic analysis, existing conditions reflect the period since 1992, when NMISC began leasing Project water. Economic impacts are reported in 2001 dollars unless otherwise specified.

Table 16. Chaves County crop acreage by water source (1999).

Water Source	Forage	Grains	Cotton	Fruits and Vegetables	Misc. Field Crops	Pecans	Total
Rio Hondo	140	1,407	0	0	0	0	1,547
Rio Peñasco	1,064	0	0	212	0	0	1,276
RAB & Pecos Pumpers	67,639 [1]	4,823 [1]	6,145	1,938	0	2,650	83,195
Scattered	600	200	0	0	0	0	800
Gross Irrigated	69,443	6,430	6,145	2,150	0	2,650	86,818

[1]Includes 3,000 acres of multiple –cropped small grains followed by corn silage.

Source: NMOSE 2004, unpublished.

Table 17. Eddy County crop acreage by water source (1999).

Water Source	Forage	Grains	Cotton	Fruits and Vegetables	Misc. Field Crops	Pecans	Total
Black River	1,079	69	0	0	0	21	1,169
Carlsbad GW Basin	1,143	59	0	336	15	11[1]	1,564
CID	13,874	881	4,216	176	80	314[2]	19,541
Rio Peñasco	29	9	0	0	0	0	38
Roswell Artesian Basin	12,020 [5]	2,011 [3, 5]	5,984	570	10	1,300 [4]	21,895
Gross Irrigated	28,145	3,029	10,200	1,082	105	1,646	44,207

[1]Includes 2 acres of pistachio orchards.

[2]Includes 5 acres of pistachio orchards.

[3]Includes 300 acres of winter wheat with corn (grain) and alfalfa.

[4]Includes 120 acres of native pasture with pecans.

[5]Includes 600 acres of spring wheat with new alfalfa.

Source: NMOSE 2004, unpublished.

Table 18. CID crop acreages by category (1992 – 2001).

Year	Forage	Grains	Cotton	Fruits and Vegetables	Misc. Field Crops	Pecans	Total
1992	12,508	98	4,388	860	70	229	18,153
1993	11,437	344	5,387	329	50	229	17,776
1994	11,941	777	3,417	349	78	229	16,791
1995	11,250	845	3,570	268	69	229	16,231
1996	11,097	722	3,713	251	75	229	16,087
1997	13,103	726	5,229	250	97	229	19,634
1998	14,150	1,016	4,412	224	100	229	20,131
1999	13,874	881	4,216	176	80	229	19,456
2000	14,362	904	1,993	50	864	290	18,463
2001	13,905	882	2,278	47	320	290	17,722
2002	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Average	12,763	720	3,860	280	180	241	18,044

N/A = Data currently not available.
Source: Reclamation 2003b*;* Bailey 2004.

Table 19. CID crop acreage complied by NMOSE (1999).

Year	Forage	Grains	Cotton	Fruits and Vegetables	Misc. Field Crops	Pecans	Total
1999	13,874	881	4,216	176	80	314[1]	19,541

Note: All units are acres.
[1]5 acres of pistachios is included under "Pecans."
Source: NMOSE 2004, unpublished.

Table 20. RAB crop acreage by County (1999).

County	Forage	Grains	Cotton	Fruits and Vegetables	Misc. Field Crops	Pecans	Total
Chaves	67,639 [1]	4,823 [1]	6,145	1,938	0	2,650	83,195
Eddy	12,020 [2]	2,011 [2, 4]	5,984	570	10	1,300 [3]	21,895
Gross Irrigated	79,659	6,834	12,129	2,508	10	3,950	105,090

[1]Includes 3,000 acres of multiple –cropped small grains followed by corn silage.
[2]Includes 300 acres of winter wheat with corn (grain) and alfalfa.
[3]Includes 120 acres of native pasture with pecans.
[4]Includes 600 acres of spring wheat with new alfalfa.
Source: Wilson et al. 2003.

