US Army Corps
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Albuquerque District

FINAL ENVIRONMENTAL ASSESSMENT
FOR A
TEMPORARY DEVIATION IN THE OPERATION
OF COCHITI LAKE AND JEMEZ CANYON DAM, SANDOVAL COUNTY,
NEW MEXICO

March 2009

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

CONVERSION FACTORS

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

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US Army Corps
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Albuquerque District

FINDING OF NO SIGNIFICANT IMPACT

TEMPORARY DEVIATION IN THE OPERATION OF COCHITI LAKE AND JEMEZ CANYON DAM, SANDOVAL COUNTY, NEW MEXICO

The U.S. Army Corps of Engineers (Corps) is proposing a contingency plan, if needed, to implement a temporary deviation from its water control plans for the Cochiti Lake Project and the Jemez Canyon Dam Project to facilitate spawning and recruitment flows for the federally endangered Rio Grande silvery minnow (RGSM, *Hybognathus amarus*) and to provide seasonal overbank flooding opportunities to create ideal habitat for the federally endangered Southwestern Willow Flycatcher, (SWFL , *Empidonax traillii extimus*). The deviation would only be implemented when, based on the spring snowmelt runoff forecasts, native flow would not be enough to meet the species' needs. The Projects are located in Sandoval County, New Mexico, and were authorized for flood and sediment control (Flood Control Acts of 1948, PL 858; 1950, PL 516; 1960, PL 86-645), recreation (Flood Control Act of 1944, PL 534), and development of fish and wildlife resources. All Project facilities and a major portion of the flood control pool lie within the bounds of the Pueblo de Cochiti, and the Pueblo of Santa Ana, respectively. The duration of the planned deviation between both reservoirs is from late February through June, beginning in 2009, for the next 5 years. Approval from Pueblo de Cochiti, Pueblo of Santa Ana and the Rio Grande Compact Commission (Commission) will be required for the Corps to implement the proposed deviation. Prior to implementation, the planned 5-year deviation would require the approval of the Corp's South Pacific Division.

In 2003, the Corps and the U.S. Bureau of Reclamation (Reclamation) formally consulted with the Fish and Wildlife Service (Service) pursuant to Section 7 of the Endangered Species Act regarding the continued operation of dams within the Middle Rio Grande valley of New Mexico. In March 2003, the Service issued the *Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico*. The Reasonable and Prudent Alternative (RPA) of the Biological Opinion requires, in part, that the Corps and Reclamation, annually provide an increase in flow to cue spawning of the RGSM, if needed. Successful spawning and the subsequent recruitment of young into the adult population are essential to the survival and recovery the RGSM.

The RPA of the Biological Opinion also requires, in part, that the Corps will ensure seasonal overbank flooding over baseline levels to increase the recurrence of inundation to produce suitable riparian habitat for the flycatcher.

There are two potential actions under the proposed deviation which are described below. The decision on which action will be implemented in a given year will be based on the spring snowmelt runoff forecasts when native flow is inadequate for the desired ecological functions, and in consultation with Pueblo de Cochiti, Pueblo of Santa Ana, and the Commission.

The first potential action is temporary storage and soon-to-follow release of native Rio Grande water to supplement flows in the main stem of the Rio Grande below Cochiti Lake for the benefit of the RGSM. The Corps would establish a temporary pool for storage of between 5,000 to 20,000 acre-feet at Cochiti Lake. The release of stored water would provide a minimum spawning and recruitment flow at the Albuquerque gage of 3,000 cfs for seven days.

The second potential action is temporary storage and soon-to-follow release of native Rio Grande water for overbanking flows in the main stem of the Rio Grande to create RGSM and SWFL habitat. The Corps would establish a temporary pool for storage for a maximum combined storage of 45,000 ac-ft at Jemez Canyon Dam and Cochiti Lake. The release of stored water would be limited to the amount necessary to provide a minimum flow of 5,800 cfs for 5 days at the Rio Grande at Albuquerque gage.

The water for either action would be stored on the ascending limb of the runoff hydrograph when native flows exceed downstream demands and would be released at the peak and descending limb of the runoff hydrograph. Once the deviation has occurred, the hydrograph recession would ramp down flow by 250 cfs per day until reaching a flow of 1,500 cfs. Any remaining water not needed to meet the spawning and recruitment flows would be completely evacuated prior to June 15.

The Corps will coordinate annually with Reclamation, and the Service to determine if native flow is sufficient to meet species needs, or whether flow management is desirable. The storage of water for the proposed deviation could be done by using Cochiti Lake conservation storage only (recruitment), or both Cochiti Lake and Jemez Canyon Dam conservation storage (overbanking) to meet species needs. Where the storage takes place, the volume required for the action, and how long water would be stored will be determined based on hydrological conditions in a particular year. If all parties agree on the deviation, the Corps will coordinate with the Commission, the Service, and Reclamation on where the storage takes place and how much is required for the proposed deviation based on hydrological conditions in a particular year.

Under the no-action alternative, temporary storage of native Rio Grande water at Cochiti Lake and Jemez Canyon Dam for later release to facilitate downstream recruitment flows and provide overbank flows below Isleta Diversion Dam would not occur. The dams would be operated to safely pass inflow according to the existing water control plan. The change in surface elevations at the reservoirs would not exceed normal operating conditions.

The proposed action would result in only minor and temporary impacts to resources in the action area. No significant or unusual effects on the resources in the action area are foreseen. The following elements have been analyzed and would not be significantly affected by the proposed action: socioeconomic environment, air quality, water quality, noise levels, recreation, flood plains, riparian areas, wetlands, waters of the United States, biological resources, endangered and threatened species, prime and unique farmland, cultural resources, and Indian trust assets.

The proposed action has been fully coordinated with Federal, tribal, state, and local governments with jurisdiction over the ecological, cultural, and hydrologic resources in the affected area. Based upon these factors and others discussed in detail in the Environmental Assessment, the planned action would not have a significant effect on the human environment. Therefore, an Environmental Impact Statement will not be prepared for the conduct of this planned deviation from the water control plan of the Cochiti Lake Project and Jemez Canyon Dam.

3/26/09
Date

Kimberly M. Colloton
Lieutenant Colonel, U.S. Army
District Commander

CERTIFICATION OF LEGAL REVIEW

The *Environmental Assessment for a Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir, Sandoval County, New Mexico*, including all associated documents required by the National Environmental Policy Act, has been fully reviewed by the Office of Counsel, Albuquerque District, and is approved as legally sufficient.

for M. LeeAnn Summer
District Counsel

3/25/09
Date

FINAL ENVIRONMENTAL ASSESSMENT FOR A TEMPORARY DEVIATION IN THE OPERATION OF COCHITI LAKE AND JEMEZ CANYON DAM, SANDOVAL COUNTY, NEW MEXICO

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1.0 BACKGROUND, PURPOSE AND NEED

The U.S. Army Corps of Engineers, Albuquerque District (Corps) is proposing a temporary deviation from its normal flood control operation at the Cochiti Lake Project as well as the Jemez Canyon Dam Project, Sandoval County, New Mexico. This planned deviation from the current Water Control Manual would entail a proposal to implement a temporary deviation from its Water Control Manual for the Cochiti Lake Project and the Jemez Canyon Dam Project to facilitate spawning and recruitment flows for the Rio Grande silvery minnow, (RGSM, *Hybognathus amarus*), and provide overbanking opportunities to create ideal habitat for the Southwestern Willow Flycatcher, (SWFL, *Empidonax traillii extimus*). The Cochiti Lake Project and Jemez Canyon Dam Project were authorized for flood and sediment control by Public Laws 858, 516, and 86-645. The Cochiti Dam Project is also authorized for recreation (PL 534), and development of fish and wildlife resources. All Project facilities and a major portion of the flood control pool lie within the bounds of the Pueblo de Cochiti and Pueblo of Santa Ana. The duration of the planned deviation for both projects is from late February through June beginning in 2009 for the next 5 years. Approval from Pueblo de Cochiti, Pueblo of Santa Ana and the Rio Grande Compact Commission (Commission) will be required for the Corps to implement the proposed deviation. Prior to implementation, the planned 5-year deviation would require the approval of the Corp's South Pacific Division.

The RGSM was listed as endangered by the U.S. Fish and Wildlife Service (Service) in July 1994 (USFWS 1994). Historically, the RGSM occupied the Rio Grande and Pecos rivers from north-central New Mexico downstream to the Gulf of Mexico. Currently the minnow occurs only within the approximately 160-mile reach of the Rio Grande from Cochiti Dam to Elephant Butte Lake. The SWFL was listed as endangered on February 27, 1995 (USFWS 1995). The species is restricted to historically rare and sparsely distributed dense riparian associations of willow, cottonwood, buttonbush, and other deciduous shrubs and trees throughout the southwest United States.

Since the RGSM was listed as endangered in 1994, the population gradually declined through 2003—a period that included an extended drought in New Mexico. In 2003, the Corps and the U.S. Bureau of Reclamation (Reclamation) formally consulted with the Service pursuant to Section 7 of the Endangered Species Act regarding the continued operation of dams within the middle Rio Grande valley of New Mexico. In March 2003, the Service issued the *Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico* (USFWS 2003a). The Reasonable and Prudent Alternative of the Biological Opinion states, in part, that the Corps and Reclamation, annually provide an increase in flow to cue spawning of the RGSM, if native flow is insufficient.

In 2002 and 2003, Reclamation purchased water to create flow increases for spawning spikes that did not produce sufficient recruitment for population growth. The natural hydrograph in 2004 with an increased magnitude and duration (3000 cfs for five days) produced sufficient recruitment for a significant population increase based on the fall fish surveys. During 2004 and 2005, the population increased nearly to its size at the time of listing in response to sustained flows of both moderate and exceptional discharge in the middle Rio Grande (see Section 3.07). In 2006, there was no natural snowmelt runoff, but the summer flows were abnormally high. Despite the relatively high population levels the previous year, the CPUE decreased by nearly an order of magnitude (Dudley and Platania 2007). Low spring runoff resulted in poor habitat for spawning and recruitment.

The 2004 hydrograph provided the elevated flow criteria (3,000 cfs at the Albuquerque gage for seven days) for recruitment that was produced by the Corps' Temporary Deviation in 2007 (U.S. Army Corps Engineers, 2007). Successful spawning and the recruitment of young into the adult population were achieved in 2007. Higher than average flow in 2008 provided additional recruitment. However, assuring recurring recruitment is required to avoid jeopardizing the continued existence of the RGSM.

The Service listed the SWFL as an endangered species under the Endangered Species Act (ESA) in 1994 (USFWS, 1994), with critical habitat was designated in 2005 (USFWS, 2005).The willow flycatcher is a widely distributed summer resident of much of the United States and southern Canada (Brown 1988). Historically, the southwestern willow flycatcher was widespread across the southwestern United States, breeding in riparian habitats ranging from sea level to approximately 7,000 feet in Arizona, southern California, New Mexico, southern Nevada, southern Utah, southwestern Colorado, west Texas, and extreme northwest Mexico (Phillips 1948, USFWS 1995, McKernan and Braden 2001, Smith et al. 2004). In New Mexico southwestern willow flycatcher breeding territories have been documented on the upper, middle, and lower Rio Grande; the Rio Chama; the Zuni River; and the middle and lower Gila River (Sogge et al. 1997, Williams 1997, Finch and Kelly 1999, Marshall 200). During presence/absence surveys conducted along the middle Rio Grande, 334 southwestern willow flycatcher were documented, of which 274 were thought have been resident southwestern willow flycatcher and 60 were reported as migrant males (Reclamation 2005).

Deviations in flood control operation at Cochiti Lake and Jemez Canyon Dam require approval of the Commission. Due to the success of the 2007 deviation which showed a ten-fold increase in RGSM population, the Corps is working with Pueblo de Cochiti, and Pueblo of Santa Ana, to develop a 5-year strategy that entails a range of flexible water operations at Cochiti Lake and Jemez Canyon Dam to provide suitable flows for RGSM recruitment and support continued development of riparian habitat for SWFL nesting.

Regulatory Compliance

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

- American Indian Religious Freedom Act (42 U.S.C. 1996); and
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470);
- Clean Water Act of 1972 and Amendments of 1977 (CWA);
- Clean Air Act of 1972, as amended (42U.S.C. 7401 *et seq.*);
- Endangered Species Act of 1973, (ESA) as amended (16 U.S.C. 1531 *et seq.*);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, 1994;
- Farmland Protection Policy Act of 1981, as amended (7 U.S.C. 4201 *et seq.*);
- Federal Noxious Weed Act of 1974 (Public law 93-269; 7 U.S.C. 2801);
- Floodplain Management (Executive Order 11988);
- National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq.*);
- Regulations of Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq.*);
- National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq.*);
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq.*);
- Protection and Enhancement of the Cultural Environment (Executive Order 11593);

- Protection of Historic and Cultural Properties (36 CFR 800 *et seq.*);
- Protection of Wetlands (Executive Order 11990);
- U.S. Army Corps of Engineers' Procedures for Implementing NEPA (33 CFR 230; ER 200-2-2)

This document and associated analyses for reservoir storage have been coordinated with the Pueblo de Cochiti and the Pueblo of Santa Ana. This document also reflects compliance with applicable State of New Mexico regulations and standards for water quality, as well as regulations conserving endangered plants and animals.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.01. BACKGROUND

The 2007 deviation may have contributed to a ten-fold increase in RGSM population by extending the elevated flow for a few days, The Corps is working with Pueblo de Cochiti, and Pueblo of Santa Ana technical staff, to develop a 5-year strategy that entails a range of flexible water operations at Cochiti Lake and Jemez Canyon Dam to provide information essential for the RGSM and SWFL long term survival.

The Corps used the Riverware-based reservoir-routing model developed by the Upper Rio Grande Water Operations Modeling (URGWOM) Team to examine historic Middle Rio Grande streamflow (1975-2005). The model evaluated scenarios for temporarily storing water at Jemez Canyon Dam and Cochiti Lake to augment native flows, and enumerated when the proposed actions contributed to achieving the target objective flows for overbanking or spawning and recruitment.

2.02. NO-ACTION ALTERNATIVE

Under the no-action alternative, temporary storage of native Rio Grande water at Cochiti Lake and Jemez Canyon Dam for later release to facilitate downstream recruitment flows would not occur. The dams would be operated to safely pass inflow according to the existing Water Control Manual. The change in reservoir elevations at the lakes would vary depending on flood control operation under the current water control plan.

Reclamation acquires and maintains a pool of Supplemental Water (USBR 2006b) used to meet the various flow and habitat support requirements in the 2003 Biological Opinion (USFWS 2003a). The availability of water from willing sellers has decreased over the past few years. If the Service determines that augmentation of native Rio Grande flows to provide sufficient spawning and recruitment opportunities is necessary, and is the highest priority need (recognizing the limited Supplemental Water supply), then the action agencies, in coordination with parties to the consultation, would discuss this request with the Service.

2.03. PROPOSED ACTION

Two potential actions under the proposed deviation are described below. The 2003 Biological Opinion, RPA A, states the need for, timing, magnitude, and duration of spawning flows will be determined in coordination with the Service and RPA V states the timing, amount, and locations of overbank flooding will be planned each year in conjunction with the Service. The decision on which action will be implemented in a given year will be based on the spring snowmelt runoff forecasts and in consultation with Reclamation, the Service, Pueblo de Cochiti, and Pueblo of Santa Ana (if Jemez Reservoir is under consideration for storage). The action agencies will coordinate with Isleta Pueblo, the Middle Rio Grande Conservancy District (MRGCD), the New Mexico Interstate Stream Commission (NMISC), the Commission, and other stakeholders via the water operations conference call and email. Coordination among the stakeholders would maximize the benefits for the species and minimize effects to facilities. Re-regulating Cochiti Lake and / or Jemez Canyon Dam inflow would be a no-cost solution for the federal government to meet RPA Elements A and V.

The first potential action is temporary storage and soon-to-follow release of native Rio Grande water to supplement flows in the main stem of the Rio Grande below Cochiti Lake for the benefit of the silvery minnow. As part of this action, the Corps will establish a temporary pool for storage of between 5,000 to 20,000 acre-feet at Cochiti Lake. The water would be stored on the ascending limb of the runoff hydrograph leading up to the peak, when native flows exceed downstream demands, and released at the peak and descending limb of the runoff hydrograph. Storage of the temporary pool would be in the flood pool at Cochiti Lake and would begin in late April or early May to minimize the storage period, and inundation of upstream riparian areas. The release of stored water would be limited to the amount necessary to provide a minimum spawning and recruitment flow at the Albuquerque gage of 3,000 cfs for seven to ten days. It is anticipated that the release of the stored water would not be more than 500 to 1,000 cfs per day above downstream demand flow for 10 days from combined storage at either project. The maximum combined storage for the spawning and recruitment flows is 20,000 acre-feet.

The 3,000 cfs target flow would provide sufficient inundated habitat on point bars and islands for successful silvery minnow spawning and recruitment to maintain viable population densities from year to year through much of the Rio Grande action area (Figure 1). Release of the stored water is expected to start in mid-May to early June. For this action the recession of the hydrograph drops by 250 cfs per day until reaching a flow of 1,500 cfs. Any remaining water not needed to meet the spawning and recruitment flows would be completely evacuated prior to June 15, with the intention of releasing it prior to the runoff's tailing off, or by June 15 whichever comes first.

The second potential action is temporary storage and soon-to-follow release of native Rio Grande water to supplement flows in the main stem of the Rio Grande action area (Figure 1) below Cochiti Lake and Jemez Canyon Dam to provide an overbank condition downstream from Isleta Diversion Dam (just south of Albuquerque), for silvery minnow and the Southwestern Willow Flycatcher (flycatcher) habitat. As part of this action, the Corps will establish a temporary pool for storage of between 20,000 to 45,000 acre-feet at Cochiti Lake and/or up to 25,000 acre-feet at Jemez Canyon Dam. The water would be stored on the ascending limb of the runoff hydrograph leading up to the peak, when native flows exceed downstream demands, and released at the peak and descending limb of the runoff hydrograph in coordination with stakeholders. Storage of the temporary pool would be in the flood pool at Cochiti Lake and would begin in late April or early May to minimize the storage period, and inundation of upstream riparian areas. In Jemez Canyon Dam the storage would begin in mid February or early March. The release of stored water would be limited to the amount necessary to provide a minimum flow of 5,800 cfs for 5 days at the Rio Grande at Albuquerque gage. The maximum combined storage for the overbank flows is 45,000 ac-ft.

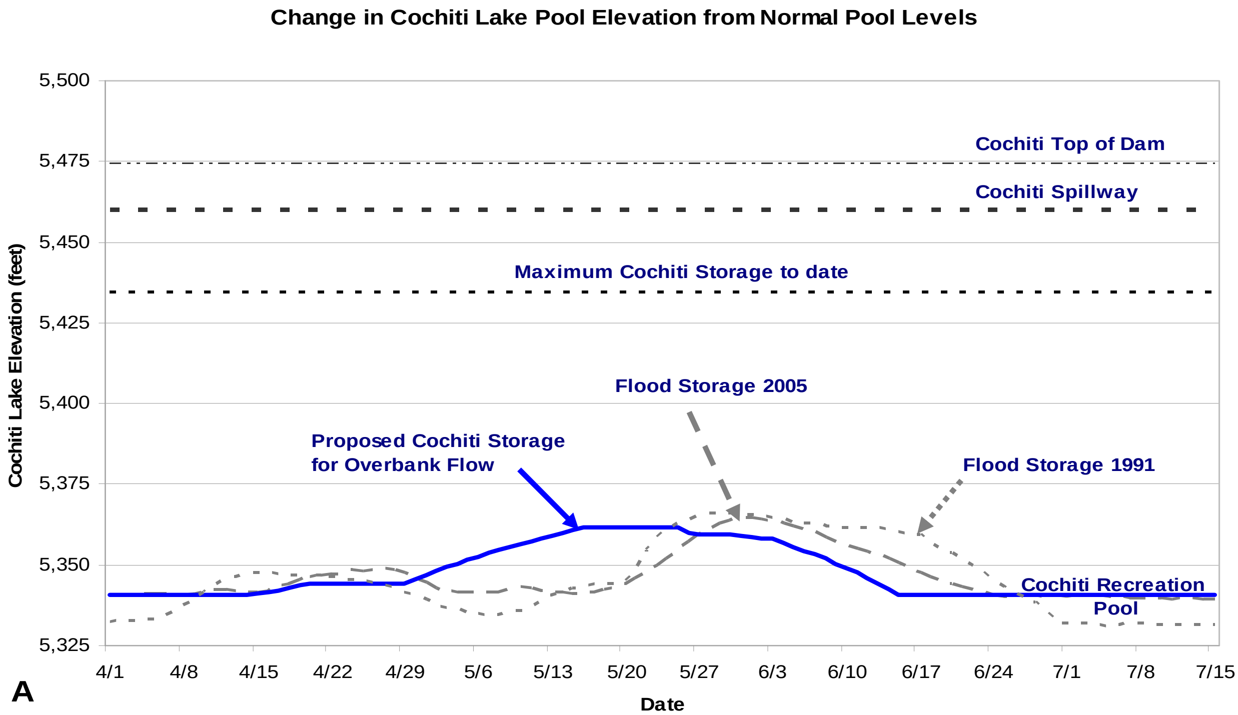
River flow during spring runoff for the flycatcher is important on two temporal scales. On the short term (seasonal basis), the presence of overbank flooding to provide low-velocity flooded vegetation has been cited as a key component for the physical structure utilized in selection of nest locations by flycatchers. In addition, the overbank flooding is important for the long term creation and maintenance of the riparian ecosystem. Silvery minnow recruitment will also benefit from the overbank flow with additional inundated habitat for spawning. Release of the stored water is expected to start in mid-May to early June. For this action the recession of the hydrograph drops by 250 cfs per day until reaching a flow of 1,500 cfs. Any remaining water not needed to meet the spawning and recruitment flows would be completely evacuated prior to June 15, with the intention of releasing it prior to the runoff's tailing off, or by June 15 whichever comes first.

The Corps will coordinate annually during the five year deviation with Reclamation, and the Service to determine if native flow is sufficient to meet species needs, or whether recruitment or overbank flows are desirable for silvery minnow population or riparian habitat management. The storage of water for the proposed deviations could be accomplished by using Cochiti Lake flood space only (for both recruitment & overbanking flows), Jemez Canyon Dam sediment pool only (for overbanking flows), or both Cochiti Lake flood space and Jemez Canyon Dam sediment pool respectively (for overbanking flows). The Corps, Reclamation, and NMISC will reach consensus on the magnitude for the proposed deviation based on hydrological conditions in a particular year, where and how much storage is required, the optimal storage period, and the source of depletion offsets for recruitment flows prior to the Corps initiating storage for such flows.

Storage would only occur when native flows exceed downstream irrigation demands (typically 500-1,000 cfs). Storage would occur on the ascending limb of the runoff hydrograph and would be released at the expected peak of runoff. All water stored under this proposal but not needed to meet the flow objectives would be completely evacuated from Cochiti Lake and Jemez Canyon Dam no later than June 15 to assure its downstream delivery to Elephant Butte Lake as required by the NMISC. Since the middle Rio Grande basin is fully appropriated, depletions associated with endangered species flow requirements under this deviation would need to be offset. Losses due to evaporation during temporary storage and overbank habitat would be estimated based on methodology developed by the NMISC (Appendix A). Reclamation shares 2003 Biological Opinion responsibility with the Corps to provide recruitment flows. Reclamation will determine whether sufficient supplemental water is available (Appendix A) and appropriate for use in a given year to meet the 2003 Biological Opinion instream flow targets, then additional supplemental water could be made available to offset all or part of the depletions associated with recruitment flows. Reclamation will not provide supplemental water to offset depletions associated with overbank flows.

Surface water elevation at Cochiti Lake would increase approximately 5 to 13 feet for recruitment storage and 18 to 25 feet (Figure 1A) for storage of overbanking flows. The maximum pool depth at Jemez Canyon Dam would be approximately 10 to 41 (Figure 1B) feet for overbanking storage. Depending on actual flow conditions, water may be held in storage for 5 to 60 days prior to its release. Storage would be managed to minimize the period of upstream riparian inundation while ensuring adequate target volume for the downstream target flow. The storage period is not anticipated to require the full 60 day action period. Figure 1 depicts the changes to surface water elevation at the reservoirs according to modeling results. Figure 2 illustrates the expected inflow and outflow rates. If both projects are used in conjunction to store in the conservation pools then the elevation changes would vary and be less than the stated maximums, depending on the amount of storage required in each project. Depending on actual flow conditions, the release of stored water from the reservoir may vary from the depicted schedule.

The Corps may evacuate the described temporary pool or any portion thereof as necessary for flood control purposes, in accordance with the Projects' authorizations. The Corps further reserves the right to take such measures as may be necessary to preserve life and property, including being able to meet emergency situations or to permit maintenance or repair of the dam or appurtenant structures. Regulation and releases will be accomplished with the Corps service gates and the Corps will not be liable or responsible for any loss of stored waters due to any malfunction of the service gates.



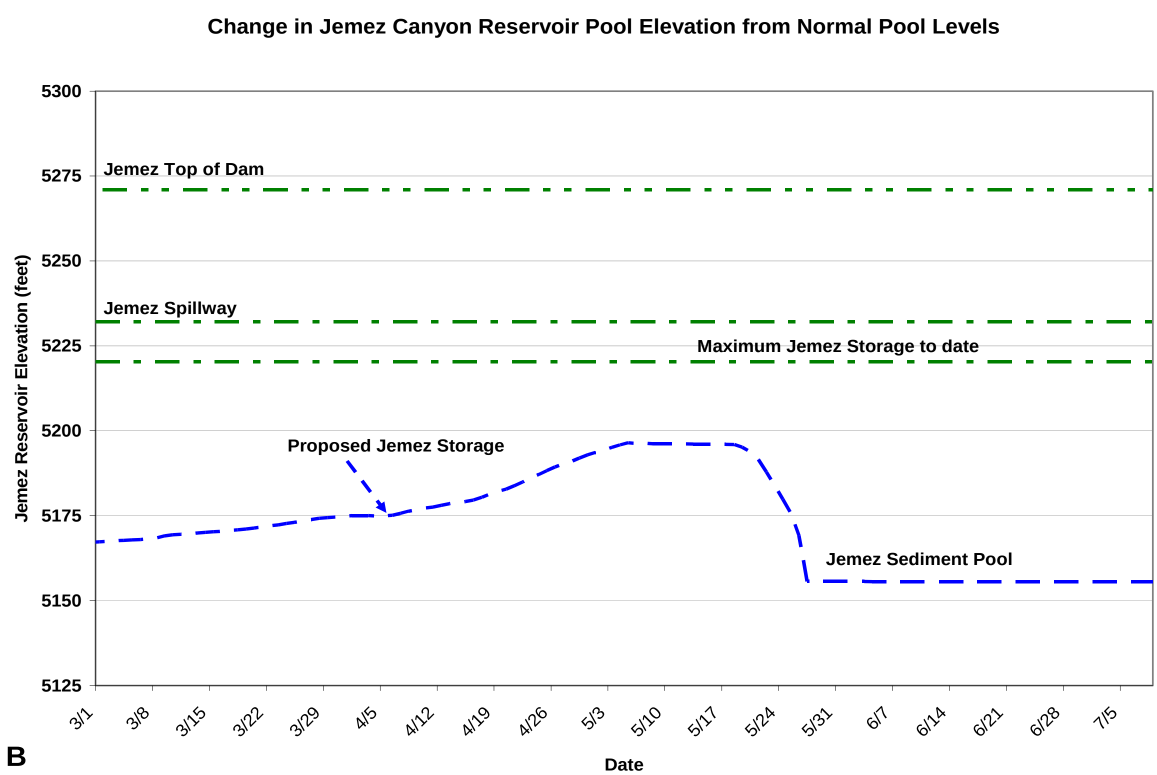


Figure 1. Projected maximum change in surface water elevations at Cochiti Lake (A) and Jemez Canyon Dam (B) based on the Upper Rio Grande Water Operations Model.