Crop Production. Direct and indirect effects on crop production are estimated using quantitative methods. Effects on crop production are based on 1999 cropping data because they are the most recent complete data for all crops in the RAB and CID, and because they represent average cropping patterns under existing conditions. Similarly, 1999 crop budgets are used because they are the most recently available data (ERO 2005a). For analysis of direct and indirect economic effects and regional modeling of economic impacts, it is assumed that changes between 1999 and the present are not significant because the agricultural economy has not changed substantially during that period. Also, the focus of the analysis is on the relative difference between alternatives, not the economic effects in a particular year.

Regional Economic Impacts. Direct and indirect effects to the regional economy are determined using a quantitative approach for estimating economic impacts of retiring agricultural land, including changes in inputs, outputs, income, and tax receipts (Piper 2003). The method selected for quantitative analysis of the alternatives was the input-output IMPLAN model, a commonly used tool for estimating regional economic impacts (Snyder and Crook 2005).

Direct and indirect economic impacts were determined by calculating the changes in several economic indicators (Snyder and Crook 2005). The following indicators were used:

- Employment
- Income
- Taxes
- Value Added
- Gross output

The 2001 IMPLAN data set for New Mexico is used for the analysis because it is the most recent data set available. Although the data set is several years old, it adequately represents existing conditions because no major changes in the structure of economic activity have occurred in the analysis area since 2001. Also, the most important results from this analysis are the relative changes in economic activity that would result from implementation of either the No Action Alternative or the Proposed Action when compared to existing conditions, rather than the absolute changes in economic activity.

Net present values of total value added and gross output, at discount rates of 6 percent and 10 percent over a period of 20 years, are reported to provide a sensitivity analysis of effects on the regional economy. Lower discount rates reflect a low real value of the time preference for money and slower adjustment of the regional economy to the change in economic activity, while higher discount rates reflect higher time preferences for money and more rapid adjustment of the regional economy to impacts.

Priority Call. The economic impacts resulting from a difference in the risk of a priority call are evaluated qualitatively. These qualitative estimates are based on results reported by Whittlesey et al. (1993) for a sequence of single-year priority calls. Whittlesey et al. estimated the economic impacts of a priority call that would periodically curtail all water rights junior to 1920 to provide an average annual increase of 15,000 acre-feet in state line water deliveries. As a result of a priority call, the study estimated that 89,000 acres would be completely fallowed and about 29,000 acres would not have supplemental water supplies. About 90 percent of the priority calls would occur in Chaves and Eddy counties (Whittlesey et al. 1993)

Social Effects. Social effects from the No Action and Proposed Action alternatives are evaluated

qualitatively. In this analysis, potential social effects are evaluated for the following categories:

- Population characteristics—population size, and ethnic or racial diversity
- Institutional structures—local government, employment patterns, and political and social organizations
- Agricultural community resources—land use patterns, community services, quality of life, and social relationships

3.12.2.2 Effects of the No Action Alternative

In the No Action Alternative, NMISC's water leasing programs in CID would cease in 2009. Without a miscellaneous purposes contract, the NMISC could not use Carlsbad Project water for purposes other than irrigation. Water rights appurtenant to the 164 acres currently owned by the NMISC would remain in storage or be used beneficially but not to produce crops.

Crop Production. In the No Action Alternative, it is assumed 3,416 acres in CID fallowed by NMISC's water leases would be returned to irrigation beginning in 2009 and would produce additional forage crops, cereals, and cotton in proportion to the 1999 acreage of those crops. The basis of the cropping assumption is that forage crops, cereals, and cotton are large components of the cropping pattern under existing conditions, which reflects that the relatively large markets for these products could absorb the increased production. Compared to existing conditions, the increase of crops is estimated to be 2,498 acres of forage, 159 acres of grains, and 759 acres of cotton. Total crop revenue would be increased by about $492,000 per year in 2009 and future years.

Regional Economic Impacts. The likelihood of a priority call would be considerably higher in the No Action Alternative than with existing conditions or the Proposed Action because NMISC would no longer be able to use Project water to meet its Compact obligation (ERO 2005b). As a result of a priority call, there is an increased risk that the regional economy would lose jobs and bear millions of dollars of direct and indirect socioeconomic impacts.