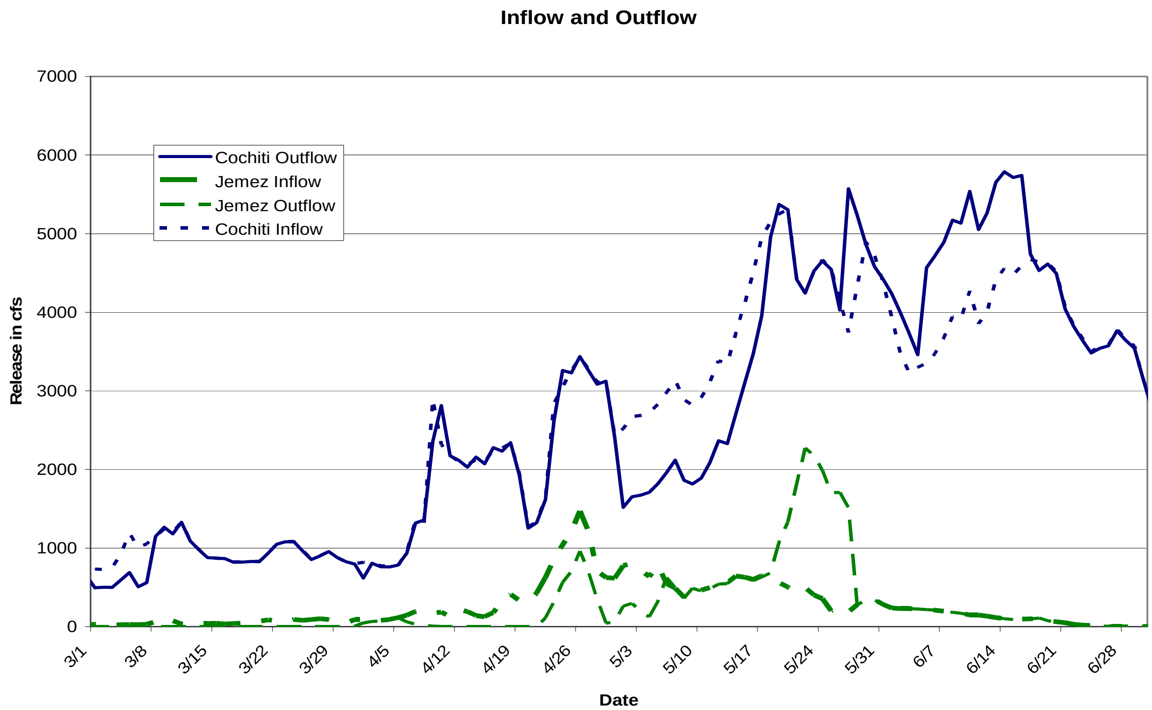


Figure 2. Projected inflow and outflow rates at Cochiti Lake and Jemez Canyon Dam for overbank flow action supporting riparian habitat and silvery minnow recruitment based on the Upper Rio Grande Water Operations Model.

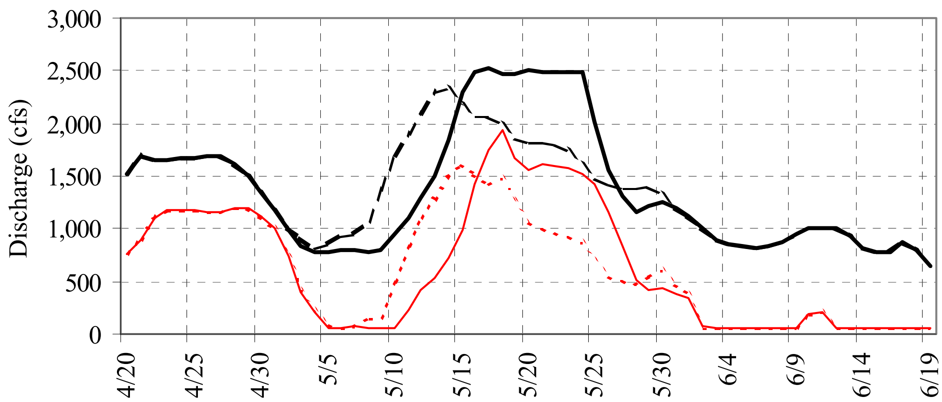


Figure 3. Projected use of temporarily stored water at Cochiti Lake for action supporting silvery minnow recruitment at San Marcial based on the Upper Rio Grande Water Operations Model.

Based on modeling discussed above, the predicted runoff in the Middle Rio Grande would not provide sufficient spring flow for spawning and recruitment in 25% of the years. About 40% of the years would have overbank flow regardless of operations, with another 10% with suitable flow for spawning and recruitment. However, even a slight decrease in actual runoff volume could necessitate the need for flow augmentation to achieve target flow objectives. The proposed deviation has the potential for sufficiently raising flow during the remaining 25% of the years for overbank or spawning and recruitment levels.

The Corps has proposed this water control deviation to temporarily store water in order to be fully prepared if the need arises, and to assure spawning and recruitment flows and possibly overbank flows in future years. The actual schedule of releases from Cochiti Lake and Jemez Canyon Dam would be coordinated during routine morning conference calls among Middle Rio Grande reservoir operators and stakeholders.

All Cochiti Lake Project facilities and a major portion of the flood control pool, lie within the bounds of the Pueblo de Cochiti. The Corps and the Pueblo de Cochiti would monitor inundation at Cochiti Lake and White Rock Canyon during temporary storage. Spawning and subsequent population levels of RGSM would be documented through an established monitoring program.

All Jemez Canyon Dam Project facilities and the entire flood control pool, lie within the boundaries of the Santa Ana Indian Reservation. The Corps would seek concurrence by the Pueblo of Santa Ana for water storage at Jemez Canyon Dam on an annual basis. The Corps would monitor inundation elevation and seepage levels with existing piezometers during temporary storage. The Pueblo of Santa Ana would continue data collection from existing groundwater wells during temporary storage.

Pursuant to Corps regulation, the Albuquerque District would request approval of the proposed water control deviation from the Corps' South Pacific Division. The Final Environmental Assessment and a *Finding of No Significant Impact* would be signed by the District Commander and included in the final submittal for approval.

2.04. ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

The Corps initially evaluated alternative locations for the temporary storage of water for facilitating recruitment flows. Storage at both El Vado and Abiquiu Reservoirs for the deviation objectives is not practical for a variety of reasons. The additional 24-48 hour travel time (depending on the reservoir) for a release increases the difficulty in coordinating the release to meet the objectives. The Rio Chama 1800 cfs channel capacity limit below Abiquiu Reservoir could preclude a release, especially for overbanking flow, during peak runoff.

Abiquiu Reservoir was eliminated from further consideration because of storage space limitations. The conservation storage space in Abiquiu Reservoir may be full or near capacity with San Juan-Chama storage in some years. The additional storage of 10,000 acre-feet of water for recruitment flows would raise the pool above the current limit of storage easements (6,220 feet above mean sea level).

El Vado Reservoir was eliminated from further consideration because of operational and storage space limitations. Reclamation operates El Vado Reservoir for Middle Rio Grande Conservancy District, and Pueblo Prior and Paramount Water irrigation storage. It is likely to be full during time period needed for spawning, recruitment and overbank flow.

The no action alternative relies on native flow and the use of supplemental water (San Juan-Chama water) purchased by Reclamation to benefit the RGSM and SWFL (RPA Elements A, B, and V). Using San Juan-Chama water for spawning, recruitment, or overbanking flows would reduce the Reclamation's ability to meet instream target flows from late June through October. The Rio Chama channel capacity limit below Abiquiu Reservoir limits the volume of San Juan-Chama water for flow objectives.

3.0 EXISTING ENVIRONMENTAL SETTING

3.01. COCHITI LAKE AND JEMEZ CANYON DAM

The Corps coordinates flood control operations among Cochiti, Abiquiu, Jemez Canyon and Galisteo Reservoirs (Rio Grande Water Control Manual) in order to regulate for the maximum safe flow at Albuquerque (7,000 cfs). Reservoir releases are restricted to the maximum non-damaging capacity of the downstream channel as measured at Albuquerque, approximately 7,000 cfs (USACE 1996). When inflow would exceed the channel capacity of the Rio Grande downstream, flood control storage is initiated. Floodwaters are stored only for the duration required and are evacuated as rapidly as downstream conditions permit. Public Law 86-645 states that deviations in operation must be approved by the Commission.

Cochiti Lake Project

The Cochiti Lake Project is located on the mainstem of the Rio Grande, about 50 miles north of Albuquerque (Figure 5). The dam spans both the Santa Fe River and the Rio Grande near their confluence. The Flood Control Act of 1960 (Public Law 86-645) authorized the construction of Cochiti Dam for flood and sediment control. In 1964, Public Law 88-293 (see Appendix A) authorized the establishment of a permanent pool for the conservation and development of fish and wildlife resources and recreation purposes. The 1,200-acre (approx. 50,000 acre-feet) permanent pool was created, and is maintained, by allocations from the San Juan-Chama Project (trans-mountain diversion). Construction of Cochiti Dam began in 1965 by the Corps and the project was put in operation in 1975.

The dam's spillway crest and the top of the flood control pool space (approximately 582,000 acre-feet) are at an elevation of 5,460.5 feet[1] (Figure 1A); and the maximum pool elevation is at 5,474.1 feet (approx. 718,000 acre-feet). The current elevation of the permanent pool (approx. 50,000 acre-feet) is 5,340.2 feet. The majority of the permanent pool creates the large lake visible from the dam. The permanent pool also inundates approximately 3 miles of the Rio Grande channel within White Rock Canyon. Between 1975 and 2003, Cochiti Lake has retained approximately 30,760 acre-feet of sediment. The current sediment reserve volume is approximately 78,000 acre-feet.

Flood storage is normally associated with snowmelt runoff during April through June. Summer flood storage is generally the result of short-term, high intensity thunderstorm events. The maximum water storage to date has been 396,167 acre-feet (water surface elevation 5,434.5 feet, Figure 1A), which occurred in 1987. This volume included the permanent pool and flood control storage pools.

Flowage easements for flood control were obtained in a series of agreements beginning in 1965. Currently, the flood control pool includes approximately 4,609 acres of the Pueblo de Cochiti, 8,236 acres of the Santa Fe National Forest, 361 acres of Bandelier National Monument, and 345 acres of Los Alamos National Laboratory. The Corps holds fee title to 139 acres within the flood pool (USACE 1996). When full, the flood pool would extend approximately 22.6 miles upstream from the dam.

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[1] All elevations in this document indicate feet above mean sea level, NGVD, 1929 datum.

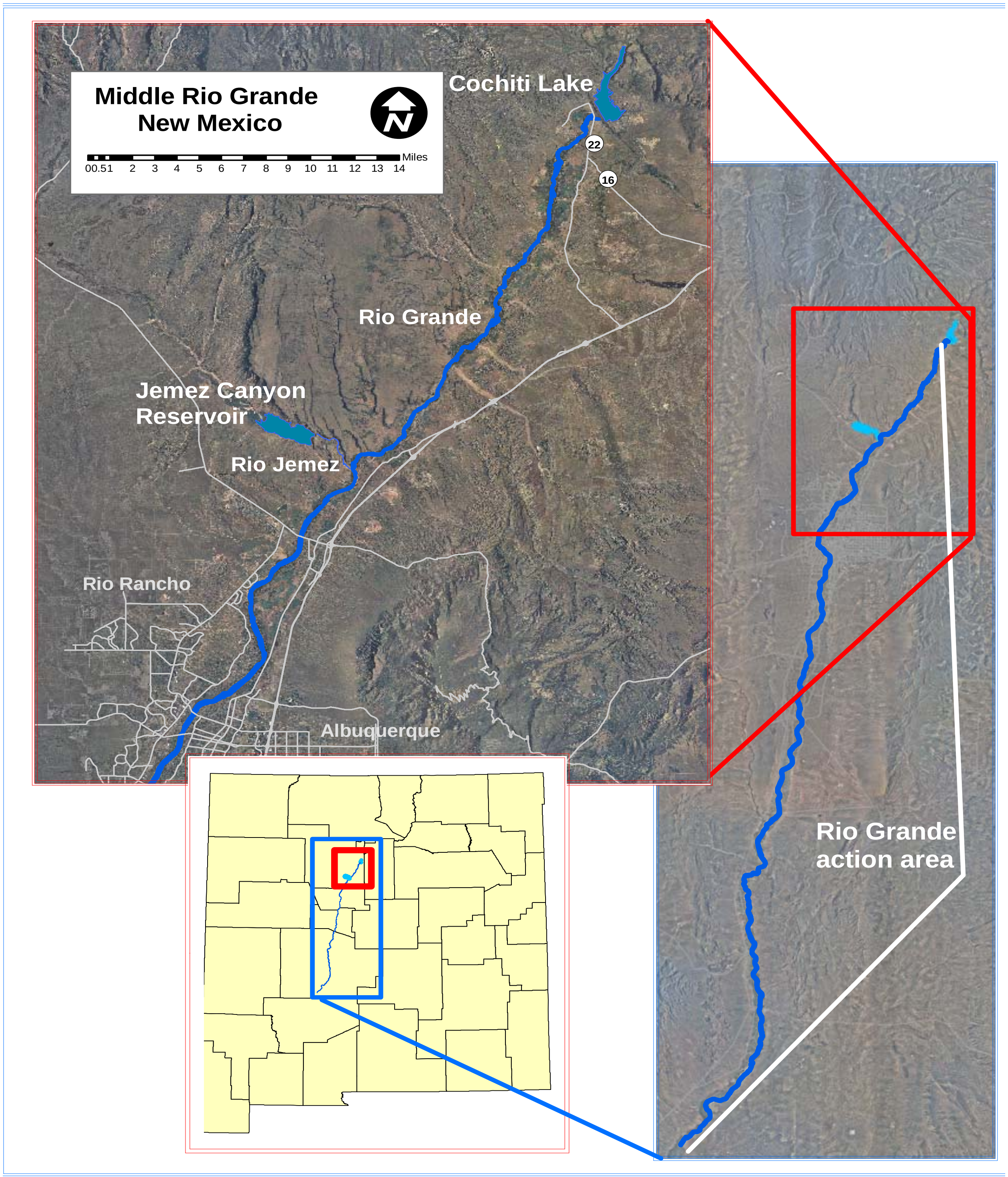

Figure 4. Cochiti Lake, Jemez Canyon Dam, Rio Jemez and the Middle Rio Grande. Flow magnitude would be increased in the Middle Rio Grande action area.

Jemez Canyon Dam Project

The Jemez Canyon Dam Project is located on the Rio Jemez, 2.8 miles upstream from its confluence with the Rio Grande, and 5 miles Northwest of Bernalillo, Sandoval County, New Mexico. The Rio Jemez enters the Rio Grande about 24 miles below Cochiti Dam. Congressional authority for the construction of Jemez Canyon Dam is contained in the Flood Control Acts of 1948 (P.L. 80-858) and 1950 (P.L. 81-516). The facility regulates Rio Jemez flows for flood damage reduction and sediment control. Construction of the dam began in May 1950, and it was completed and placed into operation in October 1953. All lands associated with the Jemez Canyon Dam Project (about 6,711 acres) are held in trust by the United States for the benefit and use of the Pueblo of Santa Ana. The Department of the Army and the Pueblo signed an MOU in 1952 (amended in 1978 by P.L. 95-498) which established a perpetual right and privilege for the construction, operation, and maintenance of the Jemez Canyon Dam Project. The Pueblo of Santa Ana reserved the right to use all associated lands for any purposes not inconsistent with those expressly granted to the government for the facility.

The reservoir at spillway crest (elevation 5,232 feet, Figure 1B) is about 6 miles long and 1 mile wide. Initial capacity allocations were 73,000 acre-feet for flood control and 44,000 acre-feet for sediment deposition. Top-of-dam elevation is 5,271.6 feet (NGVD), which is approximately 149 feet above the original streambed. Intake floor elevation is 5,125 feet. Flood storage is normally associated with snowmelt runoff during April through June. Summer flood storage is generally the result of short-term, high intensity thunderstorm events. The maximum storage to date has been 72,254 acre-feet (elevation 5,220.3 feet, Figure 1B), occurring in 1987.

Jemez Canyon Dam initially had a sediment retention pool of 2000 acre-feet (1953 -1986). This was increased to approximately 24,000 ac-ft from 1986-2001. The MOU with the Pueblo of Santa Ana expired in 2001, and was not renewed. The pool was evacuated in November of 2001 with the project operated as a "dry reservoir" since 2001. Settlement of the Rio Jemez adjudication (United States of America v. Tom Abousleman, CV 83-1041 C) may affect water availability for temporary storage in Jemez Canyon Dam.

Rio Grande Channel

The Programmatic Biological Assessment (USBR 2003) provides detailed discussion on how the major stakeholders manage the amount, timing and duration of water deliveries, and the importance of Rio Grande Compact deliveries with native flows. The effects of water management on the aquatic and adjacent riparian habitat are evaluated in the 2003 Biological Opinion (USFWS 2003a). Cochiti Dam is the principle flood control facility on the Middle Rio Grande upstream of Elephant Butte Reservoir. Galisteo Dam limits peak flood flow from Galisteo Creek downstream of Cochiti Lake, while Jemez Canyon Dam regulates Rio Jemez floodwater entering the Rio Grande downstream of Angostura diversion dam. These dams prevent downstream flooding by managing releases for a maximum channel capacity of 7,000 cfs at the Rio Grande at the Albuquerque gage. The Rio Puerco and Rio Salado enter the Rio Grande downstream of Bernardo and contribute high flash flood flows with a heavy sediment load. MRGCD diverts irrigation water at Cochiti Dam, Angostura, Isleta, and San Acacia Diversion Dams.

Elevated flows are associated with increased RGSM recruitment (Dudley and Platania 2007). The duration and magnitude of first action would provide opportunities for spawning leading to recruitment of juvenile RGSM to the population. These flows would support existing riparian vegetation. Reclamation and ISC have agreed to methods for calculating of depletions with agreements to offset depletions for recruitment flow (Appendix A). Flood or overbank flows are considered essential for regular development of native riparian vegetation (FWS 2003a). Encroachment of non-native plants reduces the quantity and quality of RGSM habitat. Overbank flooding creates in-channel habitat for RGSM, and initiates new stands of riparian vegetation for future SWFL habitat. ISC has provided methods for calculating of overbank flow depletions (Appendix B).

Habitat restoration benefits numerous species including the RGSM and SWFL along with plants and wildlife. The Pueblo of Santa Ana with the Corps and Reclamation have constructed 935 acres of riparian, wetland, and aquatic habitat on the Rio Grande downstream of the Rio Jemez. The Middle Rio Grande Endangered Species Act Collaborative Program (Program) is a partnership created to protect and improve the status of the RGSM and SWFL, while simultaneously protecting existing and future water uses in the area. The Program has funded 657 acres of habitat restoration projects to benefit the listed species from Cochiti Dam downstream to Los Lunas (Bureau of Reclamation 2008).

The Rio Grande Compact of 1938 (Compact) is administered by the State of New Mexico to set and enforce depletion limits on the Rio Grande (USBR 2003). The New Mexico State Engineer has determined that ground water usage which impacts surface flows of the Rio Grande must be offset to assure reliable flow (USFWS 2003a).

3.02. PHYSICAL ENVIRONMENT

Cochiti Lake Project

The Cochiti Lake Project is located within the Rio Grande Rift valley (Hawley 1978). Cochiti Dam, located at the downstream end of White Rock Canyon, marks the northern most extent of the Santo Domingo Basin (Hawley 1978). The Rio Grande valley lies in the middle of the rift valley, which is filled with thousands of feet of alluvial sediments. Lining the valley both upstream and downstream from Cochiti Dam are volcanic deposits (magmatic and erupted deposits such as tuffs); the most noted of the volcanoes is the caldera forming the Jemez Mountains (Dunbar 2005). Downstream from Cochiti Dam, the Rio Grande Valley is fairly broad with extensive floodplains and a reduced gradient.

Soil material in the bed of the Rio Grande and Cochiti Lake is alluvial in origin. The deepest area of sediment deposition (approximately 80 feet) is near the southern end of White Rock Canyon, with decreasing sediment deposition in upstream sections. Sediment accumulation within the main body of Cochiti Lake averages several feet. Ildefonso soils, which is a very stony loam is the principal soil series on the slopes of White Rock Canyon. This well-drained soil is derived principally from basalt. Permeability of this soil is high, and available water capacity is low. Runoff is rapid and the hazard of water erosion is moderate (NRCS 1999).

The Cochiti Lake delta has approximately 243 acres of wetlands and riparian habitat in White Rock Canyon (NWI 2006). The delta and channel are bordered by Santa Fe National Forest, Bandelier National Monument, and Los Alamos National Laboratory. The native riparian vegetation around the shallow backwaters upstream of Cochiti Lake should develop into suitable SWFL habitat.

Jemez Canyon Dam Project

The Jemez Canyon Dam Project is located on the Rio Jemez about 1 mile upstream from the Rio Grande/Rio Jemez confluence. The Jemez Canyon Dam was constructed in a naturally narrow point in the Rio Jemez valley, where Pliocene basalt and andesite flows are capping the Santa Fe formation (Anderson et al. 1997). Within the delta area there is a minimal amount of basalt talus. The Santa Fe formation is composed of clay, silt, sand, gravel, and cobbles. The formation at the site is generally horizontally bedded; however, the beds are discontinuous both vertically and horizontally.

The Jemez Canyon Dam has not been surveyed by soil scientists. Interpolation from other data collected on similar sites off Pueblo lands, indicates that Christianburg-Navajo soils occur principally along the floor of the Rio Jemez valley (USDA Soil Conservation Service et al. 1977). They are nearly level, fine-textured alluvium weathered from shale and sandstone and are highly susceptible to erosion. These soils encompass nearly the entire flood pool area of the reservoir and floodplain upstream of the pool area (*i.e.*, below elevation 5,232 feet).

Rio Grande Channel

The Rio Grande is an alluvial river that was a historically aggrading system creating a wide, sandy, braided planform. It normally inundated an extensive floodplain/wetland habitat during high flows (Makar et al. 2006; Massong et al. 2006). From 1950 to 1975, federal agencies constructed of a series of dams on the Rio Grande (and its tributaries) for flood and sediment control (Lagasse 1980). Two of the dams have been cited as particularly important for evolution of the Rio Grande: Cochiti Dam and Jemez Canyon Dam. Cochiti Dam on the Rio Grande started operations in 1973, retaining flood flows and the upstream sediment supply. On the Rio Jemez, the original and current operations of Jemez Canyon Dam are as a dry reservoir; however, 1979-2002, a permanent pool was added that retained not only flood flows, but also sediment. By 1980, much of the Rio Grande downstream from Cochiti Dam had converted to a coarse gravel bedded channel, with that transition migrating downstream to its present location in the Albuquerque area today. As two major supplies of sediment were removed from the Rio Grande, rapid channel incision has occurred throughout this area of the Rio Grande. Much of the historical floodplain has become abandoned through degradation of the channel bed, with vegetated bars constituting the majority of flooded surfaces in years with normal spring discharge (Tashjian et al., 2006).

3.03. CLIMATE

The climate of north-central New Mexico can be generally characterized as semi-arid continental, with mild summer and cold winter temperatures. The average precipitation for the area is approximately 10 inches per year, and about 70 percent of this moisture falls during the warmer months of the year (June, July, and August). Summer moisture is carried into the state by southerly and southeasterly air circulation from the Gulf of Mexico and is usually released in brief, often intense thunderstorms. An average of 50 such storms occurs in the area each year. Winter moisture is carried into the state by eastward-moving storms from the Pacific Ocean and is often blocked from reaching the project area by the Jemez Mountains and other mountain ranges to the north and west. Snowfall (averaging 7.4 inches annually) that does reach the project area is generally of short duration.

Temperatures in the area are influenced both by elevation (approximately 5,200 to 5,400 feet above sea level) and the highly variable topography of north-central New Mexico. Cold air draining from the Jemez Mountains is often directed through White Rock Canyon during the colder months, resulting in somewhat lower temperatures during the winter than might be expected at this elevation. The mean annual temperature is close to 50 degrees F, and usually only about 11 days per year reach 90 degrees F. Most days in November through March have freezing temperatures, but only rarely during winter does the temperature fall to zero degrees F.

Winds in the area are predominantly from the west-southwest during the spring (when strongest) and shift to the north-northwest during the rest of the year. Average wind speeds are approximately 12 miles per hour, increasing to 25 miles per hour or greater about 5 percent of the time. Annual sunshine is nearly 75 percent of the total possible and is important during the summertime in the generation of localized winds and storm systems in the project area.

Since the installation of the weather station at Jemez Canyon Dam in 1954, the maximum annual precipitation was 13.88 inches in 1987 and the minimum was 2.40 inches in 1956. The maximum recorded 24-hour rainfall was 2.75 inches on October 17, 1960. During the winter months, heavy snowfall occurs in the upper mountainous areas of the watershed and snow is light over the lower basin. Snow remains in the mountainous areas above 7,000 ft. elevation from December into April. Below 7,000 feet in elevation, snow seldom stays on the ground more than a few days. The average annual snowfall varies from 10 inches at Jemez Canyon Dam to over 100 inches in the mountains.