Whittlesey et al. (1993) estimated the single-year costs of a priority call would be $52.2 million, $35.8 million in direct costs and $16.4 million in indirect costs to the regional economy (in 1992 dollars). The total net present value of several single-year priority calls over a 40-year period was estimated to be about $160 million in direct economic costs and $68.6 million of indirect costs to the regional economy of the Pecos River basin. These estimated costs are likely to be at the lower end of the range of potential impacts because of the conservative assumptions used in the study (Whittlesey et al. 1993; ERO 2005b). Updating the single-year cost estimates to 2001 price levels using the Producer Price Index, the single-year costs of a priority call would be $59.6 million ($40.9 million in direct costs and $18.7 million in indirect costs).

It is not possible to accurately quantify the increased likelihood of a priority call because a number of factors would affect the probability and extent of such events. However, each 10 percent increase in the probability of a priority call would increase the expected value of the single-year economic impact by about $6 million.

Regional Effects in Years without a Priority Call. The net decrease in employment under the No Action Alternative would be 12 full time equivalent (FTE) jobs (Snyder and Crook 2005). Although increased crop production would increase employment, reduced expenditures resulting from

reduced water lease revenues would reduce employment in the regional economy.

Average lease revenues from NMISC under the No Action Alternative would be reduced by about $1.5 million per year (ERO 2005a). As a result, net labor income would decline by about $330,000 per year and other property income would decline by about $120,000 per year (Snyder and Crook 2005). Lease revenues are approximately $439 per acre, most of which is net income to the lessee. In contrast, net income from agricultural production is approximately $53 per acre. A substantial amount of the revenues from agricultural production are expenditures that are imports to, or exports from, the region, which do not contribute to the local economy. In contrast, the lease revenues are assumed to contribute to the local economy because most of the lessees are local farmers with continuing operations on other agricultural lands in the region. Net indirect business taxes would decline by about $6,000 per year under the No Action Alternative. This decrease would reflect lower excise taxes, property taxes, fees, licenses, and sales taxes paid by businesses and households (Snyder and Crook 2005).

The average net decrease in value added in the regional economy would total about $460,000 per year, or about 0.02 percent of the total value added in the regional economy. This value represents the net change in payments made to labor income, other property income, and indirect business taxes. The net present value of total value added over a 20-year period from 2005 ranges from a loss of about $3.3 million at a 6 percent discount rate to a loss of $2.2 million at a 10 percent discount rate (Snyder and Crook 2005).

Under the No Action Alternative, gross output in the regional economy would decrease about $800,000 per year, or less than 0.001 percent. The net present value of gross output over a 20-year period from 2005 ranges from a loss of about $5.8 million at a 6 percent discount rate to a loss of about $3.8 million at a 10 percent discount rate (Snyder and Crook 2005).

Social Effects. A priority call would have considerable adverse social effects to communities in Chaves and Eddy Counties. Farmers in the analysis area would experience a sudden reduction in irrigation water and significant reductions in harvested crops. In years with a priority call, social impacts would be larger, especially for institutional structures and agricultural community resources, because of reduced employment, losses of income, and lower tax revenues. Agricultural community resources—land use patterns, community services, quality of life, and social relationships—would be adversely affected.

In years without a priority call, a slight increase in agricultural production and small decrease in water leasing in CID resulting from the No Action Alternative would not have significant social effects in the analysis area. Population size and ethnic or racial diversity is not likely to change. Institutional structures and agricultural community resources would not likely be significantly affected by the small changes associated with implementing the No Action Alternative. Those individuals whose quality of life is tied to the agricultural community would benefit from the No Action Alternative in years without a priority call.

3.12.2.3 Effects of the Proposed Action

In the Proposed Action, NMISC would continue to lease water for the purpose of state line delivery. Most likely, the current leasing program would continue with historical levels of leasing of Project water and land fallowing. The economic analysis of land fallowing under the Proposed Action assumes existing conditions would not change.

However, the proposed contract would allow for a maximum of 50,000 acre-feet of water that could be used in a given year for delivery to the state line.

Compared to the No Action Alternative, which approximates existing conditions in the analysis area, it is not likely that there would be a significant change in crop production, employment, income, indirect business taxes, or value added in the regional economy. However, if NMISC leased the maximum amount of water available under the contract in a particular year, there would likely be changes resulting from the reduction in agricultural production and increase in lease revenue. It is expected that the effects of additional leasing would be the opposite of the results from the analysis of the No Action Alternative in Section 3.12.2.2—i.e., an increase in regional employment, income, indirect business taxes, and value added.

Priority Call. The likelihood of a priority call would be substantially lower in the Proposed Action than the No Action Alternative (ERO 2005b). Thus, there is a reduced risk that the regional economy would be subject to job losses and millions of dollars of impacts resulting from a priority call. Quantifying the benefit of this reduced risk of a priority call is difficult, but under the preferred alternative, the adverse impacts of a priority call (see Table 4) likely would not occur.

Social Effects. Adverse social effects in the analysis area are not expected because the Proposed Action maintains existing conditions and would reduce the likelihood of a priority call.

3.13 Environmental Justice

3.13.1 Affected Environment

According to the 2000 Census, percentages of non-white persons in Eddy and Chaves counties ranged from 24 to 28 percent of the total population (Table 21). Numbers of non-white persons were less than the statewide average of 33 percent and were near the nationwide average of 25 percent. In all counties, Hispanic and Latino ethnicities made up the majority of non-white persons (USCB 2003).

Poverty levels in 2000 for Eddy and Chaves counties ranged from 17.2 to 21.3 percent, similar to the statewide average of 18.4 percent, but higher than the nationwide average of 12.5 percent (USCB 2003).

Table 21. Percent whites and non-whites in Eddy and Chaves counties (2000).

Location	White	Non-White
Eddy	76%	24%
Chaves	72%	28%
New Mexico	67%	33%

Source: USCB 2003.

3.13.2 Environmental Consequences

3.13.2.1 Effects of the No Action Alternative

In the No Action Alternative, lower income and minority populations may slightly benefit due to increased employment opportunities in the CID during the growing and harvest season for forage crops, cereals, and cotton. However, that potential benefit is more than offset by the increased risk of a priority call, which would adversely impact these populations due to reduced farm labor requirements and lower incomes in other portions of the analysis area.

3.13.2.2 Effects of the Proposed Action

The Proposed Action is not expected to adversely affect lower income and minority populations because there would be no change from existing conditions. These populations would benefit as the result of the reduced potential for a priority call.

3.14 CULTURAL RESOURCES

3.14.1 Affected Environment

Cultural resources are locations of human activity, occupation, or use. They include expressions of human culture and history in the physical environment, such as prehistoric or historic archaeological sites, buildings, structures, objects, districts, or other places. Cultural resources can be natural features, plants, and animals that are considered to be important to a culture, subculture, or community. Cultural resources also include traditional lifeways and practices. Identified cultural resources along the Pecos River reflect the long prehistoric use of the area; attempts to regulate riverflows and irrigate crops; historic era settlement, farming, and grazing activities; and the continuity of Hispanic and Native American cultural traditions and practices.

3.14.1.1 Regulatory Setting

Any federal action determined to have the potential to significantly affect the quality of the human environment requires the identification and evaluation of cultural resources pursuant to the National Environmental Policy Act of 1968 (NEPA) and Section 106 of the National Historic Preservation Act of 1966 (NHPA, as amended) and its implementing regulations under 36 CFR 800. 36 CFR 800 outlines the participants to be involved in the Section 106 process; when initiation of the Section 106 process is required; the process by which to identify cultural resources potentially impacted by a federal undertaking; the process by which to assess and resolve adverse effects to cultural resources; and special requirements for protecting National Historic Landmarks, among other provisions.

Each cultural resource identified within an area of potential effect of a proposed federal undertaking is evaluated for its potential to be listed in the National Register of Historic Places (NRHP). If cultural resources meet certain criteria, they are considered eligible for listing in the NRHP. If a proposed project would alter or affect the characteristics for which the resources are eligible, measures must be developed and implemented to minimize or mitigate the effects.