3.04. LAND USES

Cochiti Lake Project

Lands surrounding Cochiti Lake on Pueblo de Cochiti land are devoted to residential and agricultural (cropland, irrigated and non-irrigated livestock pasture) uses. The Tetilla Peak and Cochiti Recreation Areas are within the Pueblo land easement devoted to floodwater and sediment control for the Cochiti Dam Project. The Corps/Pueblo easement area also contains much of the 1,200-acre permanent pool for recreation and fish and wildlife enhancement. The Pueblo de Cochiti reserved the right to use all associated lands for any purposes not inconsistent with those expressly granted to the Federal Government for the facility.

Lands to the west of the dam at the Town of Cochiti Lake are leased from the Pueblo by private entities and are mainly for residential and recreational uses. Properties at the town of Peña Blanca adjacent to Pueblo de Cochiti and Santo Domingo Pueblo lands are privately owned and, in general, are dedicated to residential and agricultural uses.

North of the Pueblo de Cochiti in White Rock Canyon, the permanent pool and Rio Grande channel are bordered by Santa Fe National Forest on the east, with Bandelier National Monument and Los Alamos National Laboratory property on the west. The U.S. Forest Service, National Park Service, and Department of Energy, are responsible for the management of their respective lands within the Corps' easement for all purpose other than flood control.

Farmland that is protected from conversion or other adverse effects under provisions of the Farmland Protection Policy Act (Public Law 97-98) includes lands defined as prime or unique, or that are of statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the appropriate state or unit of local government agency or agencies. Prime farmland soil survey units within Sandoval County include El Rancho, Jocity, Peralta, Aga, Gilco, and Zia. The latter three soils are present below the dam. There are no prime farmlands within the flood pool easements of either the Cochiti Lake or the Jemez Reservoir Projects.

Jemez Canyon Dam Project

All lands associated with the Jemez Canyon Dam Project are held in trust by the United States for the benefit and use of the people of the Pueblo of Santa Ana. The Department of the Army and the Pueblo of Santa Ana signed an MOU in 1952 (augmented in 1978 by P.L. 95-498) which established a perpetual right and privilege for the construction, operation, and maintenance of the Jemez Canyon Dam Project. The Pueblo of Santa Ana reserved the right to use all associated lands for any purposes consistent with those expressly granted to the government for the facility.

No livestock are allowed to graze in the project area; however an occasional breach of fencing may occur with resultant short-term utilization of the area by cattle. Hunting, hiking, fishing, swimming, horseback riding, and ceremonial activities occur near the proposed project impact area.

Rio Grande Channel

The Middle Rio Grande Endangered Species Collaborative Program has constructed over 600 acres of riparian, wetland, and aquatic habitat on the Rio Grande downstream of Cochiti Dam. The Pueblo of Santa Ana with the Corps and Reclamation have constructed 935 acres of riparian, wetland, and aquatic habitat on the Rio Grande downstream of the Rio Jemez. Restoration by other pueblos combined with Reclamation's bioengineered bank stabilization projects contributes additional riparian and aquatic habitat acreage to the Rio Grande ecosystem. This habitat benefits numerous species including the RGSM and SWFL along with plants and wildlife.

Large wetlands and an extensive cottonwood gallery forest occupied the floodplain of the Rio Grande prior to major modifications of the ecosystem (USACE 2008). Prior to regulation, the Rio Grande's flow regime was controlled by regional climate, basin geology, and floodplain geomorphology. The combined influence of these features was evident in the early growing season. Melting winter snows in the basin's upper watersheds produced a swollen river that often overflowed its banks, producing scoured banks for cottonwood and willow seedling germination, and avulsion events leading to new channel formation.

Human induced changes in fluvial geomorphic processes have influenced bosque vegetation dynamics since the late 1700s (USACE 2008). Channelization, levee construction, Kellner jetty jack installation, sediment retention in reservoirs, and flow regulation have resulted in channel incision and a narrower floodplain disconnected from the river. The result has been disruption or termination of major processes depicted in the conceptual model of dynamics in a naturally functioning bosque ecosystem (USACE 2008).The loss of meander migration, meander cut-off, and flood scour processes has changed the dynamics for aquatic and riparian habitat.

3.05. HYDROLOGY AND WATER QUALITY

The Rio Grande and Santa Fe River watersheds upstream from Cochiti Dam drain an area of more than 11,000 square miles in northern New Mexico and southern Colorado. The drainage basin lies between the Continental Divide and the Sangre de Cristo Mountains and includes several other tributary streams, including the Rio Chama, Rio Hondo, Red River, and Rio Pueblo de Taos. Snowmelt runoff from high elevations is the most significant contributor to stream flows in the basin.

Stream slopes in the highest elevations of the basin may be several hundred feet per mile, decreasing to 150 feet per mile or less in the Rio Grande Gorge, and only about 10 feet per mile in the Española Valley and White Rock Canyon. From Cochiti Dam downstream, the channel slope is only 4 to 5 feet per mile.

Prior to the construction of Cochiti Dam and other upstream dams, flood flows of 10,000 to 20,000 cfs were periodically recorded in White Rock Canyon and downstream reaches. Present-day discharges in the Rio Grande downstream from Cochiti Dam range from a typical minimum winter flow of about 300 cfs, to spring runoff peaks that, through regulation, do not exceed 7,000 cfs at the Albuquerque gauge. This is the current safe channel capacity water control criterion that is defined in the Cochiti Lake Water Control Manual (USACE 1996).

The elevation of Cochiti Lake during the spring runoff period has reached or exceeded an elevation of 5,348 feet during 14 of the past 33 years (1975-2007). Except for exceptionally long storage periods in 1985 through 1987, this elevation has been inundated for periods of approximately 2 to 60 days between late April and the end of June. The most recent flood control storage occurred in 2005 when the lake reached an elevation of about 5,364 feet.

The Compact is an agreement between Texas, New Mexico and Colorado apportioning the waters of the Rio Grande above Ft. Quitman, Texas (USFWS 2003a). New Mexico's annual water allocation available for use within the Middle Rio Grande is a maximum of 405,000 acre-feet of the flow of the Rio Grande as determined based upon the measurement at the Otowi index gage. New Mexico deliveries are measured as the releases from Elephant Butte Dam plus the change in storage in Elephant Butte, thus the evaporation loss is counted against New Mexico's Compact allocation. New Mexico is allowed to consume all of the tributary inflows into the Rio Grande between the Otowi gage and Elephant Butte. The Compact requires annual water accounting and provides for a system of annual debits and credits. Water must be retained in storage in reservoirs constructed after 1929 to the extent of each state's debits and cannot be used. It must be released upon demand of the downstream state. ArticleVII of the Compact provides that if usable storage in Elephant Butte and Caballo Reservoirs is less than 400,000 acre-feet, neither Colorado nor New Mexico may increase the amount of water stored in upstream reservoirs constructed after 1929. Water imported from the Colorado River Basin, in particular the San Juan-Chama water supply is not subject to the Rio Grande Compact apportionment. The Compact does not affect the obligations of the United States to Indian tribes or impair Indian water rights. The purpose of the Compact was to equitably apportion the uses of the waters of the Rio Grande among the three states based on how that apportionment existed in 1929, thereby allowing each state to develop its water resources at will, subject only to the delivery obligations set forth in the Compact. The Compact requires that the upper states of Colorado and New Mexico deliver a specified percentage of flow in the Rio Grande to the next lower state. These percentages are based on specified gaging stations and index schedules contained within the Compact.

Taking into account New Mexico's Compact delivery obligations to Texas, the middle Rio Grande basin is fully appropriated. That means that there is no excess water available beyond that which is currently being depleted from the system. Any additional depletions or new use of water in the basin must come from an existing use. Depletions associated with specified endangered species flow requirements are a new use on the system that must come from an existing use. New Mexico Compact delivery water temporarily stored during snowmelt runoff period for later release for a spawning & recruitment or overbanking results in additional depletions on the system. Since the middle Rio Grande basin is fully appropriated, those additional depletions on the system can only come from an existing use. Therefore any additional depletions as a result of the actions taken under this deviation would need to be offset. While Reclamation's supplemental water could offset depletions in a spawning and recruitment action, an additional source of water will need to be made available to offset the depletions in an overbanking action.

The New Mexico Water Quality Control Commission (2000) has designated uses and standards for interstate and intrastate streams in New Mexico (by stream segment). Cochiti Lake is designated for use as livestock and wildlife watering, warm water fishery, coldwater fishery, and primary contact. Designated uses of the main stem of the Rio Grande from Cochiti Dam downstream to the Angostura Diversion Works are irrigation, livestock watering, wildlife habitat, secondary contact, coldwater fishery, and warm water fishery. State water quality standards do not apply to tribal lands.

3.06. BIOLOGICAL RESOURCES

Plant Communities at Cochiti Lake Project

The Cochiti Dam project area is located within the Great Basin Conifer Woodland and the Plains and Great Basin Grassland biotic communities as defined by Brown (1982). These biotic communities characterize the vegetation outside of the Rio Grande floodplain. Uplands adjacent to the Rio Grande and Cochiti Lake are vegetated by one-seed (*Juniperus monosperma*) and Rocky Mountain juniper (*J. virginiana* var. *scopulorum*), piñon pine (*Pinus edulis*), Apache plume (*Fulugia paradoxia*), rabbit brush (*Chrysothamnus depressus*), skunkbush (*Rhus tribolata* var. *tribolata*), four-wing saltbush (*Atriplex canescens*), snakeweed (*Gutierrezia glutinosa*), walkingstick cholla (*Opuntia* sp.), prickly pear (*Opuntia fragilia* var. *fragilia*), and a variety of forbs and grasses including phlox (*Phlox* sp.), groundsels (*Senecio bigelovii* var. *hallii*), asters (*Aster* sp.), grama grasses (*Bouteloua* spp.), dropseeds (*Sporobolus* spp.), muhly (*Muhlenbergia torreyia*), and western wheatgrass (*Agropyron occidentale*).

Since the completion of Cochiti Dam in 1974, wetland vegetation has been developing in the lake's delta in White Rock Canyon. Currently, approximately 243 acres of wetlands occur within the reach entailing the permanent pool (NWI 2006). The extent of delta vegetation has increased 60% from the 152 acres estimated in 1993 (Allen *et al*. 1993). Storage during the spring runoff period has inundated the majority of this vegetation in 6 of the 15 years between 1993 and 2007.

Vegetation adjacent to the permanent pool within White Rock Canyon consists of emergent and shrub wetland types. Emergent wetlands — entailing approximately 22 acres — are dominated by cattail (*Typha latifolia*), barnyard grass (*Echinochla crus-galli*), salt grass (*Distichlis spicata*), and inland rush (*Juncus interior*) (Allen *et al*. 1993). Shrub stands (approx. 167 acres) are dominated by Goodding's willow (*Salix nigra* var. *gooddingii*) and coyote willow (*Salix exiguis*) ranging from less than 5-feet to about 12-feet tall. Approximately 54 acres of mixed emergent/shrub stands occur within this reach (NWI 2006).

<u>Plant Communities at Jemez Canyon Dam Project</u>

The Jemez Canyon Dam is within the Plains-Mesa Sand Scrub biotic community as defined by Dick-Peddie (1993), and vegetation typical of this community dominates the entire area south of the Rio Jemez on Pueblo of Santa Ana lands. The following grasses and forbs occur in sparse to moderately dense stands throughout the area: black grama, New Mexico feathergrass, western wheatgrass, galleta, sand dropseed, and ring muhly. Shrubs commonly found throughout the area include fourwing saltbush, sand sagebrush, rabbitbrush, and bush penstemon. Unconsolidated sand dunes with sparse pioneer vegetation occur in a portion of this community. At slightly higher elevations, and often interspersed with the sand scrub community, are piñon pine /one-seed juniper woodlands.

Jemez Canyon Dam began operation in 1953. By the early 1970s, vegetation occupied about 624 acres of the 1,143-acre Jemez Reservoir flood pool below an elevation of 5,197 feet (USACE 2003). Vegetation development was likely enhanced by increased soil moisture and nutrient availability due to periodic flooding during flood control operations. The relatively moist soils along the Rio Jemez channel support willow and cottonwood growth, with salt cedar has expanded across the drier soils within the sediment pool (Pueblo of Santa Ana, 2006). Plant communities in the upstream portion of the reservoir have been affected where sediment deposition patterns were altered as a result of the pool. A narrow band of riparian vegetation occurs along the former sediment pool margins with,large mixed stands of Rio Grande cottonwood, Gooding's willow, and coyote willow containing non-native Russian olive, salt cedar, and Siberian elm in the delta.

Executive Order 11990 (Protection of Wetlands) requires the avoidance, to the extent possible, of long- and short-term adverse impacts associated with the destruction, modification, or other disturbances of wetland habitats.

Wildlife and Fish at Cochiti Lake and Jemez Canyon Dam Projects

The following vertebrate animal species are known or expected to occur in the general area of Cochiti Lake, White Rock Canyon, the Jemez Canyon Dam, and their surroundings.

Mammals known or likely to be present include little brown myotis (*Myotis lucifugus*), Yuma myotis (*Myotis yumanensis*), pallid bat (*Antrozous pallidus*), big free-tailed bat (*Tadarida macrotis*), desert cottontail (*Sylvilagus auduboni*), black-tailed jackrabbit (*Lepus californicus*), rock squirrel (*Spermophilus variegatus*), Botta pocket gopher (*Thomomys bottae*), beaver (*Castor canadensis*), western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), white-footed mouse (*P. leucopus*), piñon mouse (*P. truei*), house mouse (*Mus musculus*), meadow jumping mouse (*Zapus hudsonius*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), bobcat (*Felis rufus*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitus*), mule deer (*Ococoileus hemionus*), and elk (*Cervus canadensis*) (Biella and Chapman 1977, Walker 2001).

Hubbard and Hubbard (1979) reported a total of 154 species of birds occurring at least seasonally at Bandelier National Monument, which borders a portion of Cochiti Lake. Many, if not most, of the same species occur in the Project area as well. Common breeding species include Canada Goose (*Branta canadensis*), Mallard (*Anas crecca*), Turkey Vulture (*Cathartes aura*), Red-Tailed Hawk (*Buteo jamaicensis*), Swainson's Hawk (*B. swainsoni*), American Kestrel (*Falco sparverius*), Killdeer (*Charadrius vociferous*), Mourning Dove (*Zenaida macroura*), Greater Roadrunner (*Geococcyx californianus*), Western Screech-Owl (*Otus Kennecotti*), Great Horned Owl (*Bubo virginianus*), Belted Kingfisher (*Ceryle alcyon*), Northern Flicker (*Colaptes auratus*), Western Kingbird (*Tyrranus vociferans*), Barn Swallow (*Hirundo pyrrhonota*), Scrub Jay (*Aphelocoma coerulescens*), Black-billed Magpie (*Pica pica*), Common Raven (*Corvus corax*), American Crow (*C. brachyrhynchos*), Black-capped Chickadee (*Poecile atricapilla*), Canyon Wren (*Catherpes mexicanus*), American Robin (*Turdus migratorius*), Mountain Bluebird (*Sialia currucoides*), Western Meadowlark (*Sturnella neglecta*), Brown-headed Cowbird (*Molothrus ater*), Spotted Towhee (*Pipilo maculatus*). Common species during migration and winter includes Great Blue Heron (*Ardea herodias*), Northern Shoveler (*A. clypeata*), Ring-Necked Duck (*A. collaris*), Common Merganser (*Mergus merganser*), Sandhill Crane (*Grus canadensis*), American Coot (*Fulica americana*), Ring-Billed Gull (*Larus pipixcan*), Dark-eyed Junco (*Junco hyemalis*), and White-crowned Sparrow (*Zonotrichia leucohhrys*).

Sandhill Cranes formerly used Jemez Canyon Dam as an overnight roosting area during fall migration. Evacuation of the reservoir during fall 2001 resulted in 87 Sandhill Cranes becoming trapped in deep fine sediments near the dam. A total of 14 were successfully rescued and released with 73 mortalities attributed to entrapment.

Amphibians and reptiles known to occur in or near the project area include tiger salamander (*Ambystoma tigrinum*), plains spadefoot (*Sciaphiopus bombifrons*), Woodhouse toad (*Bufo woodhousei*), northern leopard frog (*Rana pipiens*), bullfrog (*R. catesbeiana*), painted turtle (*Chrysemys picta*), spiny softshell turtle (*Trionys spiniferus*), lesser earless lizard (*Holbrookia maculata*), eastern fence lizard (*Sceloporus undulates*), plateau whiptail (*Cnemidophorus velos*), checkered whiptail (*C. tesselatus*), western hognose snake (*Heterodon nascius*), coachwhip (*Masticophis flagellum*), glossy snake (*Arizona elegans*), common gartersnake (*Thamnophis sirtalis*), western hognose snake (*Heterodon nascius*), and western diamondback rattlesnake (*Crotalus atrox*) (Degenhardt *et al*. 1996).

Cochiti Lake is primarily a warm-water fishery consisting of northern pike (*Esox lucius*), walleye (*Sander vitrius*), black bullhead, channel catfish, common carp, white bass (*Morone chrysops*), smallmouth bass (*Micropterus dolomieui*), largemouth bass, green sunfish (*Lepomis cyanellus*), white crappie (*Pomoxis annularis*), black crappie (*Poxomis nigromaculatus*), and bluegill (Ortiz 2001). The

New Mexico Department of Game and Fish occasionally performs supplemental stockings of walleye, largemouth bass, and channel catfish in the lake.

In 1998 through 2000, the Service's Fishery Resources Office completed three surveys of fishes in the lower Rio Jemez in cooperation with the Pueblo of Santa Ana. Common carp was the most abundant fish, followed by white sucker, fathead minnows, and Rio Grande silvery minnow (USFWS 2000). Fish surveys conducted near the confluence of the Rio Jemez and Rio Grande have found that the abundant fish species included red shiner, flathead chub, and western mosquitofish, followed by white sucker, fathead minnow, and RGSM, gizzard shad, longnose dace, and channel catfish (Lang and Platania 1993, Dudley *et al*. 2006). The fish fauna in the river within the former reservoir pool has not been documented. Fish would be expected to disperse into the reservoir pool during temporary storage and back into the river during evacuation.

In a study of the Middle Rio Grande, Plateau Ecosystems Consulting, Inc. (2001) identified 14 fish species within the Cochiti Pueblo reach below the dam. Most common are the longnose dace (*Rhinichthys cataractae*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), white sucker (*Catostomus commersoni*), black bullhead (*Ictalurus melas*), channel catfish (*Icalurus punctatus*), common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), river carpsucker (*Carpiodes carpio*), and bluegill (*Lepomis machrochirus*).

3.07. ENDANGERED AND THREATENED SPECIES

Three agencies have a primary responsibility for the conservation of animal and plant species in New Mexico: the Service, under authority of the Endangered Species Act of 1973 (as amended); the New Mexico Department of Game and Fish, under the authority of the Wildlife Conservation Act of 1974; and the New Mexico Energy, Mineral and Natural Resources Department, under authority of the New Mexico Endangered Plant Species Act and Rule No. NMFRCD 91-1. State of New Mexico regulations do not apply to Pueblo and tribal lands. Each agency maintains a list of animal and or plant species that have been classified or are candidates for classification as endangered or threatened based on present status and potential threat to future survival and recruitment. Of these species, those with potential to be affected by the proposed action are discussed below.

Southwestern Willow Flycatcher

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

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

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

Southwestern Willow Flycatchers arrive in New Mexico in late May and early June (Yong and Finch 1997). Breeding activity begins immediately and young may fledge as soon as late June. Late nests and re-nesting attempts may not fledge young until late summer (Sogge and Tibbitts 1992; Sogge *et al.* 1993).

Occupied and suitable flycatcher nesting habitat occurs within the Middle Rio Grande Valley in the 230-mile reach between Velarde and San Marcial: approximately 44 breeding pairs or territorial males were identified in 2004 surveys, approximately 30 were found in 2005 (USBR and USACE 2006) and more than 37 were know to be present in 2006 (USBR 2006a). The largest breeding concentration of flycatchers along the Rio Grande occurs at the headwaters of Elephant Butte Lake (downstream from San Marcial) where 130, 107, and 142 pairs or territorial males were present in 2004 through 2006, respectively (USBR 2006a). Occupied and suitable habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's willow and peachleaf willow, Rio Grande cottonwood, coyote willow, and salt cedar. The nearest known breeding flycatchers from Cochiti Lake occur along the Rio Grande near San Juan Pueblo approximately 39 miles upstream.

As previously described, approximately 167 acres of shrub wetlands consisting primarily of Gooding’s and coyote willow occur upstream from Cochiti Dam along the Rio Grande within White Rock Canyon. At least half of this acreage is estimated to be up to 10 feet in height. Shrub stands are small (mean = 2.7 acres, median = 1.0 acre; N = 61) and scattered along a 6.5-mile reach. Six willow stands range in size from 5 to 11 acres, and a large, 42-acre stand occurs near the mouth of the canyon. Therefore, it is likely that a small portion of this area may be suitable breeding habitat for the flycatcher. Any of these willow stands could be used by flycatchers during migration.

Remoteness and limited accessibility make regular surveys for willow flycatchers very difficult in the 20-mile-long White Rock Canyon. The National Park Service has performed protocol surveys within the Bandelier National Monument portion of the canyon in 1994, 1995, 1997, and 2001. A small number of migrant, but no breeding, flycatchers have been observed during formal and informal surveys within this reach (*pers. comm.*, Stephen Fettig, Biologist, Bandelier Nat. Mon., April 2007).

The 400-acre delta at the upstream end of Jemez Canyon Dam consists of a variety of wetland and riparian vegetation communities, including extensive stands of coyote willow, often mixed with salt cedar. Flycatcher surveys conducted since 2002 have noted migrant, but not breeding birds (*pers. comm.*, Glenn Harper, Department of Natural Resources, Pueblo of Santa Ana, 2008).

Critical habitat for the SWFL was designated throughout its range in July 1997 (USFWS 1997); however, that rule was vacated in 2001 as a result of litigation. The Service re-designated critical habitat in October 2005 (USFWS 2005). Critical habitat does not occur at Cochiti Lake or Jemez Canyon Dam. Critical habitat has been designated along the Rio Grande beginning approximately 66 miles downstream from Cochiti Dam and extending downstream for 104 miles (excluding Sevilleta and Bosque del Apache National Wildlife Refuges). The proposed operational deviation would affect flow within this designated reach.

Reduced frequency of spring overbank flooding and the lack of sediment for seed germination, has resulted in monotypic age-class stands of older cottonwood trees, and increased encroachment of saltcedar and Russian olive between Cochiti Lake and the headwaters of Elephant Butte Reservoir (Howe and Knopf 1991). Overbank flooding creates shallow, low velocity backwaters, to maintain and restore native riparian vegetation for SWFL habitat downstream of Cochiti Lake (USFWS 2003a). The lower frequency of large peak flows contributes to channel incision and the elimination of overbank flooding, limiting development of suitable riparian SWFL habitat. Peak spring flow of 5800 cfs is anticipated to produce sufficient overbank flooding for germination of native riparian species.

Rio Grande Silvery Minnow

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

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

The RGSM is a moderately sized, stout minnow, reaching 3.5 inches in total length, which spawns in the late spring and early summer, coinciding with high spring snowmelt flows (Sublette *et al*. 1990). Spawning also may be triggered by other high flow events such as spring and summer thunderstorms. This species produces neutrally buoyant eggs that may drift downstream with the current (Platania 1995) and use floodplain habitats for nursery areas (Pease *et al.* 2006). The eggs may drift considerable distances at lower flow volumes during spawning (Bestgen and Platania 1991, USFWS 1993a, Platania 1995). Maturity for this species is reached toward the end of the first year. Most individuals of this species live one year, with only a very small percentage reaching age two (Sublette *et al*. 1990, Bestgen and Platania 1991, USFWS 1993a).

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

Channel narrowing by encroachment of non-natives forming a single-threaded channel reduces the quantity and quality of silvery minnow critical habitat (USFWS 2003a). Flows that produce overbank flooding create pointbars and islands that function as nursery areas essential for recruitment (Fluder et al. 2007). The shallow backwaters that form on the terraces, pointbars, islands and arroyo confluences are a component of silvery minnow critical habitat. Past actions have reduced the total habitat from historic conditions and altered habitat conditions for the RGSM. Narrowing and deepening of the channel, lack of side channels and off-channel pools, and changes in natural flow regimes have all adversely affected the RGSM and its habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (USFWS 1993a). In addition, flood control and diversion dams block upstream migration and restrict the species' redistribution. The coarser substrate, deeper channel, and higher velocities that occur in the incised channel downstream of the Cochiti Dams do not provide the conditions where large numbers of RGSMs are known to occur.

Inundated floodplains provide nursery habitat for many riverine larval fish (Coutant, 2004) to escape the current and initiate feeding, including silvery minnows (Pease, 2004). Recent channel incision through much of the Middle Rio Grande has abandoned the historical floodplain (Massong et al. 2006), significantly reducing access to floodplain nursery habitats during years with reduced runoff discharge (Porter and Massong 2004). In-channel surfaces (bank attached bars and islands) provide floodplain-like surfaces when spring flow reaches 2000-3000 cfs (Tashjian and Massong 2006).

Since it was listed as endangered in 1994, the RGSM population gradually declined through 2003 (also an extended period of drought conditions in New Mexico). During 2004 and 2005, the population increased nearly to its size at the time of listing in response to sustained flows of both moderate and exceptional discharge in the middle Rio Grande (see Figure 5). The population rebounded in 2007 from a population index (CPUE) of 1.37 / 100 m^2 (Dudley and Platania 2006) to 9.96 / 100 m^2 (Dudley and Platania 2007b).

Nursery habitat studies demonstrated utilization of inundated pointbars by silvery minnows during the recruitment flow manipulation at Cochiti Reservoir (Reclamation 2007). A total of 2,173 RGSM eggs were collected in 189 of the 2,525 kicknet and 785 seine samples (total 3,310). There were 324 silvery minnows among the 5,865 fish captured during the study. The timing and nursery habitat components (depth, vegetation, other variables) used by RGSM larvae requires more quantification by focused studies.

The RGSM population index (based on standard sampling methodology at 20 locations) has been found to be positively correlated to peak annual discharge within the Middle Rio Grande (Dudley and Platania 2008). Figure 6 illustrates this relationship from 1993 to 2008 (Dudley and Platania 2008). . At Albuquerque, the catch rates of minnows during October was significantly correlated (p<0.001) with the annual number of days that discharge exceeded 2,000 or 3,000 cfs. Similarly, the number of days that discharge exceeded 2,000 cfs at the San Marcial gauge was highly correlated (p<0.001) with the October catch rate. These results, along with the significant population increase observed in 2004 in response to relatively moderate spring discharges, indicate that target flows for successful RGSM recruitment be 2,500 to 3,000 cfs for 7 to 10 days at Albuquerque. The lower catch rates in 2007 and 2008 (Figure 6) indicate additional factors regulating the RGSM recruitment that require quantification.