3.14.1.2 Carlsbad Irrigation District National Historic Landmark

Portions of the Carlsbad Project are designated as the Carlsbad Irrigation District National Historic Landmark. National Historic Landmarks, protected under the Historic Sites Act of 1935 (as amended), are places where significant historical events occurred, where prominent Americans worked or lived, that represent those ideas that shaped the nation, that provide important information about our past, or that are outstanding examples of design or construction. Designated in 1964, the CID National Historic Landmark provides important documentation of components of the Carlsbad Project, one of the earliest, large-scale, federally supported irrigation projects in the United States.

The CID National Historic Landmark is considered nationally significant “as an excellent representation of the historical evolution of western American reclamation activity and policy” (Hufstetler and Johnson 1993). The CID National Historic Landmark is a historic district containing 22 contributing structures, 7 contributing buildings, and 1 non-contributing building (Table 22). The CID owns one building, the First National Bank of Eddy (Element No. 30), and the following structures: the “Main” or “South/West” Canal (20), the Canal Bifurcation Works (21), the Canal Wasteway No. 2 (22), the Canal Wasteway No. 3 (23), the “East Side” Canal (24), the Pecos River Flume (25), the

Table 22. Elements of the CID National Historic Landmark.

Element Name	Element Type (Number)	Element Status	Element Name	Element Type (Number)	Element Status
McMillan Dam and Reservoir	Structure (1)	Contributing	Avalon Garage	Building (16)	Contributing
McMillan Spillway No. 1	Structure (2)	Contributing	Avalon Warehouse	Building (17)	Contributing
McMillan Spillway No. 2	Structure (3)	Contributing	Avalon Guard House	Building (18)	Contributing
McMillan West Embankment	Structure (4)	Contributing	Avalon Storage Building	Building (19)	Non-contributing
McMillan East Embankment	Structure (5)	Contributing	"Main" or "South/West" Canal	Structure (20)	Contributing
McMillan Railroad Dike	Structure (6)	Contributing	Canal Bifurcation Works	Structure (21)	Contributing
McMillan Gate Keeper's House	Building (7)	Contributing	Canal Wasteway No. 2	Structure (22)	Contributing
McMillan Garage/Boathouse	Building (8)	Contributing	Canal Wasteway No. 3	Structure (23)	Contributing
Avalon Dam and Reservoir	Structure (9)	Contributing	"East Side" Canal	Structure (24)	Contributing
Avalon Spillway No. 1	Structure (10)	Contributing	Pecos River Flume	Structure (25)	Contributing
Avalon Spillway No. 2	Structure (11)	Contributing	Dark Canyon Siphon	Structure (26)	Contributing
Avalon Spillway No. 3	Structure (12)	Contributing	Black River Supply Ditch	Structure (27)	Contributing
Avalon Suspension Bridge	Structure (13)	Contributing	Black River Diversion Dam	Structure (28)	Contributing
Avalon Water Distribution System	Structure (14)	Contributing	Black River Ditch	Structure (29)	Contributing
Avalon Gate Keeper's House	Building (15)	Contributing	First National Bank Building of Eddy	Structure (30)	Contributing

Source: Hufstetler and Johnson 1993.

Dark Canyon Siphon (26), the Black River Supply Ditch (27), the Black River Diversion Dam (28), and the Black River Ditch (29). Reclamation retains title to the other elements.

The system of irrigation laterals was originally excluded from the CID National Historic Landmark. In 2000, O'Mack and others recommended that the entire distribution system (all laterals, water-control features, associated buildings, and the Otis Yard) be included in the CID National Historic Landmark and the boundaries redrawn (O'Mack et al. 2000). These recommendations have not been implemented because a new nomination would need to be completed and submitted to the Keeper of the National Register.

Of the additional elements identified, seven laterals and one associated building were recommended as contributing elements of the National Historic Landmark (Table 23). The laterals were recommended as contributing elements of the National Historic Landmark because they retained their original character of construction type or possessed

a type of construction method that consists of "laterals lined with CCC-era [Civilian Conservation Corps] limestone and mortar, laterals lined with concrete at various times prior to the R & B [Rehabilitation and Betterment] project, and unlined laterals of generally indeterminate age" (O'Mack et al. 2000). Those canals and laterals associated with the R & B project consisted of improvement to 98 miles of existing laterals and modernization or replacement of many existing structures (checks, turnouts, measuring devices, and wasteways) following procedures outlined by the Reclamation Rehabilitation and Betterment Act of 1949 (Hill 1968). Improvements to the laterals consisted of lining them with concrete, which was accomplished between 1968 (when the plan was drafted) and 1977, with about one-third of the laterals relocated (O'Mack et al. 2000). None of these were considered contributing elements. The final feature recommended as a contributing element is the ditchrider house near the Pecos River Flume, "based on its high degree of integrity and because its location near the flume reflects the historical importance of the ditchrider in the functioning of the system" (O'Mack et al. 2000).

3.14.1.3 Other Cultural Resources in the Analysis Area

In 2001, Reclamation transferred to the CID all interests the United States held in the irrigation and drainage system of the Carlsbad Project, and all related lands. As part of the project, Reclamation reviewed existing cultural resource surveys, and completed new ones (Katz and Katz 1985a, 1985b, 1985c; Gibbs et al. 2001b; Gibbs et al. 2001a, 2002a, 2002b; Weymouth and Polk 2000; Gibbs 2002; O'Mack et al. 2000). The surveys identified 44 sites; most were north of Avalon Reservoir and are not located within the analysis area.

3.14.1.4 Traditional Cultural Properties

Traditional Cultural Properties (TCP), generally applied to federally recognized Native American tribes, are protected under National Register Bulletin No. 38 (supplemental to Section 106 of the NHPA), the American Indian Religious Freedom Act, and the Native American Grave Protection and Repatriation Act. A TCP may be eligible for listing in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's or tribe's history, and (b) are important in maintaining the continuing cultural identity of the community or tribe. Examples relevant to the analysis area include locations associated with traditional beliefs of a Native American tribe, locations that Native American religious practitioners have historically used or are known to use today, or locations where a group has traditionally carried out economic, artistic, or other cultural practices.

Consultations were initiated with Jemez Pueblo, Ysleta del Sur Pueblo, Isleta Pueblo, Kiowa Nation, Mescalero Apache, Fort Sill Apache, Comanche Nation, and the Hopi to identify and evaluate TCPs (Reclamation 2004c). To date, no traditional cultural properties have been identified as part of the consultation process. No effects on TCPs are expected.

Table 23. Additional elements recommended as contributing to the CID National Historic Landmark.

Element	Description	Comments
Lateral 2 (East Canal)	2.88 miles, CCC limestone-and-mortar, except for 2A and 2A1	Generally excellent preservation; 2A is pre-R&B concrete of probable CCC construction; 2A1 is an unlined, small, shallow lateral.
Lateral 5 (East Canal)	0.86 miles, pre-R&B concrete and CCC limestone-and-mortar	Generally excellent preservation.
Lateral 8 (East Canal)	0.96 miles, combination of pre-R&B concrete, unlined, CCC limestone-and-mortar, with a short branch that is pre-R&B concrete	CCC limestone-and-mortar lining is generally well preserved.
Lateral 5 (Main Canal)	0.63 miles, pre-R&B concrete and an unlined segment	Head is a CCC limestone-and-mortar culvert stamped 1939; lining is probably also CCC era.
Lateral 6 (Main Canal)	0.38 miles, CCC limestone-and-mortar and pre-R&B concrete	Abandoned; unlabeled in field, not on CID system map; concrete headgate for north arm has "1924" scratched in it.
Lateral 23 (Main Canal)	4.56 miles, pre-R&B and R&B concrete; Lateral 23C - concrete-block-lined; Lateral 23D - unlined	Lateral 23C is the only example of continuous concrete-block lining.
Lateral 26 (Main Canal)	3.16 miles, pre-R&B concrete and unlined; Lateral 26A - R&B concrete; Lateral 26B - unlined and R&B concrete	Especially large pre-R&B lateral.
Ditchrider's House	East of southern end of Pecos River Flume	Wood frame structure on concrete foundation, stucco exterior, side-gable roof.