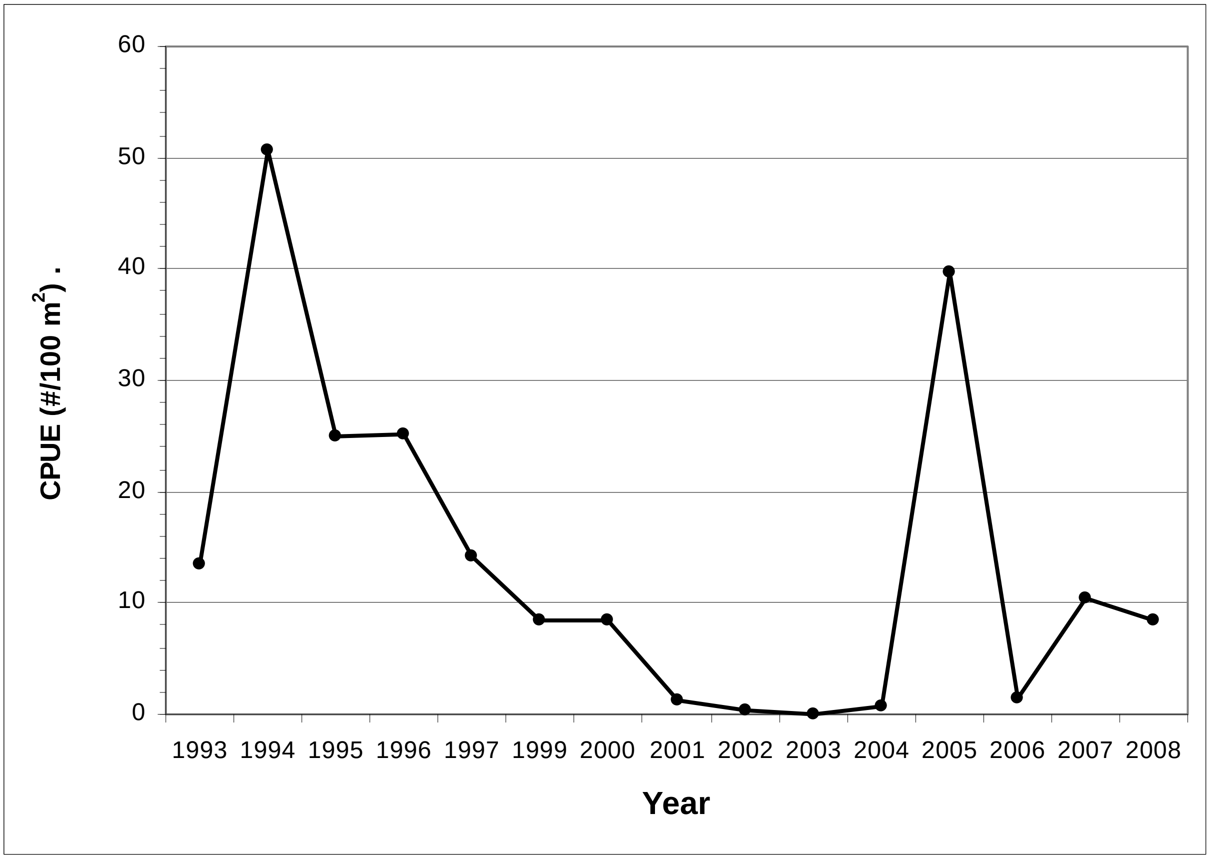

Figure 5. Rio Grande silvery minnow catch rates (catch per unit effort, CPUE) during October, 1993-1997 and 1999-2008.

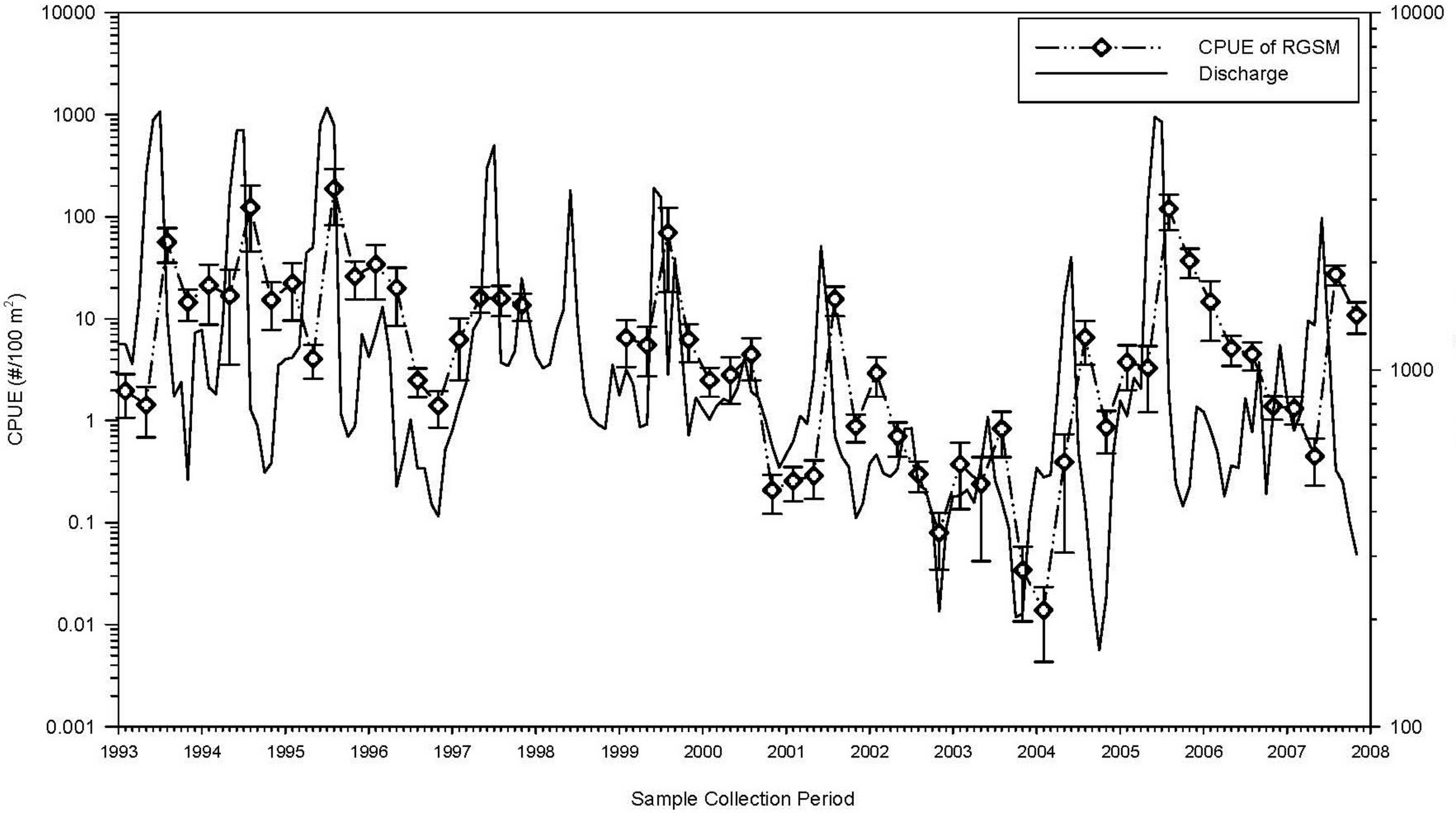

Figure 6. Time sequence of quarterly Rio Grande silvery minnow catch rates at population monitoring sites and discharge at the Albuquerque gauge. Diamonds indicate sample means for each survey and capped bars represent the stand error. (From Dudley and Platania 2008.)

3.08. CULTURAL RESOURCES

Cultural History

The proposed action at Cochiti Lake and the Jemez Canyon Dam are within the Northern Rio Grande archaeological region as defined by Wendorf and Reed as the Northern Rio Grande Region (Rodgers 1979:16). This brief cultural overview is based on the results of survey and excavation conducted by the Office of Contract Archeology for the National Park Service and the Corps in the mid-1970s, resulting in the four-volume set of archaeological research at Cochiti Dam (e.g., Biella and Chapman 1979).

The approximately 12,000 years of cultural interaction in this area has been subdivided into broadly defined periods based on constellations of artifacts recovered archaeologically. The ecological characteristics of the action areas on both pueblos, and of the surrounding region, include semiarid with low productivity, and seasonal and annual variability of rainfall and temperature. The primary adaptation to this ecosystem for the 10,000 years was a hunter-gatherer adaptation that relied on short-term resource exploitation and frequent moves. The earliest sites date between approximately 10,000 B.C. and 5,500 B.C. and represent the Paleo-Indian big-game hunters of the now extinct Pleistocene megafauna. Clovis Points (10,000 B.C. to 9,000 B.C.), generally associated with mammoth, and Folsom Points (9,000 B.C. to 8,000 B.C.) associated with the extinct *Bison antiquus* are found in isolation and at small sites. Other extinct game animals include camel, sloth, and horse. No sites from this time period occur in the area of the proposed project. Most Paleo-Indian sites in the nearby Albuquerque area have been recorded during survey, although some excavation occurred prior to housing construction on the west mesa. The range of site types identified includes tool manufacturing, resource processing related to hunting, and base camps occupied for longer periods of time. Many of these sites are on high ground with unobstructed views (Rodgers 1979:16-17). Following the Folsom Period a series of Paleo-Indian Point types have been recognized in the Southwest and New Mexico. These include Hell Gap, Midland, Plainview, Milnesand, Meserve, and Scottsbluff. Diagnostic Paleo-Indian spear points are generally lanceolate-shaped with central flutes removed from both sides of the point's stem; other tools that have been recovered include scrapers, knives, perforators, and informally utilized flakes. While plant gathering and processing occurred, the artifacts associated with these activities have not been generally recognized.

The Archaic Period extends from approximately 5,500 B.C. to A.D. 400 and represents a continuation of the hunting-gathering adaptation; however, the population of plants and animals is similar to those found today. The absence of the Pleistocene mega-fauna represents the primary difference from the preceding Paleo-Indian Period. Both large and small animals were hunted and trapped. Based on the increasing presence of grinding stones, manos and metates, it is clear that the processing of plants became more important later in the Archaic period. Towards the end of the Archaic, longer-term habitation sites that include shallow pit houses are found in areas of the Southwest including central New Mexico. Two major changes occurred towards the end of the Archaic. Indications of maize appear in the archaeological record by about 2,000 B.C.; however, maize became relatively more common after 1,000 B.C, although it was not a major food resource until after 500-700 A.D. The second major change was the appearance of the bow and arrow by about A.D. 400 or 500. The result was the replacement of the spear and spear thrower as the primary weapon. Archaic-period sites were recorded during the 1975 archaeological survey of the Cochiti proposed reservoir pool area. Several lithic scatters lacking diagnostic projectile points, but possibly from the Archaic Period, occur within the Jemez Canyon Dam area. Limited activity Archaic Period sites without diagnostic projectile points, especially those exposed on the surface, can be difficult to identify and are recorded as temporally unknown sites. The undiagnostic lithic scatter is the most commonly recorded site in the state of New Mexico, as represented in the state's Laboratory of Anthropology data base. Along the Rio Grande within northern and central New Mexico, the Archaic–Period inhabitants are referred to as the Oshara Tradition. This Period is subdivided into six temporal phases based on differing diagnostic projectile points and other tools (Rodgers 1979:16-18; Bayer 1994: 250-252).

The Archaic Period is succeeded by the Ancestral Pueblo Period. Depending on the location within New Mexico, between three and five major temporal phases are recognized and are based on a host of characteristics, including house forms and construction techniques, settlement patterns, pottery types, and other elements of material culture. While hunting and gathering continued, reliance on agricultural products continually increased. Pit house villages, some with larger communal structures, indicate larger social groups living in one location for longer periods of time. Through time there is a transition from pit house villages to living and storage rooms on the surface while a few below ground structures are used for communal and religious purposes. As populations increased, these small surface houses were replaced with large rock and or adobe buildings of up to several hundred rooms. Not all of the rooms were necessarily occupied at once, as older portions were replaced by newer and, in some cases, larger rooms.

The Developmental Period dates between A.D. 600 and 1200 and can be subdivided into Early and Late depending on the predominance of either pit house or above- ground architecture. Early in the period the associated ceramics are similar to those found throughout northern New Mexico; later in time the stylistic attributes, including paint, design, and temper, become more locally diagnostic. The Coalition Period, A.D. 1200 to 1325 marked a more intensive use of the Pajarito Plateau, north of the project location. There was a change in the decorated pottery from mineral-base to carbon-base painted pottery and, as suggested by the number, size, and distribution of larger permanent habitation and seasonally-specific special-use sites, there was a marked increase in the population. The Classic Period, A.D. 1325 to 1600, spans the time of the widest settlement distribution, the largest sites, and the earliest Spanish contact, beginning with the Coronado Expedition in 1540. After several additional exploratory expeditions, the first permanent Spanish occupation in New Mexico began in 1598 near the present location of Ohkay Owingeh (San Juan) Pueblo. Glaze-painted pottery was introduced for the first time. Increasingly severe and widespread droughts and a variety of impacts from European colonizers including new diseases and resettlement of the Indians disrupted the native populations. Through time there was a gradual consolidation of the population into relatively few settlements (Rodgers 1979:18-22; Bayer 1994:252-255).

The Historic Period is characterized by rapid change and acculturation between the Indians, Spanish, Mexicans, and Americans. The Period, dating from about A.D. 1540 to the present, can be divided into seven phases reflecting differing aspects of social interaction. These phases include Spanish Exploration, followed by Colonization, the Pueblo Revolt, Spanish and Mexican Colonial, United States Territorial, and Statehood.

Currently, there are four major linguistic groups among the Pueblo Indians of the Southwest—Zuni, Uto-Aztecan (Hopi), Tanoan, and Keres. There are seven major dialects of Keres, including the western groups of Acoma and Laguna; and the eastern groups of Santo Domingo, San Felipe, Cochiti, Zia, and Santa Ana. There is general agreement among researchers and the eastern Keres that the recent ancestral homeland of Cochiti and Santa Ana, after A.D. 1300, included locations in the Puerco River area and the Jemez Mountains, including the Pajarito-Frijoles River areas, locations adjacent to the Rio Grande, the Galisteo Basin and perhaps the site of Paa-ko on the eastern side of the Sandia Mountains. However, there is less agreement concerning their ancestor's location prior to A.D. 1300. Based on a variety of materials recovered archaeologically, including ceramics, many believe that their ancestors originated from the general area around Mesa Verde and the Four Corners of New Mexico, Colorado, Arizona, and Utah. There is also a general agreement that many Keresan ancestors lived in the Galisteo Basin particularly in and around the region of turquoise deposits and San Marcos Pueblo (Akins 1993:139-144; Bayer 1994:247-266).

Cochiti Lake Archaeological Survey

The intensive archaeological survey for the Cochiti Reservoir was conducted in two stages in early to mid-1975. The first area to be surveyed was the permanent pool, and the second was the flood control pool; this sequence was adopted so that any required excavations could be completed in advance of the rising water following completion of the dam. The standards employed for the archaeological work were up to the requirements of that era. The interval between the surveyors varied from 10 to 15 meters depending on terrain and vegetative cover and both archaeological sites and isolated occurrences were recorded (Biella and Chapman 1977:173-175). These are the standards generally used today.

A total of 325 archaeological sites were documented; 102 within the boundaries of the permanent pool and 223 in the flood control pool. Twenty of these sites were previously recorded by others. The majority of the sites are either nonstructural artifact scatters frequently associated with hearths or small one- to three-room structures with associated artifact scatters. Only one large pueblo (200 to 400 rooms) was recorded. Additional classes of sites included rock shelters, depressions, agricultural terraces, corrals, pens, and petroglyphs. Any single site location may contain remains from several temporal periods. At the time of the surveys, there were approximately 90 artifact scatters, 187 ancestral Pueblo sites, and 85 historic-period sites. There are three major periods of occupation represented by the sites: Late Archaic, 800 B.C. to A.D. 400; ancestral Pueblo, A.D. 600 to A.D. 1600; and Historic, A.D. 1540 to the present (Biella and Chapman 1977:201).

Traditional cultural properties occur within and adjacent to the Cochiti Lake projects.

Jemez Canyon Dam Archaeological Survey

No archaeological work occurred at the time of the 1950 to 1953 Jemez Dam construction; however, two archaeological surveys were conducted in conjunction with later undertakings at the dam. The first survey was conducted in 1977. The survey included a 200-foot wide road right-of-way for an entrance road to the dam from Highway 44, the realignment of the old haul road into the canyon, and a 10-acre overlook recreation area. A total of 10 limited activity sites were discovered. These included one prehistoric ceramic and lithic scatter from the Classic Period; four undiagnostic lithic scatters; one field house with no associated artifacts; two small habitation structures with associated corrals; and two religious sites (Ward 1977).

The second archaeological investigation, a survey of 1,200 acres in the flood pool, occurred in 1979 in conjunction with the establishment of a permanent 2,000 acre-foot sediment pool. A total of 18 archaeological sites and 17 locations of isolated artifacts were recorded. Seven prehistoric sites; six early historic sites, dating after A.D. 1550; and five sites from the recent historic, after A.D. 1700, were recorded. The kinds of sites recorded include petroglyphs, lithic scatters, habitation, agricultural, and ranching.

No excavations were conducted. During the survey, a small number of sherds and lithics were collected in order to accurately determine their typological categories. These artifacts were returned to the Pueblo in 1980 (Rodgers 1980). Traditional cultural properties occur within and adjacent to the Jemez Canyon Dam projects.

3.09. SOCIOECONOMICS

Cochiti Lake and Jemez Canyon Dam are in Sandoval County. The county is roughly 3,709 square miles in size, with approximately 24.2 persons per square mile. It is generally rural in character and has one minor urban center. The Town of Bernalillo (the county seat) and City of Rio Rancho have populations of 6,611 and 51,765, respectively, in 2000 (Table 1). Both communities are considered “bedroom communities” of the Albuquerque metropolitan area. The total population of Sandoval County in 2000 was 89,908 (U.S. Census Bureau 2000a).

Principal employment sectors include agriculture and service. Over the past 25 years, the Pueblo of Santa Ana has developed a successful agricultural enterprise centered on the production and processing of organic blue corn products. Other natural resource enterprises include sand and gravel mining and a native plant nursery. Extensive recreational and entertainment attractions include the Santa Ana Star Casino, the Prairie Star Restaurant, a 27-hole golf course, and a 22-field soccer complex. The Tamaya Hyatt resort opened in December 2000.

Socioeconomic resources include population and economic activity, as reflected by personal income, employment distribution, and unemployment. Some related secondary components, such as housing availability and public services, are not considered in this analysis because the action has no potential to generate measurable changes in populations that would create demand for these resources. Statistics at the county, state, and national level will be used to describe the socioeconomic context. Sandoval County serves as the Region of Influence in which most impacts can be expected to occur, and the state and region serve as regions of comparison.

In 2000, Sandoval County had a per capita personal income (PCPI) of $22,247. This PCPI ranked fifth in the State of New Mexico, and was 101 percent of the State of New Mexico average of $21,931, and was 75% of the national average of $29,469. In 1990, the PCPI of Sandoval County was $14,404 and the county ranked ninth in the State. The average annual growth rate of PCPI over the past 10 years was 4.7 percent. The average annual growth rate for the State of New Mexico was 3.9 percent and for the nation was 4.2 percent (BEA 2002a,b).

The demographics at the county, state, and national levels are compared in Table 1. When compared to the national level, the population of Sandoval County has proportionately more persons of Hispanic background, while less of other minority groups, including Asian and Black. However, racial composition is similar to the state as a whole, with a higher percentage of American Indian and Alaska Native (17.2 percent compared to 10.5 percent for New Mexico). It should be noted that persons of Hispanic or Latino origin might be White or any other race. In addition, roughly 14.4 percent claimed to be of some other race, while only 5.5 percent did so at the national level. When compared to New Mexico, Sandoval County has a lower percentage of Hispanics. Consequently, the population of Sandoval County is not disproportionately composed of minority groups compared to the region, although there may be specific locations where this is not the case.

Table 1. Profile of Demographic Characteristics, Year 2000.

Geographic Area	Total Population	Race (Percent of Total Population)*						
		White	Black or African American	American Indian & Alaska Native	Asian	Native Hawaiian & Pacific Islander	Some Other Race	Hispanic or Latino (of any race)
U.S.	281,421,906	75.1	12.3	0.9	3.6	0.1	5.5	12.5
New Mexico	1,819,046	69.9	2.3	10.5	1.5	0.2	19.4	42
Sandoval County	89,908	68.1	2.2	17.2	1.5	0.2	14.4	29.4
Bernalillo (Town)	6,611	63.3	1.0	4.6	0.3	0.2	34.3	74.8
Rio Rancho (City)	51,765	82	3.4	3.4	2.1	0.3	13.1	27.7

* Percentages may add to more than 100% because individuals may report more than one race.
(Source: U.S. Census Bureau 2001a,b.)

The percentage of the population in New Mexico living below poverty (19.3 percent) is higher than for the nation (13.3 percent). Similarly, the percent of children living below poverty in New Mexico (27.5 percent) is considerably higher than the nation (19.3 percent). Poverty conditions in Sandoval County are somewhat better than the state, with 12.9 percent below poverty and 17.7 percent of children below poverty. Therefore, Sandoval County, when compared to the state, is not disproportionately low-income (U.S. Census Bureau 2000a, b).

3.10. INDIAN TRUST ASSETS

Indian Trust Assets (ITA) are legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of trust assets include land, minerals, hunting and fishing rights, and water rights. The United States has an Indian Trust Responsibility to protect and maintain rights reserved by or granted to Indian tribes or individuals by treaties, statues, executive orders, and rights further interpreted by the courts. This trust responsibility requires that all federal agencies take all actions reasonably necessary to protect such trust assets.

The principal ITAs under consideration for this action are Indian Trust Lands that would be inundated during temporary storage deviation. The Pueblo lands that would be inundated during a deviation are within the flood control pools for Cochiti Lake and Jemez Canyon Dam. The Corps has coordinated with the Pueblo de Cochiti and the Pueblo of Santa Ana with the effects on Indian Trust Lands in the respective flood control pools.

3.11. RECREATION

Cochiti Lake Project

Public recreation facilities have been developed at two primary areas at Cochiti Lake: the Cochiti (west shore) and Tetilla Peak (east shore) Recreation Areas. Recreation activities include camping; picnicking; cold-water fishing; sailing and boating (at "no wake" speeds); sail-boarding; swimming; sightseeing; and wildlife viewing. The highest visitation at the lake occurs during the months of April through September. Overall, there is sustained public use of the area throughout the year. The Visitation Estimation and Reporting System (VERS) utilized by the Corps defines a “visit” as the entry of one person into a recreation area or site to engage in one or more recreation activities. A “visit” is a “head count” of visitors and does not measure amount of use or length of stay.

The Visitation Estimation and Reporting System program estimates percentages of visitors participating in various activities based on a recreation use survey conducted in 1991. Visitors entering a recreation area were surveyed to document the types of recreational activities that they planned to participate in during their visit. Table 2 provides information on the principle recreational activities that visitors participated in while visiting Cochiti Lake in the months of May, and June from 2005 to 2008. Visitation was higher at both recreation areas during the period of flood storage (2005) than in subsequent years.

Table 2. Distribution of recreational activities at the two Cochiti Lake recreation areas (estimated number of visits per month).

		Cochiti Recreation Area							
		2005		2006		2007		2008	
		May	June	May	June	May	June	May	June
Sightseeing	36.9%	11893	11111	7151	9773	7635	10266	7305	10391
Fishing	25.2%	4310	4026	2591	3542	2767	3720	2647	3765
Picnic	22.4%	5955	5563	3581	4894	3823	5140	3658	5203
Boating	20.2%	2645	2471	1590	2173	1698	2283	1624	2311
Swimming	13.4%	6014	5618	3616	4942	3861	5191	3694	5254
Camping	11.6%	2979	2783	1791	2448	1912	2571	1830	2603
		Tetilla Peak Recreation Area							
		2005		2006		2007		2008	
		May	June	May	June	May	June	May	June
Sightseeing	36.9%	7915	6565	4098	5639	4950	6169	4660	6468
Fishing	25.2%	11359	9422	5882	8093	7105	8853	6687	9283
Picnic	22.4%	6739	5590	3490	4802	4215	5252	3968	5507
Boating	20.2%	9644	8000	4994	6871	6032	7517	5678	7882
Swimming	13.4%	4175	3463	2162	2975	2611	3254	2458	3412
Camping	11.6%	5445	4517	2819	3879	3406	4244	3206	4450

Public access to Santa Fe National Forest land in White Rock Canyon is very limited and no recreational facilities exist within this reach. Within Bandelier National Monument, visitors can enjoy hiking, sightseeing, and wildlife viewing within Frijoles Canyon to its confluence with the Rio Grande. Monument lands downstream from Frijoles Canyon comprise a designated wilderness area and public access for backpacking and hiking is relatively low, in accordance with National Park Service policy.

Jemez Canyon Dam Project

At Jemez Canyon Dam, the Corps maintains a picnic area near the dam overlooking the reservoir. There are no recreational facilities around or within the reservoir sediment pool.

4.0 FORESEEABLE EFFECTS OF THE NO-ACTION AND PROPOSED ACTION ALTERNATIVES

In the draft Environmental Assessment for the proposed action, impacts were evaluated based on the storage levels needed for recruitment and overbank flows. The temporary storage of native Rio Jemez flow may begin in early March. The temporary storage of native Rio Grande flow may begin about mid-April.

4.01. PHYSICAL ENVIRONMENT

The no-action and proposed action alternatives would not adversely affect geology and soils.

Cochiti Lake Project

The no-action and proposed action alternatives would not adversely affect agricultural or grazing lands and practices at the Pueblo de Cochiti, or prime agricultural lands downstream from the dam. Groundwater levels in the agricultural fields located immediately downstream of Cochiti Dam are affected by fluctuating reservoir levels rather than fluctuations in the Rio Grande. To help mitigate this downstream response to reservoir water surface levels, drains were designed and installed in the areas of concern (USACE 1990). Models used for the design of the drains assumed pool elevations higher and for longer durations than those described for this proposed deviation. Therefore the deviation described should not adversely affect current operation and capacity of the drains.

Jemez Canyon Dam Project

The proposed deviation would alter current sediment transport within the Jemez Canyon Dam and delivery of the reservoir sediments to the Rio Grande. Sediment would be deposited during storage with only some of the finer sediments being remobilized during the final stages of drawdown. At present, most of the sediment transport occurring in the reservoir, occurs during spring runoff; without sediment transport occurring during the normal runoff, the impact would be long-term storage of sediments in Jemez Canyon Dam.

Rio Grande Channel

The Corps would coordinate releases from Cochiti Lake and Jemez Canyon Dam during regularly scheduled conference calls among Middle Rio Grande reservoir operators and stakeholders (USFWS 2003a). This coordination would ensure successful recruitment flow and overbank flooding while delivering water to all stakeholders.

Inundation of the wetlands, islands and pointbars for 5-10 days would provide spawning and rearing areas for RGSM recruitment and suitable conditions for riparian habitat. The general trends of channel incision and coarsening would be expected to remain unchanged for both the no-action and proposed action alternatives. Supply of fine-grained sediment would decrease under the proposed action alternatives, as it would be stored in the Jemez Canyon Dam. Deposition of fine-grained sediments in RGSM habitats would be faster under the proposed alternative simply because flows would inundate those surfaces more often. However, the rate of sedimentation is not expected to adversely affect the habitat as the total supply of sediment decreases under the proposed alternative. As the peak flows would be augmented under this proposal, the location of sediment deposition would likely shift in elevation, as some sediment would deposit on higher less frequently flooded surfaces. Sedimentation onto Santa Ana Habitat Restoration projects, may occur, but may be less than current rates as the total sediment supply would decrease, while volume of water is increasing. The sediment subsequently mobilized from Jemez

Canyon Dam during normal flows following the proposed action would be transported downstream and deposited along the river channel in a pattern similar to the no action alternative. The sedimentation of wetlands, islands and pointbars at Santa Ana would be similar between the proposed action and no-action alternatives, with only a slight increase on the higher elevation surfaces under the proposed action.

4.02. LAND USE

The proposed deviation at Cochiti Lake and Jemez Canyon Dam with the resulting increase in water surface elevation and subsequent drawdown for the durations cited does not pose any dam safety concerns for this project; provided the ongoing concrete investigation does not reveal concrete integrity issues in the Outlet Works Tower at the dam. There are no anticipated differences in land use between normal runoff conditions when the deviation would not be implemented, compared to the no-action and proposed action alternatives.

4.03. HYDROLOGY AND WATER QUALITY

Executive Order 11988 (Floodplain Management) provides Federal guidance for activities within the floodplains of inland and coastal waters. Preservation of the natural values of floodplains is of critical importance to the nation and the State of New Mexico. Federal agencies are required "to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management." The proposed work would not contribute to or result in any additional development of the Rio Grande or Rio Jemez floodplains, or the shorelines of Cochiti Lake or Jemez Canyon Dam.

The proposed storage of native Rio Grande flow would slightly decrease downstream discharges for approximately two weeks prior to peak runoff. Active storage in Corps Reservoirs would only occur when native flows exceed downstream irrigation demands. Water may be held in storage for 5 to 90 days prior to its release. The timing, duration, and magnitude of storage for the proposed action is similar to past flood control storage operation at Cochiti Lake and Jemez Canyon Dam since they began operations. No significant or unusual effects on the hydrology or water quality of the Rio Grande or Rio Jemez are foreseen.

Because storage would be limited to the ascending limb of the spring runoff hydrograph, the expected peak discharge would not be reduced by the proposed action. Rather, the peak discharge would be increased by approximately 500 to 1,000 cfs by the proposed action. Reclamation has a shared 2003 Biological Opinion responsibility with the Corps to provide recruitment flows. If Reclamation determines sufficient supplemental water is available and appropriate for use in a given year to meet the 2003 Biological Opinion instream flow targets, then additional supplemental water could be made available to offset all or part of the depletions associated with recruitment flows. Reclamation will not provide supplemental water to offset depletions associated with overbank flows. The no-action alternative would not affect hydrology, losses, or water quality. Should Reclamation utilize Supplemental Water from upstream reservoirs to facilitate recruitment flows, the passage of that water through Cochiti Lake would not alter the expected surface water elevation.

Normal operation would continue at Cochiti Lake and Jemez Canyon Dam in regards to flood and sediment control. The Corps may evacuate the described temporary pools, or any portion thereof, as necessary for flood control purposes, in accordance with authorized project purposes. The Corps further reserves the right to take such measures as may be necessary to preserve life and property, including being able to meet emergency situations or to permit maintenance or repair of the dams or appurtenant structures. Regulation and releases will be accomplished with the Corps service gates and the Corps will not be liable or responsible for any loss of the stored waters resulting from releases made to accomplish the project's flood control purpose or due to any malfunction of the service gates or inspection and maintenance of the gates that may be necessary to assure the proper and safe operation of the projects. If all parties agree on the deviation, it is expected that the Corps will be the lead agency in making release decisions in consultation with the Service, Reclamation, MRGCD, and the Rio Grande Compact Engineer Advisers.

We do not anticipate any flood threat from this operation. Approximately 4% of the flood space will be needed for this deviation at Cochiti Lake if storing for recruitment flows and approximately 10% would be needed if the maximum amount (45,000 acre-feet) is stored for overbanking flows. At Jemez Canyon Dam storage would take place in the sediment pool, therefore it would have no impact on the flood storage space for this deviation if storing for recruitment flows or overbanking flows. The amount of storage at Jemez Canyon Dam is limited by the volume available in the sediment reserve space which is approximately 25,000 acre-feet. If the runoff forecast increased sufficiently and flood space was needed, the water would not be stored and any stored water under the deviation would be immediately evacuated. Therefore, it does not impair the existing flood control regulation/operation at the project.

The maximum change in elevation at Cochiti Lake is approximately 5 to 13 feet for recruitment storage and 18 to 25 feet for storage of overbanking flows. The maximum change at Jemez Canyon Dam is approximately 10 to 41 feet for either recruitment storage or overbanking flows. If both projects are used in conjunction to store, then the elevation changes would vary and be less than the stated maximums, depending on the amount of storage required in each project.

Since the middle Rio Grande basin is fully appropriated any additional depletions resulting from a proposed action would need to be offset. Temporarily storing water during snowmelt runoff for spawning and recruitment, or overbank flows results in additional depletions on the system. Appendix A describes the methodology used in determining depletion losses from the proposed actions.

The no-action and proposed action alternatives would not encourage or induce floodplain development as addressed in Executive Order 11988.

4.04. BIOLOGICAL RESOURCES

Executive Order 11990 (Protection of Wetlands) requires the avoidance, to the extent possible, of long- and short-term adverse impacts associated with the destruction, modification, or other disturbances of wetland habitats.

Cochiti Lake Project

The timing, duration, and magnitude of storage for the proposed action at Cochiti Dam are similar to that of flood control storage activities since 1974. Plant species in the wetland and riparian habitats within White Rock Canyon are adapted to periodic inundation. Willows (*Salix nigra* and *S. exigua*) can survive flooding for more than 60 days and exhibit increased growth when inundated (Ohmann et al. 1990, Amlin and Rood 2001). Most plant species are beginning to break dormancy in late-April and early May when inundation due to reservoir storage would begin, and temporarily submerged plants would generate new growth following the evacuation of stored water.

The majority of riparian willow habitat occurs within the southern 5-mile reach of White Rock Canyon, and the substrate is one to two feet high at the channel bank. Willows range from 5- to 12-feet in height. Given the elevations of the stands most susceptible to inundation, willow communities in White Rock Canyon would not be adversely affected by 60-day inundation up to elevation 5,350 feet (NGVD 1929), and up to 45 days of flooding above that elevation (Figure 7). The maximum duration of the proposed storage scenarios is estimated to be 60 days starting before April 15th up to an elevation of 5,350 feet (Figure 1A), and 45 days starting by May 1st for elevations above 5,350 feet.

As in past years, inundation would not be detrimental to the growth and survival of wetland and riparian communities within White Rock Canyon, as demonstrated by the 60% increase in these communities since 1993. The proposed overbank storage is anticipated to be significantly less than the 60 days. Flood storage in 1991 and 2005 exceeded the maximum storage for the proposed overbank flow objective (Figure 1A). Inundation in 1991 probably contributed to the re-establishment of riparian vegetation in White Rock Canyon. Inundation of the riparian areas during 2005 flood storage did not adversely impact the vegetation. The proposed peak storage for overbanking would probably occur 14 days earlier than peak storage in 2005. The lower peak elevation (~3 ft relative to the peak inundation in 2005) with a two week shift earlier in the growing season should minimize adverse impacts of inundation to riparian vegetation prior to leafout. The proposed overbank storage should provide some beneficial effects for the riparian vegetation in White Rock Canyon. The proposed storage for the recruitment flow objective (Figure 7) would inundate less area in the delta for a shorter period, with reduced impacts or benefits. The Corps would monitor the depth of flooding in White Rock Canyon and follow up with a site visits later in the growing season to determine plant response to the proposed temporary inundation.

Jemez Canyon Dam Project

The fairly extensive wetland and riparian vegetation at the Jemez Reservoir delta would not be adversely affected by the proposed plan. The delta area would still be subject to periodic inundation by river flow at the current frequency. Temporary storage might benefit invasive plant species already present in the delta, but probably would not increase the area already colonized. Groundwater levels within and immediately adjacent to the existing pool would increase during the proposed action.

Terrestrial wildlife species utilizing plant communities bordering the Rio Grande and Rio Jemez would be temporarily displaced from these communities by inundation during the planned deviation. Again, this short-term (10 to 90 days) effect would be no different from that of the existing flood storage regime at either reservoir. Under the proposed action, aquatic species (e.g., waterfowl and fish) would have greater access to inundated areas and food resources than under the no-action alternative.

Storage would occur during the spring migration period followed by evacuation in May and June. The proposed evacuation period should avoided possible entrapment of migratory wading birds. The level of fish mortality during reservoir evacuation would be a function of Rio Jemez flow connectivity. Fish mortality should be minimal since reservoir evacuation would be timed for peak flow on the Rio Grande, when there should still be adequate flow for fish movement back into the Rio Jemez.

Rio Grande Channel

Inundation of the islands and pointbars for 5-10 days during spawning and recruitment flows would support RGSM population growth, provide temporary habitat for fish and other aquatic species, support riparian vegetation on in-channel features like pointbars and low islands, and cycle nutrients between terrestrial and riverine ecosystems. Overbank flows would increase the quality of ecosystem functions supported by recruitment flows, improve existing riparian vegetative growth, and support development of additional riparian habitat along the edges of the active channel. The proposed deviation would increase the frequency of hydrographs supporting RGSM recruitment and riparian habitat development as required by 2003 Biological Opinion (USFWS 2003a).

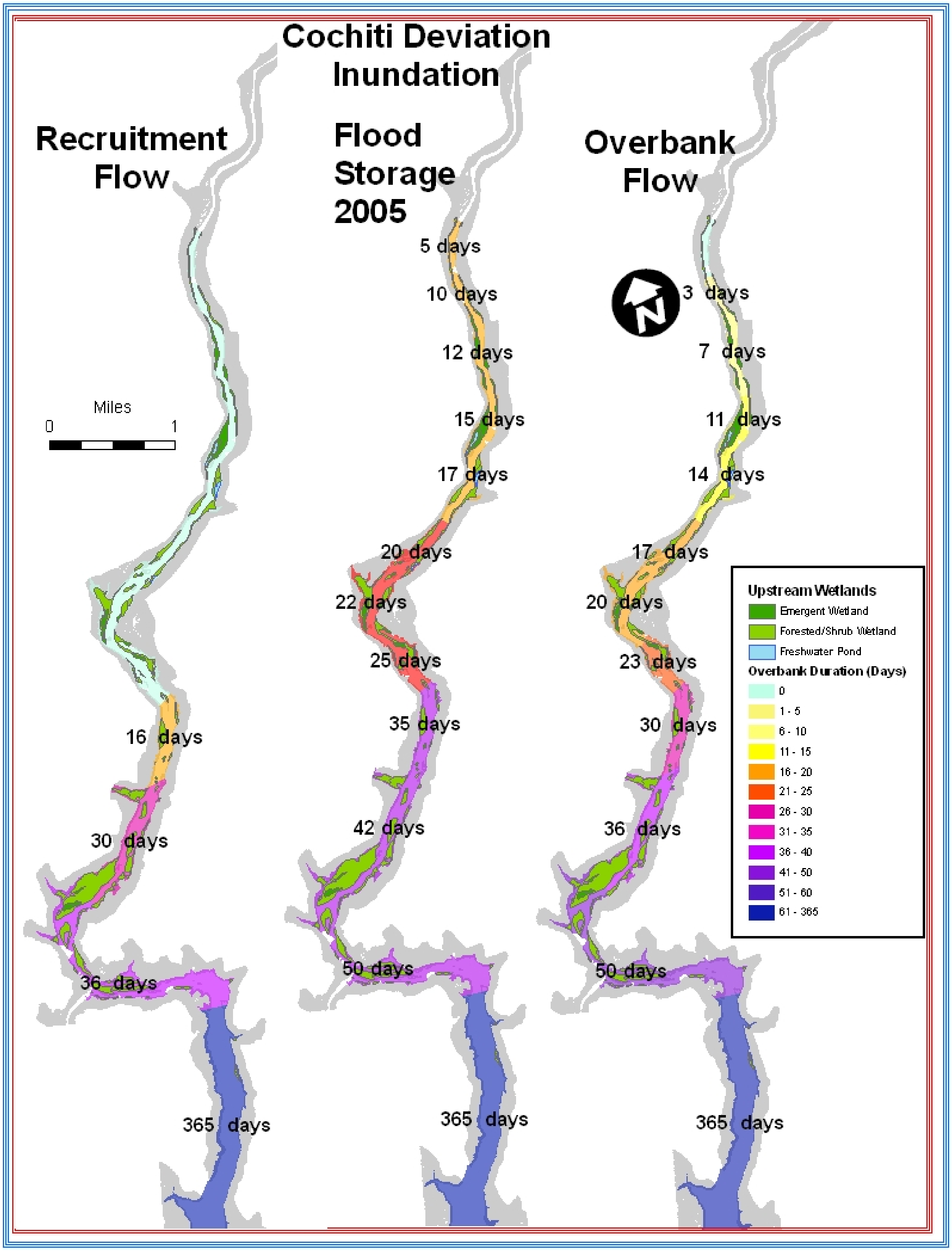

Figure 7. Estimated inundation periods (days) for upstream river reaches during storage for the recruitment and overbank flow objectives compared to flood storage in 2005.

4.05. ENDANGERED AND THREATENED SPECIES

Cochiti Lake Project

The proposed action could displace migrant Southwestern Willow Flycatchers from inundated emergent and shrub wetland habitats in the southern portion of White Rock Canyon. Suitable foraging habitat and cover exists immediately upstream and approximately 8 miles downstream from the inundated reach. It is the Corps' determination that the proposed action may affect, but would not adversely affect, the endangered Southwestern Willow Flycatcher within the Cochiti Lake reservoir pool.

Jemez Canyon Dam Project

There are no known populations of SWFL or RGSM within the Jemez Canyon Dam Pool.

Rio Grande Channel

Recruitment flow would increase in-channel riparian habitat quality and area, while overbank flow would increase riparian habitat quality and area adjacent to the active channel. Increasing riparian area and quality provides additional SWFL nesting habitat along the river corridor. It is the Corps' determination that the proposed action may affect, but would not adversely affect, the endangered Southwestern Willow Flycatcher along the Rio Grande corridor.

The proposed action may affect, but would not adversely affect the endangered RGSM. Rather, the species is expected to directly benefit from the increased spawning and recruitment potential provided by augmented flows in the Middle Rio Grande. Similarly, the proposed action would not adversely modify designated Critical Habitat for the minnow downstream from Cochiti Dam, but would improve aquatic habitat conditions due to the timely increase in discharge. During informal consultation pursuant to Section 7 of the Endangered Species Act, the Corps will request concurrence from the Service on the Corps' determinations of effects on listed species and designated critical habitat (see Appendix B).

4.06. CULTURAL RESOURCES

The proposed deviation is not a deviation in permitted water levels at the Projects; rather it is a deviation in how and when water is stored, and what it is used for. Both Projects were designed for—and have often held—water levels at or above the maximum proposed water levels throughout the years. The deviation will not impact any archaeological sites or historic properties that have not already been under water for a significant period. For example, at Cochiti Lake, from 1976-2007, there have been an average of approximately 34.5 days per year with water levels within the maximum deviation level, and 27.1 days per year above the proposed deviation. Appendix C, Enclosure 1 details previous inundations at Cochiti for the last three decades. At Jemez, the water level will be consistent with and no greater than the permanent pool from 1986-2000, when the NMISC held 25,000 acre-feet of water per year.

Cochiti Lake Project

The proposed short-term storage of up to 45,000 acre-feet in the Cochiti Lake flood control pool and its schedule of release would impact no new land. The volume of water involved in the planned deviation would increase the elevation of the lake surface by five to twenty-five feet. The change would be from the top of the permanent pool, 5,341 feet above sea level, to 5,366 feet above sea level. This twenty-five foot increment has been at least partially flooded 23 times out of the last 34 years (1975 to 2008), including three years in which the water elevation was continuously above 5,413 feet. It was continuously under water from 1996 through the spring of 1999.

Impacts to historic properties as a result of the proposed deviation are hard to quantify. At Cochiti, 115 archaeological site boundaries intersect the 5,341 to 5,366-foot level (see Appendix C, Figure 1). However, all of these have been underwater multiple times.

The Corps is proposing a five-year study to determine the effects of inundation on artifacts and sites (see Appendix C, Enclosure 2). This experimental study will track artifact movement (aluminum tags and washers) at four study locations (away from archaeological sites), each location containing 11 small artifact arrays. The purpose of this study is to assess adverse effects to historic properties (36 CFR 800.5) due to inundation. The results of the study will be used in consideration of adverse effects and resolution of adverse effects (36 CFR 800.6) for future deviations.

Jemez Canyon Dam Project

The proposed short-term storage of 25,000 acre-feet in the Jemez Canyon Dam sediment pool and its schedule of release would impact no new land. The volume of water involved in the planned deviation would increase the lake surface elevation by approximately ten to forty-one feet from 5,155 feet above sea level (at the staff gage), to 5,196 feet above sea level. The reservoir sediment pool was inundated with 25,000 acre-feet of water most of the period from 1985 to1999.

At Jemez, four sites intersect the 5,155 to 5,196-foot level (see Appendix C, Figure 2). Of these, LA 138836 is a railroad track that will not be affected by this project, LA 19231 is located 20 feet above the proposed water level, and LA 19228 is within the permanent pool and has been buried by sediment. LA 19241, a series of water control features, is partially in the area of deviation, but the area has been periodically covered by water (and sediment) since at least 1958.

Foreseeable Effects

The proposed action is within the activities anticipated prior to dam construction and the consultation. Archaeological surveys and excavations served to mitigate adverse impacts from dam construction and use. Intensive surveys have been conducted for both projects. Part of that use has been water storage for flood control which has, over the past decades, inundated historic properties at both projects. The proposed deviation will not introduce adverse effects of a different kind, but may increase the duration or frequency of inundation. The specifics of this deviation were not anticipated at the time of original construction (Jemez 1953, Cochiti 1975), and may result in unanticipated adverse effects to the sites.

The proposed action would occur on tribal land. The Pueblo de Cochiti and Pueblo of Santa Ana are active partners in this proposed action, and it would only occur with the express consent of the Pueblos.

The Corps has requested via letter dated August 4, 2008 (see Appendix C) that the New Mexico State Historic Preservation Office review the proposed study in order to seek the SHPO's concurrence in the Corps' study to determine the effects of inundation on the historic resources at Jemez and Cochiti. The results of this study would be used to understand and address future projects' effects to historic properties.

4.07. SOCIOECONOMIC RESOURCES

The no-action alternative would have no impacts to socioeconomic conditions in the action area or the region. Recent flood control operations in May and June 2005 (Table 2) did not reduce visitation to the two recreation areas at Cochiti Lake. The proposed action would be anticipated to have similar effects on recreation area visitation, and not adversely affect socioeconomic conditions in the action area or the region from reduced Memorial Day visitation at Cochiti Lake.

4.08. ENVIRONMENTAL JUSTICE

The planning and decision-making process for actions proposed by federal agencies involves a study of other relevant environmental statutes and regulations, including Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. The essential purpose of EO 12898 is to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, tribal and local programs and policies.

Also included with environmental justice are concerns pursuant to EO 13045, Protection of Children from Environmental Health Risks and Safety Risks. This EO directs federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children under the age of 18. These risks are defined as “risks to health or to safety that are attributable to products or substances that the child is likely to come into contact with or ingest.”

The proposed action areas are within Native American pueblos and a county with a relatively high Hispanic population. As described previously, no suitable alternative locations for storage were identified within the Rio Grande basin. The effects of the proposed action are similar in type, extent and magnitude as those associated with flood control storage activities.

No increased risk to the health and safety of citizens or children are inherent in the no-action and proposed action alternatives.

4.09. INDIAN TRUST ASSETS

The proposed action has been closely coordinated with the Pueblo de Cochiti and Pueblo of Santa Ana. The proposed action will not be implemented at either Cochiti Lake or Jemez Canyon Dam without the written agreement of the Pueblos. The no-action and proposed action alternatives would not adversely affect Indian trust assets.

4.10. RECREATION

Cochiti Lake Project

As is the case with flood control storage, the proposed action would necessitate the closure of certain recreational facilities. The swimming beach along the western shore may be inundated for the duration of storage and would be closed to the public for safety reasons for approximately eight weeks. Two vault toilets (constructed to endure periodic inundation) would be pumped, cleaned, and closed from about May 1 through June 15. Public rest rooms would still be available on both the east and west sides of the lake. From about mid-May through early June, the Santa Cruz access road on the east side of the lake — which leads to the preferred sailboarding launch site — would be inundated and inaccessible. Both Universally Accessible Fishing Piers (one on each side of the lake) will be inaccessible from mid-May through mid-June.

An increased of reservoir elevation at Cochiti Lake five feet (or higher) above the permanent pool would result in closure of the swim beach. Increasing the water surface elevation more than 11 feet above the permanent pool would close some picnic shelter and restrooms, require the fishing docks to be moved, closure of one universally accessible fishing dock, close the Santa Cruz road to the Tetilla Recreation Site, and adjustment of the boat ramps. An increase of water surface elevation greater than 25 feet above the permanent pool would result in total closure of day use facilities other than the boat ramps.

The elevation of Cochiti Lake may be approximately three to twenty-five feet higher than normal during Memorial Day weekend which traditionally has the highest public visitation rate over the April through October recreation season. Lake levels have been greater than three feet above the recreation pool elevation on the Memorial Day weekend in 25 times in the past 32 years as a result of flood control storage. Higher visitation during May and June of 2005 (Table 2) than in subsequent years indicates that closure of some facilities due to elevated water surface levels does not adversely impact activities at either of the recreation areas.

Because inundation would only directly affect the shoreline-based activities of swimming, fishing, and windsurfing, the overall impact to recreational opportunities at the Cochiti Lake would not be significant. The Corps will advise recreational interest groups and the general public of the potential closure of facilities through advance notices in local media and through the Corp's campground reservation system.

Jemez Canyon Dam Project

There would be no impacts to recreation facilities at Jemez Canyon Dam.

4.11. CUMULATIVE EFFECTS

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

Over the past several years, extensive efforts have been made towards the survival and recovery of endangered species in the Middle Rio Grande valley. Actions that focus on the RGSM include provision of water for meeting target flows (USACE 2001, USBR 2006b); breeding and rearing facilities; salvage operations; and completed and proposed habitat improvement projects. The proposed deviation in the operation of Cochiti Dam would have a positive impact on the environment and recovery of the RGSM the potential cumulative effects of other Federal and non-federal agencies, pueblos and non-profit groups. Settlement of the Rio Jemez adjudication (United States of America v. Tom Abousleman, CV 83-1041 C) may reduce the volume of water available for temporary storage in Jemez Canyon Dam.

5.0 PREPARATION, COORDINATION AND PUBLIC REVIEW

5.01. PREPARATION

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

Michael Porter – Fishery Biologist
William DeRagon - Biologist
Don Gallegos - Hydraulic Engineer
Ronald Kneebone, Ph.D. - Tribal Liaison
Craig Lykins – Senior Park Ranger, Cochiti Lake
April Sanders - Project Manager
John Schelberg, Ph.D - Archaeologist
Mark Sidlow, P.E. - Hydraulic Engineer

The Albuquerque District Independent Technical Review Team consisted of:

Gregory Everhart - Cultural Resources
Dennis Garcia, P.E. - Reservoir Control
Champe Green, CWB - Ecology and compliance
Cynthia Piirto - Recreation and reservoir operation

5.02. COORDINATION AND CONSULTATION

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

U.S. Bureau of Reclamation, Albuquerque Area Office
U.S. Fish and Wildlife Service
U.S. National Park Service, Bandelier National Monument
Pueblo de Cochiti
Pueblo of Santa Ana
Coalition of Six Middle Rio Grande Basin Pueblos
New Mexico Interstate Stream Commission
New Mexico State Historic Preservation Office
Rio Grande Compact Commission

5.03 COMMENTS RECEIVED AND CORPS' RESPONSES:

The Draft Environmental Assessment (DEA) was available for public review and comment from August 8 to September 7, 2008. A Notice of Availability was published in the Albuquerque Journal on August 8, 2008. The DEA was available on the Corps' website, the Albuquerque / Bernalillo County Public Library, and the Santa Fe Public Library. The comment period was extended by request of several interested agencies until October 22, 2008. Comments were received from: the Bureau of Reclamation (10/22/08); National Park Service (10/17/08); the Pueblo of Isleta (7/22/08); New Mexico Interstate Stream Commission (9/5/08); New Mexico Environment Department (10/9/08); and Terrell H. Johnson (10/22/08).

1. Bureau of Reclamation: The Bureau provided extensive comments via email.

Corps' Response: Concur. The comments received have been addressed by revisions of the Final EA as appropriate. These revisions have contributed to the readability and content of the document.

2. National Park Service: The Service provided comments expressing concerns over effects of inundation to riparian areas in White Rock Canyon.

Corps' Response: Concur with the ecological value the riparian habitat upstream of Cochiti Reservoir. The Corps has been actively communicating with park staff to clarify the possible impacts. Addressing the Service's comments has provided more detailed analyses which have been incorporated into the Final EA as appropriate.

3. Pueblo of Isleta: The letter was included though it was originally sent to the Bureau of Reclamation regarding an issue with sudden increases in flow.

Corps' Response: Concur. The Corps will continue to encourage stakeholders to participate in water operations conference calls during the irrigation season.

4. New Mexico Interstate Stream Commission: The Commission explained their responsibilities regarding the protection, conservation and development of New Mexico's water resources. The Commission has been actively involved in development of methodology to estimate depletions. The Commission expressed their support for the deviation as long as increased depletions are offset by a federal agency.

Corps' Response: Concur. Depletion methodology reviewed and incorporated in the Final EA.

5. New Mexico Environment Department: The Department's comments are in concurrence with the EA. No response required by the Corps.