Source: O'Mack et al. 2000.

Three sites were identified near Avalon Reservoir, two sites along the river between Avalon and Carlsbad, and three sites in the lower part of the CID (Table 24). These eight sites are either located within the CID National Historic Landmark boundary or within the right-of-way of the canal and lateral system.

3.14.2 Environmental Consequences

3.14.2.1 Effects of the No Action Alternative

After the existing short-term contract expires in 2009, the No Action Alternative would result in increased flows in the CID system of laterals and canals because the NMISC leasing program would cease and irrigation of fallowed lands would increase. The No Action Alternative would increase the use of some elements contributing to or recommended as contributing to the CID National Historic Landmark.

The No Action Alternative has a greater probability of a net shortfall at the state line and of a priority call than the Proposed Action. A basin-wide priority call would result in temporary "loss of use" of some elements contributing to or recommended as contributing to the CID National Historic Landmark as irrigation water is diverted to meet state line requirements. A temporary loss of use does not constitute an adverse effect because it would not affect the physical integrity of the canals and laterals, and remains consistent with the historical use of the delivery system. Archaeological sites located within the ROW of the

Table 24. Cultural resource sites within the analysis area.

Site	Feature
Sites Near Avalon Dam	
LA 131359	Historic-Structure foundation near dam, stone tank, tent base, trash dumps, and artifact scatter. "Associated with construction of Avalon Dam." Eligible
LA 131360	Mogollon- Fire Cracked Rock features near dam, bedrock mortars, and artifact scatter. Eligible
LA 131361	Mogollon- Fire Cracked Rock features north of reservoir, bedrock mortars, and artifact scatter. Historic- Road/Trail, rock alignment, and artifact scatter. Partial excavation in Feb 2003 resulted in radiocarbon date of 910 ± 40 B.P. Eligible
Sites South of Avalon Dam	
LA 35557	Not Relocated. Unspecified Prehistoric- FCR features and artifact scatter. No Eligibility Determination
LA 43436	Not Relocated. Unspecified Prehistoric- Individual Burial and shell beads (Completely destroyed by looting). Eligible
LA 43452	Florence/Vaud/Loving Townsite. Historic. No Eligibility Determination
LA 43396	Unconfirmed Location/ Composition. Historic- Agricultural Field. No Eligibility Determination
LA 43530	Not Relocated. Historic. No Eligibility Determination

Source: Reclamation 2001.

canal and lateral system would not be affected by the No Action Alternative. These sites are either within the ROW buffer or have been destroyed by previous construction activities (Reclamation 2001).

3.14.2.2 Effects of the Proposed Action

Under the Proposed Action, the NMISC leasing program would continue. The NMISC could use up to 50,000 acre-feet per year of water with the proposed long-term miscellaneous purposes contract. The maximum amount of water that could be used for miscellaneous purposes with the proposed long-term miscellaneous purposes contract (50,000 acre-feet per year) would be similar to the maximum amount of water that NMISC has used for miscellaneous purposes under the existing short-term miscellaneous purposes contract (44,800 acre-feet). The existing short-term contract has not had any effect on cultural resources (Reclamation 2004c). Consequently, the long-term miscellaneous purposes contract would not have any effect on cultural resources. The amount of use of elements contributing to or recommended as contributing to the CID National Historic Landmark would not change.

3.14.2.3 Summary of Impacts

Under the No Action and Proposed Action alternatives, cultural resources within the area of potential effect would not be adversely impacted. Both actions concern the use of the canals and laterals that provide water to downstream users. No change in the historical use of the canals and laterals would occur. As described above, cultural resources located within the variable ROW of the canals and laterals either would not be affected under the No Action and Proposed Action alternatives or have been destroyed by previous construction activities (as evidenced by not being re-located during previous inventories).