6. Terrell H. Johnson: Mr. Johnson provided comments expressing concerns over effects of inundation to riparian areas in White Rock Canyon.

Corps' Response: Concur with the ecological value the riparian habitat upstream of Cochiti Reservoir. Analyses to clarify possible impacts have been incorporated into the Final EA.

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Appendix A

Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING
FOR
OFFSET OF DEPLETIONS CREATED
BY THE FIVE-YEAR BRIDGING STRATEGY
FOR DEVIATIONS FROM NORMAL OPERATIONS OF COCHITI LAKE AND
JEMEZ CANYON RESERVOIR

This Memorandum of Understanding ("MOU", "Agreement") is entered into this 18th day of March, 2009 by and between The UNITED STATES OF AMERICA, acting through the Army Corps of Engineers ("USACE"), and the STATE OF NEW MEXICO, acting through the New Mexico Interstate Stream Commission ("NMISC"), collectively referred to as the "Parties."

WHEREAS, USACE, authorized under authority of P.L. 86-645, as amended, and in accordance with 31 U.S.C. §1535 to meet requirements set forth in the 2003 Biological Opinion, operates the Cochiti Lake and Jemez Canyon Reservoirs;

WHEREAS, the NMISC, a statutory agency of the State of New Mexico, is authorized pursuant to §72-14-3 New Mexico Statutes Annotated to do any and all other things necessary to protect, conserve and develop the waters of the State;

WHEREAS, the Rio Grande silvery minnow ("silvery minnow") and the Southwestern willow flycatcher ("flycatcher") are listed by the federal government as endangered under the Endangered Species Act, 16 U.S.C. §§ 1531 et. seq. ("ESA");

WHEREAS, USACE is an action agency under the United States Fish and Wildlife Service's ("USFWS") 2003 Middle Rio Grande Water Operations Biological Opinion ("2003 BiOp");

WHEREAS, in accordance with the Reasonable and Prudent Alternatives contained in the 2003 BiOp, USACE, in coordination with USFWS, shall provide a one-time increase in flows in the Middle Rio Grande between April 15 and June 15 of each year to cue [silvery minnow] spawning ("recruitment flows");

WHEREAS, in accordance with the Reasonable and Prudent Alternatives ("RPA's") contained in the 2003 BiOp, USACE, in coordination with USFWS, shall bypass or release floodwater, if appropriate, during the spring to provide for overbank flooding ("overbank flows");

WHEREAS, in 2007, the Engineer Advisers to the Rio Grande Compact Commission requested that USACE deviate from normal operations of its reservoirs to facilitate recruitment flows for the silvery minnow in the middle Rio Grande ("2007 Deviation");

WHEREAS, due to the success of the 2007 Deviation, USACE plans a deviation from normal operations of the Cochiti Lake and Jemez Canyon Reservoirs as part of USACE's five-year operations bridging strategy ("Bridging Strategy");

WHEREAS, pursuant to Public Law 86-645 (74 Stat. 480), the advice and consent of the Rio Grande Compact Commission is required for the USACE to deviate from normal operations of the Cochiti Lake and Jemez Canyon Reservoirs;

WHEREAS, the NMISC provides technical advice and legal counsel to the Rio Grande Compact Commissioner for New Mexico;

WHEREAS, the USACE is committed to working with the NMISC on the Bridging Strategy, and will also engage the Pueblo de Cochiti, Santa Ana Pueblo technical staff, and USFWS on the Bridging Strategy;

WHEREAS, the Parties have an interest in promoting innovative solutions that conserve and contribute to the recovery of the endangered species while protecting existing and future water uses, and agree on the importance of controlling additional depletions in the Middle Rio Grande.

NOW, THEREFORE, the Parties agree to the following:

BACKGROUND

An increase in river flow during spring and early summer appears to be an important cue for silvery minnow spawning and reproductive success. The silvery minnow is an r-selected fish with highly variable reproductive success associated with spring hydrograph magnitude and duration. Overbank flows can provide inundated habitat on point bars, islands, and in the adjacent bosque for successful silvery minnow recruitment to maintain viable population densities from year to year.

River flow during spring runoff is important for flycatchers on two temporal scales. In the short term (seasonal basis), the presence of overbank flooding to provide low-velocity flooded vegetation has been cited as a key component of the physical structure used by flycatchers in selection of nest locations. In addition, overbank flooding is important for the long- term creation and maintenance of the riparian ecosystem.

DESCRIPTION OF 5-YEAR BRIDGING STRATEGY

The USACE is pursuing a deviation from normal operations at Cochiti Lake and Jemez Canyon Reservoir ("deviation") as part of a five-year Water Operations Bridging Strategy. The strategy entails a range of flexible water operations to provide information essential for the long-term survival of the silvery minnow. The strategy would also contribute essential biological information on the flycatcher. The information obtained from the implementation of the strategy would be considered in ongoing and future consultation under Section 7 of the Endangered Species Act (ESA), as amended, 16 U.S.C. §§ 1531 et seq.

The five-year Bridging Strategy will affect several ongoing or future ESA Section 7 consultations. The proposed actions may partially fulfill the 2003 BiOp RPA A and V requirements. The USACE has completed ESA Section 7 consultation over the specific actions identified in the strategy and has received a concurrence letter from USFWS, dated August 25, 2008, for the "may affect, but not likely to adversely affect" determination. Finally, it is anticipated that the Bridging Strategy initially will be a component of the next middle Rio Grande ESA consultation.

There are two potential actions under the proposed deviation, termed "recruitment flows" and "overbank flows," that are described below. If a deviation is possible and a recruitment or overbanking flow is determined beneficial, the decision on which of the actions will be implemented in a given year will be based, in part, on the spring snowmelt runoff forecasts, available water supply, the status of silvery minnow populations, and whether depletions offsets are in place. The USACE will coordinate annually with the Bureau of Reclamation ("Reclamation"), USFWS, NMISC, Pueblo de Cochiti, Santa Ana Pueblo, and the Rio Grande Compact Commission Engineer Advisers on the implementation of the proposed deviation.

1. Recruitment Flows

The first potential action is the temporary storage and soon-to-follow release of native Rio Grande water to supplement flows in the main stem of the Rio Grande below Cochiti Lake for the benefit of spawning and recruitment of the silvery minnow. Recruitment flows are not necessary every year. USACE will coordinate annually with the USFWS to determine whether a managed recruitment flow is desired for silvery minnow population management.

As part of the spawning and recruitment action, USACE would establish a temporary pool for storage of between 5,000 to 20,000 acre-feet at Cochiti Lake. The water would be stored on the ascending limb of the runoff hydrograph when native flows exceed downstream middle Rio Grande demand, and released at the peak and/or descending limb of the runoff hydrograph. The temporary pool would occur in the flood pool at Cochiti Lake and would begin in late April or early May. The release of stored water for recruitment would be limited to the amount necessary to provide a minimum spawning and recruitment flow at the Albuquerque gage of 3,000 cfs for seven to ten days. It is anticipated that the release of the stored water would not be more than 500 to 1,000 cfs per day above downstream demand flow for 10 days from storage at the project. Release of the stored water is expected to start in mid-May to early June. For this action, the recession of the hydrograph would drop by 250 cfs per day as necessary to reach a flow of 1,500 cfs. In all instances the temporarily stored water would be completely evacuated prior to June 15, with the intention of releasing it prior to the runoff's tailing off, or by June 15, whichever occurs first. None of the stored water would be used to assist with the river recession operations required by the 2003 BiOp RPAs.

2. **Overbank Flows**

The second potential action is temporary storage and soon-to-follow release of native Rio Grande water to supplement flows in the main stem of the Rio Grande below Cochiti Lake and Jemez Canyon Reservoir to provide an overbank condition downstream from Isleta Diversion Dam (just south of Albuquerque), for the benefit of the silvery minnow and the flycatcher. The overbank flow action will be coordinated with USFWS and also with Reclamation due to the latter's river maintenance responsibilities, as well as with other parties, as necessary.

As part of this action, USACE would establish a temporary pool for storage of between 20,000 to 45,000 acre-feet at Cochiti Lake and/or up to 25,000 acre-feet at Jemez Canyon Reservoir. The water would be stored on the ascending limb of the runoff hydrograph when native flows exceed downstream demands, and released at the peak and descending limb of the runoff hydrograph. Storage of the temporary pool would be in the flood pool at Cochiti Lake and would begin in late April or early May. In Jemez Canyon Reservoir, the storage would begin in mid- February or early March. The release of stored water for overbanking would be limited to the amount necessary to provide a minimum flow of 5,800 cfs for 5 days to the Rio Grande at the Albuquerque gage. The maximum combined storage for the overbank flows would be 45,000 acre-feet.

Release of the stored water is expected to start in mid-May to early June. For this action the recession of the hydrograph would drop by 250 cfs per day until reaching a flow of 1,500 cfs. In all instances, the temporarily stored water would be completely evacuated prior to June 15, or prior to the runoff's tailing off, whichever occurs first. None of the stored water would be used to assist with the river recession operations required by the 2003 BiOp RPAs.

3. Storage

The storage of water for the proposed deviations would be accomplished by using Cochiti Lake flood space exclusively for both recruitment and overbank flows, Jemez Canyon Reservoir sediment pool exclusively for overbank flows, or both Cochiti Lake flood space and Jemez Canyon Reservoir sediment pool for overbank flows. In a given year, if the Parties agree on the deviation, the USACE will coordinate with Reclamation, the USFWS, NMISC, Pueblo de Cochiti, Santa Ana Pueblo, and the Rio Grande Compact Commission Engineer Advisers on where the storage will take place and how much storage will be required for the proposed deviation based on hydrological conditions in a particular year.

4. Advice and Consent of the Rio Grande Compact Commission

Pursuant to Public Law 86-645 (74 Stat. 480), the USACE shall not conduct any of the storage and release operations described above without the advice and consent of the Rio Grande Compact Commission to the proposed deviation from normal USACE water operations.

5. Exceptions

The Parties agree that no deviation storage and release operations under the five-year Bridging Strategy will occur in any year in which New Mexico is in an accrued debit status as defined by Articles I(i) and IV of the Rio Grande Compact, unless specifically approved by the Rio Grande Compact Commission. The Parties further agree that no deviation storage and release operations will occur in any year without the annual written approval of the Parties. Native Rio Grande water temporarily stored under the deviation shall only be used to provide recruitment or overbank flows as described above.

OFFSET OF DEPLETIONS

The USACE and NMISC agree upon the importance of controlling additional depletions in the Middle Rio Grande.

For the purposes of this agreement;

1. The USACE will be responsible for the offset of all depletions associated with recruitment flow operations conducted pursuant to this MOU. Offsets may include release during the months of November and December of bulk leased water from upstream reservoirs, or retirement of existing valid pre-1907 surface water rights. Depletions associated with recruitment flows will be calculated as described in Attachment A.

2. The USACE will be responsible for the offset of all depletions associated with overbank flow operations conducted pursuant to this MOU. Offsets may include release during the months of November and December of bulk leased water from upstream reservoirs, or retirement of existing valid pre-1907 surface water rights. Depletions associated with overbank flows will be calculated as described in Attachment B.

3. For the purposes of this agreement, an action shall be characterized either as a recruitment flow or an overbank flow, not a combination of the two. NMISC will verify the accounting for the release of offset water by using the methodologies described in Attachments A and B attached hereto. Such methodologies are solely for use pursuant to this Agreement and are not intended for use outside this MOU. The methodologies described in Attachments A and B may be revised from time to time upon written agreement of the Parties. NMISC will submit requests for offset to USACE in accordance with this MOU in the same calendar year in which the depletions occur. At its sole discretion, NMISC may make water from the Strategic Water Reserve (§72-14-

3.3 NMSA 1978), or some other source, available to USACE for offset use in accordance with this MOU.

WATER RIGHTS EXCLUSION

Nothing in this Agreement shall be construed to create a water right, to support a new appropriation of water on the Rio Grande, or to require the State of New Mexico to grant water rights to any entity. Furthermore, this Agreement shall not be construed as a de facto negotiation of water rights that may adversely impact water users in the Middle Rio Grande or Rio Grande Compact deliveries.

NO EXPANSION OR ABROGATION

Nothing in this Agreement shall be construed to expand, amend or abridge the authority of either the USACE or the NMISC to carry out its legal responsibilities, mandates or contractual obligations. The rights and obligations of the Parties to this Agreement are contractual rights and obligations and shall not be construed to modify in any way the statutory or regulatory authorities of the Parties.

DISPUTE RESOLUTION

In the event of a dispute between the Parties regarding the Agreement, the Parties shall meet in good faith and attempt to resolve such dispute. In addition, as a condition precedent of a party bringing suit for breach of this Agreement, that party must first notify the other party in writing of the nature of the purported breach and seek in good faith to resolve the dispute. If the Parties cannot resolve the dispute, they may agree to an acceptable method of non-binding alternative dispute resolution consistent with the New Mexico Governmental Dispute Resolution Act, §12-8A-1 et seq. NMSA 1978. In the event the Parties agree to seek non-binding alternative dispute resolution, each party will be responsible for its associated costs.

FUNDING

Nothing in this Agreement shall be construed as a commitment of funds in advance of appropriations by any party hereto.

TERM

This Agreement shall remain in effect until it is superseded by a subsequent agreement, or until MARCH 2013 whichever occurs first.

ENTIRE UNDERSTANDING

This Agreement constitutes the entire understanding between the Parties with respect to the subject matters hereof.

Kimberly M. Colloton
LTC, EN
Commanding

3/26/09
Date

Estevan Lopez
Director
New Mexico Interstate Stream Commission

3/18/09
Date

Attachment A

General methodology for estimating depletions associated with a deviation from normal operations for a recruitment action at Cochiti Lake

The U.S. Army Corps of Engineers (Corps) may propose deviating from its normal water control plan at Cochiti Lake during the spring runoff. This document is meant to describe the methods for computing depletions when a deviation from normal operation occurs. During a deviation, the Corps may temporarily store up to 20,000 acre-feet of native Rio Grande water and subsequently release a recruitment flow of 3,000 cfs for 7 to 10 days measured at the Albuquerque (Central Avenue) gage to support environmental needs related to endangered species. This storage deviation and release may result in increased depletions. Example calculations for depletions associated with a recruitment action using 2004 data are shown below. Appendix A provides supporting spreadsheets; Appendix B provides greater detail regarding the modeling rationale, reference materials and assumptions.

Storage in Cochiti Lake

Recruitment Flows

For storage deviations at Cochiti Lake intended to produce recruitment flows, the depletions will be calculated as:

Depletions = (CochEvapWith – CochEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO)

Where:

CochEvapWith = Total evaporation at Cochiti with the deviation
CochEvapWO = Total theoretical evaporation at Cochiti without a deviation
EBEvapWith = Total evaporation at Elephant Butte with the deviation
EBEvapWO = Total theoretical evaporation at Elephant Butte without a deviation
RivEvapWith = Total evaporation from river with deviation
RivEvapWO = Total theoretical evaporation from river without deviation

Individual terms are described below and will be calculated as follows:

CochEvapWith = Total evaporation at Cochiti Lake with the deviation: see Table 1 (Appendix A), which shows example calculations for 2004 total evaporation at Cochiti Lake with the deviation. Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

CochEvapWO = Total theoretical evaporation at Cochiti Lake without a deviation: see Table 1 (Appendix A), which shows example calculations for 2004 total theoretical evaporation at

Cochiti Lake without the deviation. To calculate the theoretical evaporation from Cochiti Lake without the deviation, set outflow equal to inflow during the duration of the deviation. This would be the normal operating procedure and holds the storage constant. Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWith = Total evaporation at Elephant Butte Reservoir with the deviation: see Table 2 (Appendix A), which shows example calculations for 2004 total evaporation at Elephant Butte Reservoir with the deviation. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake in acres, and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWO = Total theoretical evaporation at Elephant Butte Reservoir without a deviation: see Table 2 (Appendix A), which shows example calculations for 2004 total theoretical evaporation at Elephant Butte Reservoir without the deviation. To calculate the theoretical evaporation from Elephant Butte Reservoir had there been no deviation, add the cumulative Rio Grande native storage at Cochiti Lake (the storage over the hold pool that normally would have been allowed to pass) to the daily total storage at Elephant Butte Reservoir. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

RivEvapWith = Total evaporation from river/overbank with deviation: see Table 1 (Appendix A), which shows an example calculation of the total evaporation from the river with the deviation. The surface area of river inundation corresponding to a flow at Albuquerque occurring during the deviation period is determined from the curve defined by the most recent version of the FLO2D model (Cochiti to Mile 60), see Figure 1. The RivEvapWith term will use the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches will be used for each day of the deviation (0.35 inches per day is the average ET Toolbox evaporation for all reaches between Cochiti and Elephant Butte Reservoir). Recruitment flows typically do not create significant overbank flooding.

RivEvapWO = Total theoretical evaporation from river/overbank without deviation: see Table 1 (Appendix A), which shows an example calculation of the RivEvapWO term that uses the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches for each day had there been no deviation.

Flow and reservoir storage data will be taken from the USBR Riverware Accounting model. The total duration of the deviation is the number of days from when storage begins until the excess storage is completely evacuated on or before June 15.

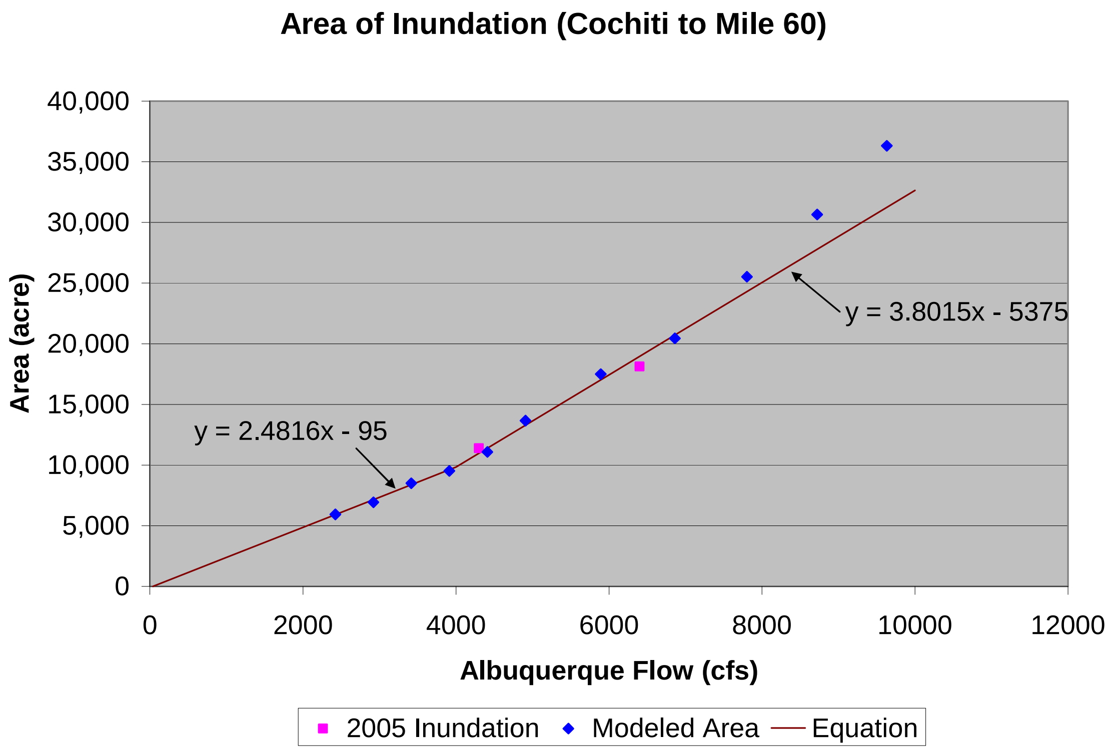


Figure 1: Inundated river area vs discharge @ Cochiti Lake. The FLO 2D total inundated area graph is based on the current Corps FLO 2D model calibrated with the 2005 inundation mapping. The Corps will continue to update the FLO 2D model as new data becomes available and the most current model will be used to compute inundated area.

Example calculations for recruitment flows using 2004 data are shown below. Values for the equation are taken from Tables 1 and 2.

Depletions = (CochEvapWith) – CochEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO)

Depletions = (1,003 – 859) + (13,634 – 13,856) + (4,215 – 4,047) = 90 ac-ft

For the recruitment example, the depletions cost as a percent of water stored using Cochiti Lake would be approximately 1 percent. The amount of water stored using the 2004 data is approximately 10,000 acre-feet.

Table 1 provides a summary of depletions associated with possible recruitment actions at Cochiti Lake using 2004 data. The use of Cochiti Lake provides more efficient storage and release for recruitment actions, incurring less than 1 percent volumetric depletions relative to the amount of water stored.

Table 1. Summary of Depletions Estimates Associated with a Recruitment Action

RECRUIMENT ACTION		
	Cochiti Lake	
Parameter (Units = acre-feet)		
Cochiti Lake Evaporation w/Deviation	1,003	
Cochiti Lake Evaporation wo/Deviation	859	
Elephant Butte Evaporation w/Deviation	13,634	
Elephant Butte Evaporation wo/Deviation	13,856	
River Evaporation w/Deviation	4,215	
River Evaporation wo/Deviation	4,047	
Total Depletion	90	
Volume Stored	9,973	
Volume Depletion loss %	0.90	

(Attachment A)
Appendix A
Recruitment Spreadsheet Tables

Table 1 Cochiti Lake Recruitment Action

	With Deviation													Without Deviation								
Date	Cochiti Rio Grande Inflow (cfs)	Cochiti Rio Grande Outflow (cfs)	Cochiti Rio Grande Storage cumulative (ac-ft)	Cochiti Rio Grande Storage daily (ac-ft/day)	Cochiti Total Storage (actual) (ac-ft)	Computed Elevation (ft)	Computed Area (acre)	Pan Evap (in/day)	Computed Evap (acre-ft/day)	Total Cochiti evap during deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet	Cochiti Rio Grande Outflow (theoretical w/out deviation) (cfs)	Cochiti total Storage (theoretical w/out deviation) (ac-ft)	Cochiti computed Elevation (theoretical w/out deviation) (ft)	Cochiti computed Area (theoretical w/out deviation) (acre)	Cochiti computed Evap (acre-ft/day)	Cochiti total theoretical evap w/out deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet
3/1/2004	559.40	497.60	116.70	#REF!	49747.00	5340.50	1228	0.15	10.75		444	1006	29	557	49549	5340.30	1205	10.54		461	1050	31
3/2/2004	595.00	498.90	304.00	187	49926.00	5340.70	1218	0.23	16.34		379	846	25	593	49541	5340.30	1205	16.17		444	1006	29
3/3/2004	583.10	515.70	465.70	162	50079.00	5340.80	1221	0.23	16.38		399	895	26	598	49532	5340.30	1205	16.17		486	1111	32
3/4/2004	657.40	553.80	676.50	211	50280.00	5340.90	1224	0.23	16.42		525	1207	35	648	49546	5340.30	1205	16.17		603	1401	41
3/5/2004	634.10	556.90	873.90	197	50475.00	5341.10	1232	0.23	16.53		629	1467	43	656	49543	5340.30	1205	16.17		711	1670	49
3/6/2004	630.10	542.00	1059.40	186	50640.00	5341.20	1238	0.23	16.61		493	1127	33	610	49573	5340.40	1209	16.22		589	1367	40
3/7/2004	624.90	578.60	1148.70	89	50719.00	5341.30	1243	0.23	16.68		441	999	29	623	49566	5340.40	1209	16.22		503	1153	34
3/8/2004	648.40	589.40	1262.30	114	50821.00	5341.40	1250	0.23	16.77		451	1024	30	646	49555	5340.30	1205	16.17		498	1142	33
3/9/2004	656.00	593.10	1383.40	121	50930.00	5341.50	1256	0.23	16.85		457	1038	30	654	49544	5340.30	1205	16.17		509	1168	34
3/10/2004	689.20	602.10	1552.00	169	51087.00	5341.60	1264	0.23	16.96		455	1034	30	688	49531	5340.30	1205	16.17		521	1198	35
3/11/2004	733.60	614.20	1784.70	233	51307.00	5341.80	1280	0.23	17.17		451	1025	30	732	49518	5340.30	1205	16.17		537	1238	36
3/12/2004	801.10	617.20	2147.70	363	51658.00	5342.00	1298	0.23	17.41		458	1041	30	801	49505	5340.30	1205	16.17		584	1355	40
3/13/2004	873.10	623.30	2639.10	491	52139.00	5342.40	1338	0.23	17.95		456	1036	30	872	49495	5340.30	1205	16.17		648	1513	44
3/14/2004	975.50	636.00	3308.00	669	52796.00	5342.90	1386	0.23	18.60		451	1023	30	974	49484	5340.30	1205	16.17		714	1678	49
3/15/2004	994.90	664.40	3958.60	651	53436.00	5343.30	1418	0.23	19.02		440	997	29	994	49472	5340.30	1205	16.17		754	1777	52
3/16/2004	1018.20	698.80	4584.50	626	54052.00	5343.80	1447	0.23	19.41		481	1100	32	1,017	49460	5340.30	1205	16.17		793	1872	55
3/17/2004	1020.70	809.10	4997.10	413	54453.00	5344.00	1456	0.23	19.53		586	1360	40	1,019	49448	5340.30	1205	16.17		867	2056	60
3/18/2004	1034.50	1032.00	4994.10	-3	54439.00	5344.00	1456	0.23	19.53		707	1660	48	1,033	49436	5340.20	1201	16.11		861	2041	60
3/19/2004	1064.00	1061.60	4991.00	-3	54424.00	5344.00	1456	0.23	19.53		903	2145	63	1,062	49423	5340.20	1201	16.11		929	2211	64
3/20/2004	1039.40	1036.20	4987.50	-4	54408.00	5344.00	1456	0.23	19.53		1011	2413	70	1,037	49409	5340.20	1201	16.11		1011	2415	70
3/21/2004	1069.00	1067.00	4984.20	-3	54392.00	5344.00	1456	0.23	19.53		947	2256	66	1,068	49394	5340.20	1201	16.11		948	2258	66
3/22/2004	1169.90	1168.20	4981.20	-3	54376.00	5344.00	1456	0.23	19.53		926	2203	64	1,169	49380	5340.20	1201	16.11		927	2205	64
3/23/2004	1301.40	1298.40	4977.90	-3	54361.00	5344.00	1456	0.23	19.53		951	2265	66	1,299	49367	5340.20	1201	16.11		952	2267	66
3/24/2004	1416.20	1415.70	4975.10	-3	54345.00	5344.00	1456	0.23	19.53		987	2353	69	1,416	49353	5340.20	1201	16.11		987	2355	69
3/25/2004	1626.80	1622.50	4971.60	-4	54331.00	5344.00	1456	0.23	19.53		1091	2613	76	1,623	49341	5340.20	1201	16.11		1092	2615	76
3/26/2004	1757.40	1755.50	4968.30	-3	54314.00	5343.90	1451	0.23	19.47		1243	2989	87	1,756	49326	5340.20	1201	16.11		1243	2991	87
3/27/2004	1849.70	1847.50	4965.10	-3	54297.00	5343.90	1451	0.23	19.47		1346	3246	95	1,848	49312	5340.10	1196	16.05		1347	3248	95
3/28/2004	1942.50	1941.70	4962.40	-3	54282.00	5343.90	1451	0.23	19.47		1446	3492	102	1,942	49298	5340.10	1196	16.05		1446	3494	102
3/29/2004	1860.90	1859.10	4959.80	-3	54269.00	5343.90	1451	0.23	19.47		1478	3572	104	1,860	49286	5340.10	1196	16.05		1478	3573	104
3/30/2004	1793.20	1791.10	4957.10	-3	54255.00	5343.90	1451	0.23	19.47		1402	3385	99	1,792	49275	5340.10	1196	16.05		1403	3386	99
3/31/2004	1675.90	1673.20	4954.20	-3	54242.00	5343.90	1451	0.23	19.47		1152	2763	81	1,674	49263	5340.10	1196	16.05		1152	2765	81
4/1/2004	1631.90	1273.40	4949.80	-4	54926.00	5344.40	1472	0.32	27.48		891	2116	62	1,262	49974	5340.70	1218	22.74		888	2110	62
4/2/2004	1657.60	1654.90	4946.50	-3	54911.00	5344.40	1472	0.28	24.04		1064	2546	74	1,655	49963	5340.70	1218	19.89		1058	2532	74
4/3/2004	1685.80	1714.80	4946.50	0	54926.00	5344.40	1472	0.01	0.86		1499	3626	106	1,711	49973	5340.70	1218	0.71		1496	3617	106
4/4/2004	1578.10	1543.70	4946.50	0	55045.00	5344.40	1472	0.11	9.45		1886	4586	134	1,538	50094	5340.80	1221	7.83		1882	4575	133
4/5/2004	1390.50	1412.30	4946.50	0	55011.00	5344.40	1472	0.05	4.29		1997	4861	142	1,409	50064	5340.80	1221	3.56		1993	4851	141
4/6/2004	1380.20	1401.90	4944.70	-2	54956.00	5344.40	1472	0.14	12.02		2287	5581	163	1,402	50011	5340.70	1218	9.95		2285	5576	163
4/7/2004	1396.40	1405.20	4943.00	-2	54927.00	5344.40	1472	0.13	11.16		2817	6896	201	1,406	49983	5340.70	1218	9.24		2817	6897	201
4/8/2004	1434.80	1459.40	4943.00	0	54933.00	5344.40	1472	0.19	16.31		2138	5209	152	1,456	49986	5340.70	1218	13.50		2137	5207	152
4/9/2004	1652.40	1623.10	4943.00	0	55009.00	5344.40	1472	0.18	15.46		1652	4003	117	1,620	50065	5340.80	1221	12.82		1649	3997	117
4/10/2004	1606.80	1628.90	4942.20	-1	54961.00	5344.40	1472	0.11	9.45		1610	3901	114	1,628	50019	5340.70	1218	7.82		1608	3896	114
4/11/2004	1515.90	1543.60	4942.20	0	54938.00	5344.40	1472	0.11	9.45		1597	3869	113	1,542	49993	5340.70	1218	7.82		1596	3866	113
4/12/2004	1450.10	1429.00	4941.40	-1	54975.00	5344.40	1472	0.11	9.45		1592	3856	112	1,428	50033	5340.70	1218	7.82		1591	3853	112
4/13/2004	1365.10	1378.10	4938.80	-3	54932.00	5344.40	1472	0.20	17.17		1352	3260	95	1,379	49992	5340.70	1218	14.21		1351	3258	95
4/14/2004	1302.40	1301.50	4935.50	-3	54914.00	5344.40	1472	0.24	20.61		1072	2566	75	1,303	49975	5340.70	1218	17.05		1073	2567	75
4/15/2004	1297.40	1288.60	4931.50	-4	54905.00	5344.40	1472	0.30	25.76		1011	2413	70	1,288	49972	5340.70	1218	21.32		1011	2414	70
4/16/2004	1229.80	1220.40	4926.70	-5	54894.00	5344.30	1468	0.35	29.97		959	2286	67	1,221	49965	5340.70	1218	24.87		959	2286	67
4/17/2004	1252.00	1241.50	4921.60	-5	54883.00	5344.30	1468	0.37	31.68		928	2209	64	1,242	49959	5340.70	1218	26.29		929	2209	64
4/18/2004	1557.80	1548.30	4917.50	-4	54876.00	5344.30	1468	0.30	25.69		1009	2408	70	1,548	49957	5340.70	1218	21.32		1009	2409	70
4/19/2004	1686.90	1667.30	4911.70	-6	54879.00	5344.30	1468	0.42	35.97		1199	2879	84	1,668	49965	5340.70	1218	29.84		1199	2880	84
4/20/2004	1641.30	1637.40	4907.50	-4	54860.00	5344.30	1468	0.31	26.55		1280	3081	90	1,637	49951	5340.70	1218	22.03		1280	3082	90
4/21/2004	1515.10	1496.60	4903.00	-5	54869.00	5344.30	1468	0.33	28.26		1201	2884	84	1,497	49964	5340.70	1218	23.45		1201	2884	84
4/22/2004	1281.60	1268.40	4897.70	-5	54861.00	5344.30	1468	0.39	33.40		1032	2467	72	1,269	49961	5340.70	1218	27.71		1033	2467	72

Date	Cochiti Rio Grande Inflow (cfs)	Cochiti Rio Grande Outflow (cfs)	Cochiti Rio Grande Storage cumulative (ac-ft)	Cochiti Rio Grande Storage daily (ac-ft/day)	Cochiti Total Storage (actual) (ac-ft)	Computed Elevation (ft)	Computed Area (acre)	Pan Evap (in/day)	Computed Evap (acre-ft/day)	Total Cochiti evap during deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet	Cochiti Rio Grande Outflow (theoretical w/out deviation) (cfs)	Cochiti total Storage (theoretical w/out deviation) (ac-ft)	Cochiti computed Elevation (theoretical w/out deviation) (ft)	Cochiti computed Area (theoretical w/out deviation) (acre)	Cochiti computed Evap (acre-ft/day)	Cochiti total theoretical evap w/out deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet
4/23/2004	1235.30	1228.10	4893.60	-4	54850.00	5344.30	1468	0.30	25.69		900	2139	62	1,228	49954	5340.70	1218	21.32		901	2140	62
4/24/2004	1325.50	1314.90	4891.50	-2	54858.00	5344.30	1468	0.17	14.56		902	2142	62	1,315	49965	5340.70	1218	12.08		902	2142	62
4/25/2004	1261.10	1243.90	4888.30	-3	54871.00	5344.30	1468	0.24	20.55		908	2159	63	1,244	49981	5340.70	1218	17.05		908	2159	63
4/26/2004	1239.20	1232.10	4884.00	-4	54858.00	5344.30	1468	0.32	27.40		855	2027	59	1,233	49972	5340.70	1218	22.74		855	2028	59
4/27/2004	1216.90	1210.30	4879.80	-4	54844.00	5344.30	1468	0.31	26.55		813	1922	56	1,210	49963	5340.70	1218	22.03		813	1923	56
4/28/2004	1240.60	1226.40	4874.70	-5	54841.00	5344.30	1468	0.37	31.68		783	1848	54	1,227	49964	5340.70	1218	26.29		783	1848	54
4/29/2004	1320.00	1308.90	4869.20	-6	54828.00	5344.30	1468	0.40	34.25		803	1897	55	1,309	49957	5340.70	1218	28.42		803	1898	55
4/30/2004	1219.60	1208.00	4864.20	-5	54820.00	5344.30	1468	0.37	31.68		835	1976	58	1,208	49953	5340.70	1218	26.29		835	1977	58
5/1/2004	1387.60	1106.80	5404.40	540	55362.00	5344.70	1482	0.17	14.70		807	1907	56	1,380	49957	5340.70	1218	12.08		878	2083	61
5/2/2004	1607.10	1094.60	6370.00	966	56353.00	5345.30	1496	0.30	26.18		717	1684	49	1,585	49980	5340.70	1218	21.32		1002	2392	70
5/3/2004	1781.20	1098.00	7709.70	1,340	57680.00	5346.20	1524	0.32	28.45		668	1563	46	1,777	49965	5340.70	1218	22.74		1173	2815	82
5/4/2004	1999.40	1094.80	9468.10	1,758	59436.00	5347.30	1590	0.41	38.03		633	1475	43	1,986	49962	5340.70	1218	29.13		1341	3233	94
5/5/2004	2058.90	1784.00	9992.70	525	59948.00	5347.70	1614	0.36	33.89		826	1954	57	2,051	49952	5340.70	1218	25.58		1513	3661	107
5/6/2004	2428.60	2410.90	9984.60	-8	59946.00	5347.70	1614	0.40	37.66		1472	3557	104	2,411	49958	5340.70	1218	28.42		1744	4232	123
5/7/2004	2733.20	2722.70	9977.50	-7	59933.00	5347.60	1608	0.35	32.83		2058	5013	146	2,723	49953	5340.70	1218	24.87		2087	5083	148
5/8/2004	2834.80	2819.60	9970.90	-7	59932.00	5347.60	1608	0.33	30.95		2332	5692	166	2,820	49959	5340.70	1218	23.45		2332	5693	166
5/9/2004	3078.40	3060.40	9961.90	-9	59927.00	5347.60	1608	0.44	41.27		2513	6140	179	3,062	49961	5340.70	1218	31.26		2513	6142	179
5/10/2004	3286.00	3508.60	9494.20	-468	59438.00	5347.30	1590	0.51	47.30		2889	7073	206	3,274	49948	5340.70	1218	36.24		2745	6716	196
5/11/2004	3313.80	3547.60	9007.00	-487	58950.00	5347.00	1571	0.26	23.83		3019	7398	216	3,309	49941	5340.70	1218	18.47		2800	6854	200
5/12/2004	3294.10	3558.10	8425.20	-582	58374.00	5346.70	1552	0.58	52.51		3055	7485	218	3,259	49969	5340.70	1218	41.21		2793	6836	199
5/13/2004	3215.20	3524.10	7774.80	-650	57715.00	5346.20	1524	0.51	45.34		3080	7548	220	3,218	49927	5340.70	1218	36.24		2788	6822	199
5/14/2004	3231.20	3538.50	7139.00	-636	57085.00	5345.80	1508	0.23	20.23		3065	7510	219	3,216	49941	5340.70	1218	16.34		2750	6729	196
5/15/2004	3215.40	3587.10	6350.70	-788	56316.00	5345.30	1496	0.36	31.42		3035	7436	217	3,186	49973	5340.70	1218	25.58		2670	6530	190
5/16/2004	3141.00	3621.60	5373.00	-978	55333.00	5344.60	1479	0.35	30.20		3040	7449	217	3,136	49958	5340.70	1218	24.87		2607	6375	186
5/17/2004	2741.60	3318.40	4197.50	-1,176	54145.00	5343.80	1447	0.51	43.05		2924	7162	209	2,723	49959	5340.70	1218	36.24		2400	5860	171
5/18/2004	2446.90	3078.90	2922.00	-1,276	52864.00	5342.90	1386	0.33	26.68		2661	6509	190	2,444	49940	5340.70	1218	23.45		2102	5120	149
5/19/2004	2384.70	2823.70	2005.20	-917	51969.00	5342.30	1327	0.31	24.00		2419	5907	172	2,363	49961	5340.70	1218	22.03		1908	4640	135
5/20/2004	2417.30	2558.10	1698.60	-307	51649.00	5342.00	1298	0.53	40.13		2185	5326	155	2,397	49963	5340.70	1218	37.66		1870	4546	133
5/21/2004	2600.00	2587.50	1695.80	-3	51638.00	5342.00	1298	0.48	36.34		1996	4858	142	2,596	49938	5340.70	1218	34.10		1892	4600	134
5/22/2004	2547.10	2527.80	1693.00	-3	51640.00	5342.00	1298	0.47	35.59		1955	4756	139	2,527	49944	5340.70	1218	33.39		1945	4732	138
5/23/2004	2285.60	2268.80	1690.30	-3	51639.00	5342.00	1298	0.46	34.83		1874	4555	133	2,269	49945	5340.70	1218	32.68		1874	4556	133
5/24/2004	2134.10	2113.70	1687.00	-3	51637.00	5342.00	1298	0.56	42.40		1704	4133	121	2,114	49946	5340.70	1218	39.79		1704	4132	121
5/25/2004	2115.60	2106.20	1684.50	-3	51623.00	5342.00	1298	0.43	32.56		1655	4011	117	2,106	49935	5340.70	1218	30.55		1654	4010	117
5/26/2004	1901.70	2017.30	1422.50	-262	51375.00	5341.80	1280	0.25	18.67		1591	3853	112	1,885	49950	5340.70	1218	17.76		1546	3741	109
5/27/2004	1798.70	2089.20	807.00	-616	50768.00	5341.30	1243	0.42	30.45		1496	3618	106	1,773	49971	5340.70	1218	29.84		1324	3190	93
5/28/2004	1714.70	2117.00	1.60	-805	49935.00	5340.70	1218	0.48	34.10		1506	3641	106	1,708	49951	5340.70	1218	34.10		1193	2865	84
5/29/2004	1524.30	1501.80	0.00	-2	49944.00	5340.70	1218	0.51	36.24		1296	3121	91	1,510	49944	5340.70	1218	36.24		1041	2488	73
5/30/2004	1429.20	1414.10	0	0	49940.00	5340.70	1218	0.47	33.39		921	2191	64	1,414	49940	5340.70	1218	33.39		871	2067	60
										1003			4215						859			4047

Table 2 Elephant Butte Reservoir Recruitment Action

	With Deviation						Without Deviation				
Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft/)
3/1/2004	141,130	4,302.20	6,364	0.23	85.38		141,204	4,302.20	6,364	85.38	
3/2/2004	139,947	4,302.00	6,337	0.25	92.41		140,022	4,302.00	6,337	92.41	
3/3/2004	137,468	4,301.60	6,282	0.09	32.98		137,546	4,301.60	6,282	32.98	
3/4/2004	134,684	4,301.20	6,227	0.12	43.59		134,806	4,301.20	6,227	43.59	
3/5/2004	132,262	4,300.80	6,172	0.11	39.60		132,521	4,300.80	6,172	39.60	
3/6/2004	129,766	4,300.40	6,118	0.23	82.08		130,334	4,300.50	6,131	82.26	
3/7/2004	127,493	4,300.00	6,063	0.24	84.88		128,204	4,300.10	6,077	85.08	
3/8/2004	125,532	4,299.70	6,006	0.24	84.08		126,353	4,299.80	6,025	84.35	
3/9/2004	124,065	4,299.40	5,949	0.25	86.76		125,005	4,299.60	5,987	87.31	
3/10/2004	122,572	4,299.20	5,911	0.19	65.51		123,645	4,299.40	5,949	65.93	
3/11/2004	121,006	4,298.90	5,855	0.2	68.31		122,164	4,299.10	5,892	68.74	
3/12/2004	119,492	4,298.70	5,817	0.37	125.55		120,817	4,298.90	5,855	126.37	
3/13/2004	118,045	4,298.40	5,760	0.18	60.48		119,569	4,298.70	5,817	61.08	
3/14/2004	116,553	4,298.20	5,722	0.18	60.08		118,356	4,298.50	5,779	60.68	
3/15/2004	115,320	4,297.90	5,665	0.2	66.09		117,468	4,298.30	5,741	66.98	
3/16/2004	113,737	4,297.70	5,628	0.31	101.77		116,275	4,298.10	5,703	103.13	
3/17/2004	112,021	4,297.40	5,571	0.4	129.99		115,024	4,297.90	5,665	132.18	
3/18/2004	110,086	4,297.00	5,495	0.4	128.22		113,745	4,297.70	5,628	131.32	
3/19/2004	108,200	4,296.70	5,438	0.38	120.54		112,587	4,297.50	5,590	123.91	
3/20/2004	106,844	4,296.40	5,382	0.37	116.16		111,592	4,297.30	5,552	119.83	
3/21/2004	105,907	4,296.20	5,344	0.37	115.34		110,798	4,297.10	5,514	119.01	
3/22/2004	105,076	4,296.10	5,325	0.39	121.14		109,988	4,297.00	5,495	125.01	
3/23/2004	104,186	4,295.90	5,287	0.2	61.68		109,102	4,296.80	5,457	63.66	
3/24/2004	103,286	4,295.70	5,249	0.2	61.24		108,202	4,296.70	5,438	63.44	
3/25/2004	102,327	4,295.60	5,230	0.46	140.34		107,240	4,296.50	5,400	144.90	
3/26/2004	101,424	4,295.40	5,192	0.32	96.92		106,335	4,296.30	5,363	100.11	
3/27/2004	100,662	4,295.20	5,154	0.49	147.32		105,570	4,296.20	5,344	152.75	
3/28/2004	100,032	4,295.10	5,136	0.46	137.82		104,937	4,296.10	5,325	142.89	
3/29/2004	99,629	4,295.00	5,117	0.45	134.32		104,530	4,296.00	5,306	139.28	
3/30/2004	99,420	4,295.00	5,117	0.35	104.47		104,320	4,295.90	5,287	107.94	
3/31/2004	100,273	4,295.20	5,154	0.42	126.27		105,170	4,296.10	5,325	130.46	
4/1/2004	101,639	4,295.40	5,192	0.32	96.92		106,534	4,296.40	5,382	100.46	
4/2/2004	102,719	4,295.60	5,230	0.36	109.83		107,611	4,296.60	5,419	113.80	
4/3/2004	103,541	4,295.80	5,268	0.21	64.53		108,424	4,296.70	5,438	66.62	
4/4/2004	105,204	4,296.10	5,325	0.21	65.23		110,084	4,297.00	5,495	67.31	
4/5/2004	107,655	4,296.60	5,419	0.23	72.70		112,524	4,297.40	5,571	74.74	
4/6/2004	110,727	4,297.10	5,514	0.13	41.81		115,586	4,298.00	5,684	43.10	
4/7/2004	114,860	4,297.90	5,665	0.28	92.53		119,710	4,298.70	5,817	95.01	
4/8/2004	119,530	4,298.70	5,817	0.31	105.19		124,375	4,299.50	5,968	107.92	
4/9/2004	123,077	4,299.30	5,930	0.31	107.23		127,918	4,300.10	6,077	109.89	
4/10/2004	125,584	4,299.70	6,006	0.25	87.59		130,421	4,300.50	6,131	89.41	
4/11/2004	127,829	4,300.10	6,077	0.1	35.45		132,666	4,300.90	6,186	36.08	
4/12/2004	130,276	4,300.50	6,131	0.1	35.76		135,112	4,301.30	6,241	36.41	
4/13/2004	132,983	4,300.90	6,186	0.18	64.95		137,816	4,301.70	6,296	66.11	
4/14/2004	135,303	4,301.30	6,241	0.34	123.78		140,131	4,302.10	6,351	125.96	
4/15/2004	137,039	4,301.60	6,282	0.38	139.25		141,864	4,302.30	6,378	141.38	
4/16/2004	138,071	4,301.70	6,296	0.58	213.01		142,892	4,302.50	6,406	216.74	
4/17/2004	138,773	4,301.80	6,310	0.61	224.53		143,592	4,302.60	6,419	228.41	
4/18/2004	139,298	4,301.90	6,323	0.61	224.99		144,113	4,302.70	6,433	228.91	
4/19/2004	139,787	4,302.00	6,337	0.62	229.19		144,599	4,302.80	6,447	233.17	
4/20/2004	140,465	4,302.10	6,351	0.46	170.42		145,275	4,302.90	6,460	173.34	
4/21/2004	141,390	4,302.30	6,378	0.34	126.50		146,198	4,303.00	6,474	128.40	

Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft/)
4/22/2004	142,281	4,302.40	6,392	0.52	193.89		147,087	4,303.10	6,488	196.80	
4/23/2004	142,986	4,302.50	6,406	0.6	224.21		147,788	4,303.20	6,502	227.57	
4/24/2004	143,659	4,302.60	6,419	0.38	142.29		148,459	4,303.30	6,515	144.42	
4/25/2004	144,224	4,302.70	6,433	0.38	142.60		149,022	4,303.40	6,529	144.73	
4/26/2004	144,676	4,302.80	6,447	0.4	150.43		149,471	4,303.50	6,543	152.67	
4/27/2004	144,976	4,302.80	6,447	0.43	161.71		149,769	4,303.50	6,543	164.12	
4/28/2004	145,467	4,302.90	6,460	0.4	150.73		150,258	4,303.60	6,556	152.97	
4/29/2004	145,769	4,302.90	6,460	0.47	177.11		150,557	4,303.70	6,570	180.13	
4/30/2004	145,578	4,302.90	6,460	0.63	237.40		150,363	4,303.60	6,556	240.93	
5/1/2004	145,688	4,302.90	6,460	0.37	139.43		150,471	4,303.70	6,570	141.80	
5/2/2004	145,808	4,302.90	6,460	0.37	139.43		150,590	4,303.70	6,570	141.80	
5/3/2004	145,894	4,303.00	6,474	0.39	147.28		150,674	4,303.70	6,570	149.47	
5/4/2004	145,581	4,302.90	6,460	0.46	173.34		150,716	4,303.70	6,570	176.29	
5/5/2004	145,122	4,302.80	6,447	0.36	135.39		150,879	4,303.70	6,570	137.97	
5/6/2004	144,496	4,302.70	6,433	0.46	172.62		151,190	4,303.80	6,584	176.67	
5/7/2004	143,764	4,302.60	6,419	0.51	190.97		151,665	4,303.80	6,584	195.87	
5/8/2004	143,946	4,302.70	6,433	0.49	183.88		152,605	4,304.00	6,611	188.96	
5/9/2004	145,360	4,302.90	6,460	0.49	184.65		154,250	4,304.20	6,639	189.76	
5/10/2004	147,458	4,303.20	6,502	0.51	193.43		156,364	4,304.50	6,680	198.73	
5/11/2004	150,466	4,303.70	6,570	0.49	187.79		159,215	4,305.00	6,748	192.88	
5/12/2004	153,713	4,304.10	6,625	0.82	316.90		162,109	4,305.40	6,803	325.41	
5/13/2004	157,110	4,304.70	6,707	0.73	285.61		165,035	4,305.80	6,858	292.04	
5/14/2004	160,799	4,305.20	6,776	0.42	166.01		168,151	4,306.30	6,927	169.71	
5/15/2004	164,519	4,305.80	6,858	0.56	224.03		171,253	4,306.70	6,981	228.05	
5/16/2004	168,204	4,306.30	6,927	0.56	226.28		174,280	4,307.20	7,050	230.30	
5/17/2004	171,710	4,306.80	6,995	0.56	228.50		177,035	4,307.50	7,091	231.64	
5/18/2004	175,032	4,307.30	7,064	0.64	263.72		179,473	4,307.90	7,146	266.78	
5/19/2004	178,035	4,307.70	7,119	0.6	249.17		181,546	4,308.20	7,187	251.55	
5/20/2004	180,512	4,308.00	7,160	0.68	284.01		183,063	4,308.40	7,215	286.19	
5/21/2004	182,582	4,308.30	7,201	0.71	298.24		184,299	4,308.60	7,242	299.94	
5/22/2004	184,134	4,308.50	7,228	0.72	303.58		185,312	4,308.70	7,256	304.75	
5/23/2004	185,285	4,308.70	7,256	0.72	304.75		186,228	4,308.80	7,269	305.30	
5/24/2004	186,232	4,308.80	7,269	0.72	305.30		187,097	4,308.90	7,283	305.89	
5/25/2004	187,079	4,308.90	7,283	0.71	301.64		187,928	4,309.10	7,311	302.80	
5/26/2004	187,901	4,309.10	7,311	0.57	243.09		188,747	4,309.20	7,324	243.52	
5/27/2004	188,721	4,309.20	7,324	0.37	158.08		189,538	4,309.30	7,338	158.38	
5/28/2004	189,380	4,309.30	7,338	0.54	231.15		190,045	4,309.30	7,338	231.15	
5/29/2004	189,769	4,309.30	7,338	0.54	231.15		190,193	4,309.40	7,352	231.59	
5/30/2004	189,775	4,309.30	7,338	0.54	231.15	13633.69	189,984	4,309.30	7,338	231.15	13856.45

(Attachment A)
Appendix B
Rationale, Reference Material and Assumptions

Rationale, Reference Material and Assumptions made for Cochiti/Jemez Deviation model runs:

General
The URGWOM Accounting model layout was used with minimal rules from the WaterOps/Planning model(s). The model was trimmed down to include only objects from Cochiti to San Marcial.

Alternatives
For the purpose of this deviation of reservoir operations at Cochiti and Jemez, four alternatives are considered: Without Project, Cochiti Conservation storage only, Jemez Conservation storage only, and Cochiti and Jemez Conservation storage. Each alternative run attempts to meet one of two actions: a Recruitment hydrograph, or an Overbank hydrograph, as described below.

Data
Historic inflow and middle valley diversion, etc., data are used as input for the 1975-2005 period.

River Surface Area
The surface area used for evaporation calculations on the Rio Grande between Cochiti and Elephant Butte were obtained from Flo-2D simulations. Documentation of the Flo-2D model can be found in “FLO-2D Flood Routing Model Development Middle Rio Grande Cochiti Dam to Elephant Butte Reservoir250 Foot Grid System”, 2007 and “FLO-2D Flood Routing Model Development Middle Rio Grande Cochiti Dam to Elephant Butte Reservoir 250 Foot Grid System Technical Addendum”, 2008.

Model Setup
The model(s) include the addition of Rio Grande Conservation pools in Cochiti and Jemez for storing and releasing water to supplement flows for Recruitment and Overbanking operations, as described in the March 2003 Biological Opinion (BO) Reasonable and Prudent Alternatives (RPA).

Recruitment Actions
The model represents Recruitment as 3,000 cfs for 7 days at the Rio Grande at Albuquerque (Central) gage. The recession of the hydrograph(s) is required to drop by 250 cfs per day until reaching a flow of 1,500 cfs. The ruleset for the model determines when the peak of the historical peak inflows occurs and then sets the target flow at Central using template values for 30 days for each Recruiment action. The amount to store at Cochiti Lake and which action to attempt to operate to is determined based on the historic NRCS Forecasts at the Rio Grande at Otowi Bridge (Otowi). For Each month from February through April, the historic forecasts are used to determine if conservation storage at Cochiti and/or Jemez
should take place (not too dry, < 50% of average, or too wet, >120% of average). Note the maximum storage for a recruitment action is 20,000 af at either Cochiti Lake. On April 15th , Cochiti Lake can begin to store up to the action requested amount. Because

of the impacts to riparian and wetland vegetation, the model(s) force the conservation storage to be released by June 15. NOTE: There are occasions when the peak of the runoff can occur prior to May 1, or after June 15, thus water may not be captured in time to meet the action hydrograph, or is released prior to meeting the action hydrograph.