3.15 Indian Trust Assets

3.15.1 Affected Environment and Environmental Consequences

Indian Trust Assets (ITAs) are legal interests in assets held in trust by the Federal Government for federally recognized Native American tribes or nations or for individual Native Americans. Assets are anything owned that has monetary value. A legal interest refers to a property interest for which a legal remedy, such as compensation or injunction, may be obtained if there is improper interference. A trust has three components: the trustee, the beneficiary, and the trust asset. The beneficiary is also sometimes referred to as the beneficial owner of the trust asset. In the Indian trust relationship, the United States is the trustee and holds title to these assets for the benefit of an Native American tribe or nation or for an individual Native American. The Secretary of the Interior manages ITAs in accordance with *Principles for the Discharge of the Secretary's Trust Responsibility* (Secretary of the Interior 2000).

These assets can be real property, physical assets, or intangible property rights. Examples include lands, minerals, water rights, hunting and fishing rights, other natural resources, money, or claims. They need not be owned outright, but can include other types of property interest, such as a lease or a right to use something. ITAs cannot be sold, leased, or otherwise alienated without Federal approval. While most ITAs are on Indian reservations, they can be off reservations.

Reclamation contacted representatives of tribal groups with historical ties to the Pecos River basin or tribal groups who had expressed interest in Reclamation activities to identify any tribal trust or treaty interests. Reclamation requested government-to-government consultation to identify any concerns about the potential effects of the proposed contract on trust assets, cultural and biological resources, or tribal health and safety. In addition, Reclamation contacted various representatives and offices of the Bureau of Indian Affairs, informing them of the consultation and requesting any feedback that the agency might have regarding the project and possible environmental effects, including the potential to affect ITAs or cultural resources. No ITAs have been identified to date. No effects on ITAs are expected. A copy of this correspondence and list of recipients is included in Chapter 6, *Consultation and Coordination.*

3.16 Other NEPA Disclosures

3.16.1 Unavoidable Adverse Impacts

The Proposed Action would result in little change in the existing conditions. Existing flows in the Pecos River would not change. While releases of larger volumes up to 50,000 acre-feet may be possible, it is highly unlikely that they would occur on a regular basis. Such releases would be similar to maximum historical release of Project water to the state line (44,600 acre-feet). If they did occur, it is likely that the current pattern of releases in July and again in October or November would continue, but with significantly larger volumes in both periods (the percentage of days with 600 cfs releases from Avalon Dam would approximately triple). Adverse effects of longer releases, such as increased sediment transport, may occasionally occur. Changes in salinity under most likely conditions would be minor. With 50,000 acre-feet annual release, salinity would decrease by up to 800 µS/cm. Any changes to vegetation

communities or wildlife habitat for increased flows below Avalon Dam would continue.

3.16.2 Relationship of Short-term Uses and Long-term Productivity

The Proposed Action would result in assisting the NMISC with long-term compliance with the Pecos River Compact and the United States Supreme Court Amended Decree in *Texas* v. *New Mexico.* The existing use of up to 21,600 acre-feet of water per year in full allotment years and land fallowing of 3,580 acres would continue.

3.16.3 Irreversible and Irretrievable Commitment of Resources

NEPA requires a discussion of any irreversible or irretrievable commitment of resources that would result from implementing the alternatives. Non-renewable resources that are consumed or destroyed, and permanently lost are considered an irreversible commitment of resources. No irreversible commitment of resources would occur with the Proposed Action.

In contrast to an irreversible commitment of resources, an irretrievable commitment of resources is the loss of resources or resource production, or use of renewable resources during the period of time that the contract is in place; in this case, 40 years. Irretrievable commitments are not permanent; they are limited to a specific time frame. For example, water used for state line delivery instead of irrigation would be an irretrievable commitment of resources. Water would not be used to grow crops or generate economic activity associated with agriculture, but instead would be used for state line delivery and Compact compliance. As long as the water is used for state line delivery, its use would be irretrievably committed. If NMISC sells or leases back its water rights, the commitment of the resource would cease.