Other Assumptions

Set Trap Efficiencies at Cochiti and Jemez to a very low value to not capture sediment over the 30 year period, this keeps the permanent pool elevation from increasing up each year.

Use some of the inflow to counteract losses at Cochiti to keep recreation pool near full (about 50,000 af).

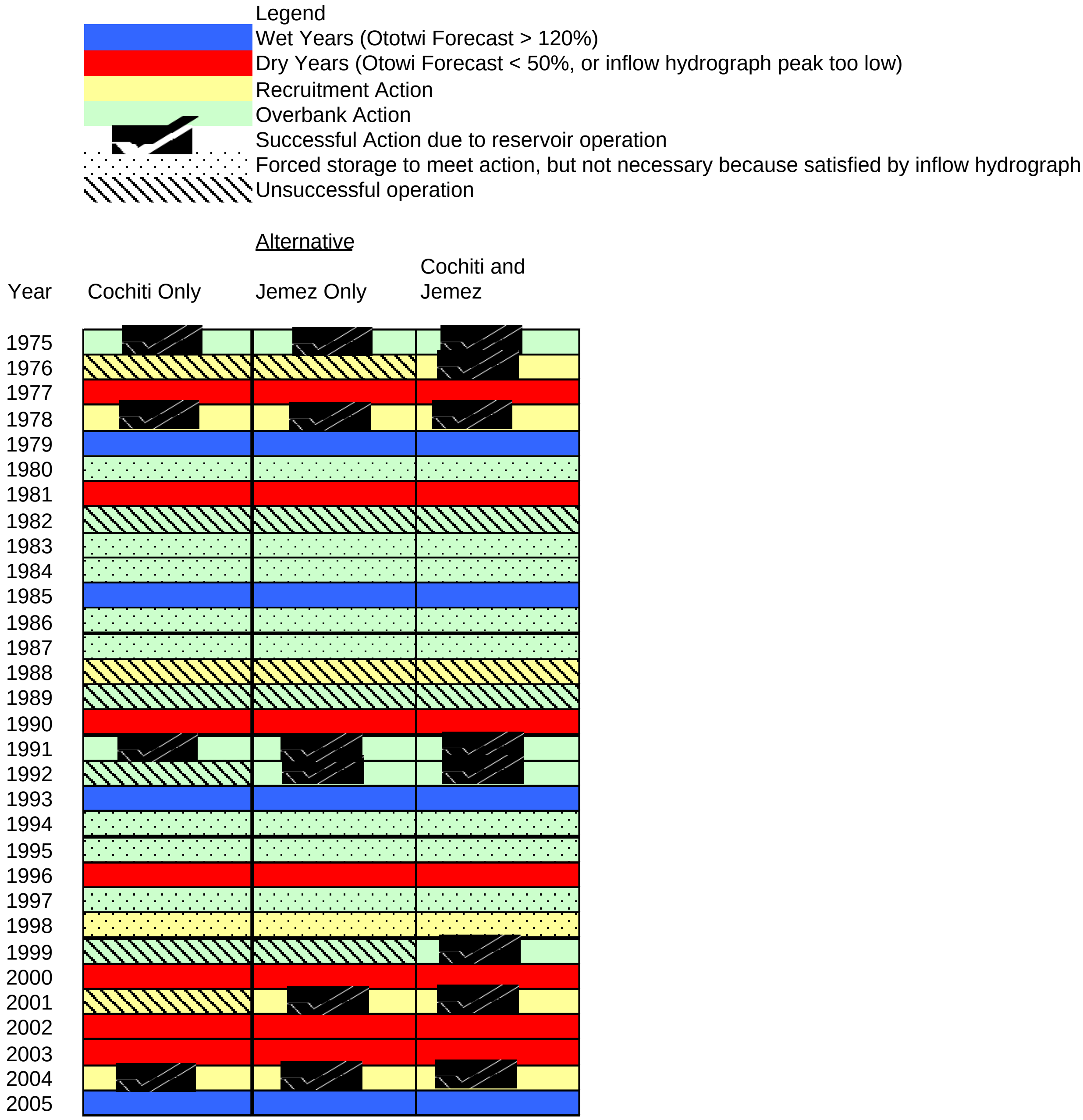
When Cochiti and Jemez are both storing and releasing conservation water, Jemez releases first to meet action.

To attempt to account for extra losses filling an empty Jemez Reservoir, seepage was included as another loss parameter in the mass balance - Seepage Coefficients used:
Base Elevation - 5160 ft (bottom of reservoir)
Slope - 0.4 ft2/s
Intercept - 0cfs
These coefficients result in seepage rates from 0 (when empty) to 14 cfs (when near 25,000 af).

Summary of Recruitment Actions at Cochiti Lake and Jemez Canyon Reservoir

Figure 2 provides an estimate of a recruitment or overbanking action might have been attempted over a 31-year period (1975 to 2005). As shown on Figure 2, recruitment conditions realizing at least 3,000 cfs for 7 to 10 days at the Albuquerque gage (including years with overbanking) occurred in 23 of 31 years. During most of these years (18 of 31), overbanking flows occurred either through naturally wet years or attempted overbank actions. Recruitment actions were attempted only in 6 of 31 years, with a fully successful action occurring in only two of those years. In the other four years, the operation was either not fully successful, or the inflow hydrograph provided a sufficient recruitment flow.

Figure 2. Total Years in model runs: 31 (1975-2005)



NOTE: The figure above is based on Cochiti Lake storing starting May 1 and Jemez Canyon Reservoir on February 1. The number of years could change if storage at Cochiti Lake started on April 15, which is the earliest that an action would take place.

Attachment B

General methodology for estimating depletions associated with a deviation from normal operations for an overbanking action at Cochiti Lake and/or Jemez Canyon Reservoir

The U.S. Army Corps of Engineers (Corps) may propose deviating from its normal water control plan at Cochiti Lake and/or Jemez Canyon Reservoir during the spring runoff. This document is meant to describe the methods for computing depletions when a deviation from normal operation occurs. During a deviation, the Corps may temporarily store up to 45,000 acre-feet of native Rio Grande and subsequently release an overbanking flow of 5,800 cfs for 5 days measured at the Albuquerque (Central Avenue) gage to support environmental needs related to endangered species. This storage deviation and release may result in increased depletions. Example calculations for depletions associated with an overbanking action using 1975 data are shown below. Appendix A provides supporting spreadsheets; Appendix B provides greater detail regarding the modeling rationale, reference materials and assumptions.

Storage in Cochiti Lake

Overbanking Flows

For storage deviations Cochiti Lake intended to produce spawning & recruitment flows with overbank flooding, depletions will be calculated as follows:

Depletions = (CochEvapWith – CochEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO)

Where:

CochEvapWith = Total evaporation at Cochiti with the deviation
CochEvapWO = Total theoretical evaporation at Cochiti without a deviation
EBEvapWith = Total evaporation at Elephant Butte with the deviation
EBEvapWO = Total theoretical evaporation at Elephant Butte without a deviation
RivEvapWith = Total evaporation from river with deviation
RivEvapWO = Total theoretical evaporation from river without deviation

Individual terms are described below and will be calculated as follows:

CochEvapWith = Total evaporation at Cochiti Lake with the deviation: see Table 1 (Appendix A), which shows example calculations for 1975 total evaporation at Cochiti Lake with the deviation. Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

CochEvapWO = Total theoretical evaporation at Cochiti Lake without a deviation: see Table 1 (Appendix A), which shows example calculations for 1975 total theoretical evaporation at Cochiti Lake without the deviation. To calculate the theoretical evaporation from Cochiti Lake without the deviation, set outflow equal to inflow during the duration of the deviation. This would be the normal operating procedure and holds the storage constant. Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWith = Total evaporation at Elephant Butte Reservoir with the deviation: see Table 2 (Appendix A), which shows example calculations for 1975 total evaporation at Elephant Butte Reservoir with the deviation. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake in acres, and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWO = Total theoretical evaporation at Elephant Butte Reservoir without a deviation: see Table 2 (Appendix A), which shows example calculations for 1975 total theoretical evaporation at Elephant Butte Reservoir without the deviation. To calculate the theoretical evaporation from Elephant Butte Reservoir had there been no deviation, add the cumulative Rio Grande native storage at Cochiti Lake (the storage over the hold pool that normally would have been allowed to pass) to the daily total storage at Elephant Butte Reservoir. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

RivEvapWith = Total evaporation from river/overbank with deviation: see Table 1 (Appendix A), which shows an example calculation of the total evaporation from the river with the deviation. The surface area of river inundation corresponding to a flow at Albuquerque occurring during the deviation period is determined from the curve defined by the most recent version of the FLO2D model (Cochiti to Mile 60), see Figure 1. The RivEvapWith term will use the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches will be used for each day of the deviation (0.35 inches per day is the average ET Toolbox evaporation for all reaches between Cochiti and Elephant Butte Reservoir).

To attempt to account for overbank flows that remain ponded in the overbank area after the river has receded into its banks, the area of flooding (the area that is greater than the inundated area at a flow of 5800 cfs) will be doubled for days when flow at the Albuquerque gage is greater than 5800 cfs.

RivEvapWO = Total theoretical evaporation from river/overbank without deviation: see Table 1 (Appendix A), which shows an example calculation of the RivEvapWO term that uses the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches for each day had there been no deviation.

Flow and reservoir storage data will be taken from the USBR Riverware Accounting model. The total duration of the deviation is the number of days from when storage begins until June 15, when the excess storage should be completely evacuated.

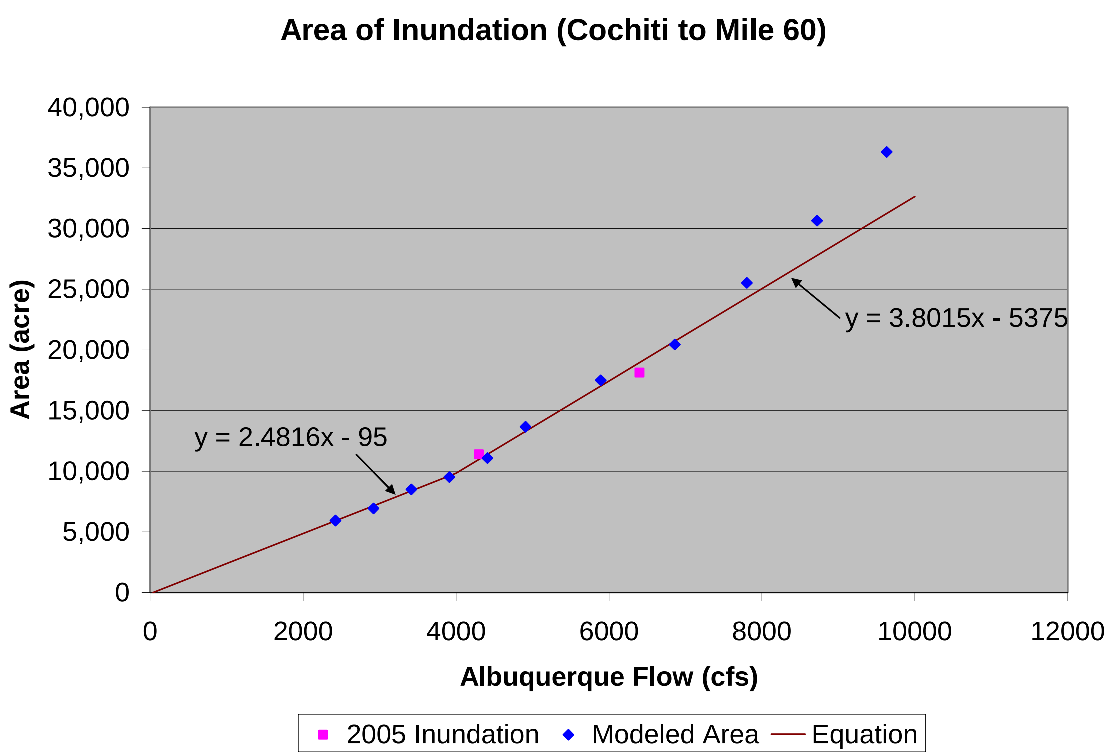


Figure 1: Inundated river area vs discharge @ Cochiti Lake. The FLO 2D total inundated area graph is based on the current Corps FLO 2D model calibrated with the 2005 inundation mapping. The Corps will continue to update the FLO 2D model as new data becomes available and the most current model will be used to compute inundated area.

Example calculations for overbanking flows using 1975 data are shown below: Values for the equation are taken from Tables 1 and 2.

Depletions = (CochEvapWith) – CochEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO)

Depletions = (1,937 – 1,332) + (15,747 – 16,085) + (12,740 – 12,102) = 905 ac-ft

For the overbanking example, the depletions cost as a percent of water stored using Cochiti Lake would be 2 percent. The overbanking action has a target of 5,800 cfs for 5 days at the Albuquerque gage which would overbank the target reach from Isleta to Belen (per Corps Environmental Fisheries Biologist). The maximum Rio Grande water in storage on May 18, is about 38,000 acre-feet.

<u>Storage in Jemez Canyon Reservoir</u>

Overbanking Flows

For storage deviations at Jemez Canyon Reservoir intended to produce spawning/recruitment flows with overbank flooding, depletions will be calculated as follows:

Depletions = (JemezEvapWith – JemezEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO) + (SeepageWith – SeepageWO)

JemezEvapWith = Total evaporation at Jemez with the deviation
JemezEvapWO = Total theoretical evaporation at Jemez without a deviation
EBEvapWith = Total evaporation at Elephant Butte with the deviation
EBEvapWO = Total theoretical evaporation at Elephant Butte without a deviation
RivEvapWith = Total evaporation from river with deviation
RivEvapWO = Total theoretical evaporation from river without deviation
SeepageWith = daily seepage values as calculated in URGWOM with deviation
SeepageWO = daily theoretical seepage values as calculated in URGWOM without deviation

Individual terms will be calculated as follows:

JemezEvapWith = Total evaporation at Jemez Canyon Reservoir with the deviation: see Table 3 (Appendix A), which shows example calculations for 1975 total evaporation at Jemez Canyon Reservoir with the deviations. Use the Jemez Canyon Reservoir area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Jemez Canyon Reservoir) with a pan coefficient of 0.7, to calculate total evaporation for the period.

JemezEvapWO = Total theoretical evaporation at Jemez Canyon Reservoir without a deviation: see Table 3 (Appendix A), which shows example calculations for 1975 total theoretical evaporation at Jemez without the deviation. To calculate the theoretical evaporation from Jemez Canyon Reservoir without the deviation, set outflow equal to inflow during the duration of the deviation. This would be the normal operating procedure and holds the storage constant at zero. Use the Jemez Canyon Reservoir area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Jemez Canyon Reservoir) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWith = Total evaporation at Elephant Butte Reservoir with the deviation: see Table 4 (Appendix A), which shows example calculations for 1975 total evaporation at Elephant Butte Reservoir with the deviation. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake in acres, and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

EBEvapWO = Total theoretical evaporation at Elephant Butte Reservoir without a deviation: see Table 4 (Appendix A), which shows example calculations for 1975 total theoretical evaporation at Elephant Butte Reservoir without the deviation. To calculate the theoretical evaporation from Elephant Butte Reservoir had there been no deviation, add the cumulative Rio Grande native storage at Jemez Canyon Reservoir (the flow that normally would have been allowed to pass) to the daily total storage at Elephant Butte Reservoir. Use the Elephant Butte area-capacity table to determine the daily surface area of the lake and the daily pan evaporation (measured at Elephant Butte) with a pan coefficient of 0.7, to calculate total evaporation for the period.

RivEvapWith = Total evaporation from river/overbank with deviation: see Table 3 (Appendix A), which shows an example calculation of the total evaporation from the river with the deviation. The surface area of river inundation corresponding to a flow at Albuquerque will be determined from the curve defined by the most recent version of the Rio Grande FLO2D model from it's confluence with the Jemez River to River Mile 60. The RivEvapWith term will use the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches will be used for each day of the deviation (0.35 inches per day is the average ET Toolbox evaporation for all reaches between Cochiti and Elephant Butte Reservoir).

To attempt to account for overbank flows that remain ponded in the overbank area after the river has receded into its banks, the area of flooding (the area that is greater than the inundated area at a flow of 5800 cfs) will be doubled for days when flow at the Albuquerque gage is greater than 5800 cfs.

RivEvapWO = Total theoretical evaporation from river without deviation: see Table 3 (Appendix A), which shows an example calculation of the RivEvapWO term that uses the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches for each day had there been no deviation.

SeepageWith = daily seepage losses as calculated in URGWOM from start of deviation to end of deviation

SeepageWO = daily seepage losses as calculated in URGWOM without deviation

Example calculations for overbanking flows using 1975 data are shown below: Values for the equation are taken from Table 3 and 4.

Depletions = (JemezEvapWith – JemezEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO) + (SeepageWith – SeepageWO)

Depletions = (1,322 –77) + (33,068 – 33,525) + (16,889 – 16,645) + (1570 – 0) = 2,602 ac-ft

Flow and reservoir storage data will be taken from the USBR Riverware Accounting model. The total duration of the deviation is the number of days from when storage begins until the excess storage is completely evacuated on or before June 15.

For the overbanking example above, the depletions cost as a percent of water stored using Jemez Canyon Reservoir would be 10 percent. The overbanking action has a target of 5,800 cfs for 5 days at the Albuquerque gage which would overbank the target reach from Isleta to Belen (per Corps Environmental Fisheries Biologist). The amount of water stored using the 1975 data from February 1 to May 5, is about 25,157 acre-feet.

Table 1 provides a summary of depletions associated with possible overbanking actions at Cochiti Lake and Jemez Canyon Reservoir using 1975 data. In comparison, the use of Cochiti Lake provides more efficient storage and release for overbanking actions, incurring 2 percent volumetric depletions relative to the amount of water stored. Jemez Canyon Reservoir has a higher depletion cost of 10 percent relative to the amount of water stored, largely due to seepage losses.

Table 1. Summary of Depletions Estimates Associated with an Overbanking Action

OVERBANKING ACTION		
	Cochiti Lake	Jemez Canyon Reservoir
Parameter (Units = acre-feet)		
Cochiti Lake Evaporation w/Deviation	1,937	
Cochiti Lake Evaporation wo/Deviation	1,332	
Jemez Canyon Reservoir Evaporation w/Deviation		1,322
Jemez Canyon Reservoir Evaporation wo/Deviation		77
Elephant Butte Evaporation w/Deviation	15,747	33,068
Elephant Butte Evaporation wo/Deviation	16,085	33,525
River Evaporation w/Deviation	12,740	16,889
River Evaporation wo/Deviation	12,102	16,645
Jemez Canyon Reservoir Seepage w/Deviation		1,570
Jemez Canyon Reservoir Seepage wo/Deviation		0
Total Depletion	905	2,602
Volume Stored	37,958	25,157
Volume Depletion loss %	2.38	10.34

Storage in Cochiti Lake and Jemez Canyon Reservoir

Overbanking Flows

For storage deviation at both Cochiti Lake and Jemez Canyon Reservoir intended to produce spawning/recruitment flows with overbank flooding, depletions will be calculated as follows:

Depletions =(CochEvapWith – CochEvapWO) + (JemezEvapWith – JemezEvapWO) + (EBEvapWith – EBEvapWO) + (RivEvapWith – RivEvapWO) + (SeepageWith – SeepageWO)

Where:

CochEvapWith = Total evaporation at Cochiti with the deviation
CochEvapWO = Total theoretical evaporation at Cochiti without a deviation
JemezEvapWith = Total evaporation at Jemez with the deviation
JemezEvapWO = Total theoretical evaporation at Jemez without a deviation

EBEvapWith = Total evaporation at Elephant Butte with the deviation
EBEvapWO = Total theoretical evaporation at Elephant Butte without a deviation
RivEvapWith = Total evaporation from river with deviation
RivEvapWO = Total theoretical evaporation from river without deviation
SeepageWith = daily seepage values as calculated in URGWOM with deviation
SeepageWO = daily theoretical seepage values as calculated in URGWOM without deviation

Individual terms will be calculated as follows:

CochEvapWith = Total evaporation at Cochiti Lake with the deviation: Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

CochEvapWO = Total theoretical evaporation at Cochiti Lake without a deviation: To calculate the theoretical evaporation from Cochiti Lake without the deviation, set outflow equal to inflow during the duration of the deviation. This would be the normal operating procedure and holds the storage constant. Use the Cochiti Lake area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Cochiti Lake) with a pan coefficient of 0.7, to calculate total evaporation for the period.

JemezEvapWith = Total evaporation at Jemez Canyon Reservoir with the deviation: Use the Jemez Canyon Reservoir area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Jemez Canyon Reservoir) with a pan coefficient of 0.7, to calculate total evaporation for the period.

JemezEvapWO = Total theoretical evaporation at Jemez Canyon Reservoir without a deviation: To calculate the theoretical evaporation from Jemez Canyon Reservoir without the deviation, set outflow equal to inflow during the duration of the deviation. This would be the normal operating procedure and holds the storage constant at zero. Use the Jemez Canyon Reservoir area-capacity table to determine daily surface area in acres, and the daily pan evaporation (measured at Jemez Canyon Reservoir) with a pan coefficient of 0.7, to calculate total evaporation for the period.

RivEvapWith = Total evaporation from river/overbank with deviation: The surface area of river inundation corresponding to a flow at Albuquerque will be determined from the curve defined by the most recent version of the Rio Grande FLO2D model from it's confluence with the Jemez River to River Mile 60. The RivEvapWith term will use the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches will be used for each day of the deviation (0.35 inches per day is the average ET Toolbox evaporation for all reaches between Cochiti and Elephant Butte Reservoir).

To attempt to account for overbank flows that remain ponded in the overbank area after the river has receded into its banks, the area of flooding (the area that is greater than the inundated area at a flow of 5800 cfs) will be doubled for days when flow at the Albuquerque gage is greater than 5800 cfs.

RivEvapWO = Total theoretical evaporation from river without deviation: Calculation of the RivEvapWO term uses the total area determined by FLO2D and an average daily evaporation rate of 0.35 inches for each day had there been no deviation.

SeepageWith = daily seepage losses as calculated in URGWOM from start of deviation to end of deviation

SeepageWO = daily theoretical seepage losses as calculated in URGWOM without deviation

Flow and reservoir storage data will be taken from the USBR Riverware Accounting model. The total duration of the deviation is the number of days from when storage begins until June 15, when the excess storage should be completely evacuated. Example calculations when using both projects to store for overbanking flows is not provided but the methodology is provided in this document should this action be undertaken. When storing for overbanking flows first preference would be to store the total amount in Cochiti Lake.

(Attachment B)
Appendix A
Overbank Spreadsheet Tables

Table 1 Cochiti Lake Overbank Action

	With Deviation													Without Deviation								
Date	Cochiti Rio Grande Inflow (cfs)	Cochiti Rio Grande Outflow (cfs)	Cochiti Rio Grande Storage cumulative (ac-ft)	Cochiti Rio Grande Storage daily (ac-ft/day)	Cochiti Total Storage (actual) (ac-ft)	Computed Elevation (ft)	Computed Area (acre)	Pan Evap (in/day)	Computed Evap (acre-ft/day)	Total Cochiti evap during deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet	Cochiti Rio Grande Outflow (theoretical w/out deviation) (cfs)	Cochiti total Storage (theoretical w/out deviation) (ac-ft)	Cochiti computed Elevation (theoretical w/out deviation) (ft)	Cochiti computed Area (theoretical w/out deviation) (acre)	Cochiti computed Evap (acre-ft/day)	Cochiti total theoretical evap w/out deviation (ac-ft)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet
5/1/1975	2517.30	1517.20	6383	#REF!	56336.00	5345.30	1496	0.21	18.33		2233	5446	159	2,517	49951	5340.70	1218	14.92		2718	6650	194
5/2/1975	2672.50	1652.60	8363	1,980	58341.00	5346.60	1546	0.20	18.04		1949	4742	138	2,653	49975	5340.70	1218	14.21		2867	7019	205
5/3/1975	2688.20	1673.60	10339	1,976	60319.00	5347.90	1624	0.37	35.05		1897	4611	134	2,674	49976	5340.70	1218	26.29		2866	7018	205
5/4/1975	2714.40	1709.30	12313	1,974	62272.00	5349.10	1669	0.42	40.89		1849	4494	131	2,709	49957	5340.70	1218	29.84		2820	6903	201
5/5/1975	2829.30	1818.50	14288	1,975	64239.00	5350.20	1748	0.38	38.75		1969	4792	140	2,819	49951	5340.70	1218	27.00		2990	7324	214
5/6/1975	2975.00	1958.60	16262	1,974	66215.00	5351.30	1850	0.38	41.01		2015	4906	143	2,959	49955	5340.70	1218	27.00		2995	7337	214
5/7/1975	3131.80	2120.40	18237	1,975	68188.00	5352.40	1900	0.31	34.36		2041	4971	145	3,121	49956	5340.70	1218	22.03		3038	7444	217
5/8/1975	2887.30	1861.80	20206	1,969	70168.00	5353.40	1934	0.48	54.15		1920	4669	136	2,866	49964	5340.70	1218	34.10		2842	6957	203
5/9/1975	2818.30	1814.90	22178	1,972	72116.00	5354.40	1995	0.37	43.06		1780	4323	126	2,815	49944	5340.70	1218	26.29		2753	6737	196
5/10/1975	2913.50	1889.50	24149	1,971	74100.00	5355.40	2077	0.40	48.46		1800	4371	127	2,893	49957	5340.70	1218	28.42		2786	6819	199
5/11/1975	3104.10	2085.60	26117	1,968	76061.00	5356.30	2124	0.48	59.47		1907	4638	135	3,089	49953	5340.70	1218	34.10		2937	7194	210
5/12/1975	3382.90	2367.40	28084	1,967	78015.00	5357.20	2174	0.48	60.87		2177	5308	155	3,370	49944	5340.70	1218	34.10		3162	7752	226
5/13/1975	3348.60	2330.00	30053	1,969	79982.00	5358.10	2218	0.42	54.34		2314	5647	165	3,334	49944	5340.70	1218	29.84		3299	8092	236
5/14/1975	3733.30	2706.10	32019	1,966	81956.00	5359.00	2253	0.48	63.08		2569	6281	183	3,713	49951	5340.70	1218	34.10		3521	8641	252
5/15/1975	4105.40	3096.20	33991	1,972	83917.00	5359.90	2306	0.31	41.70		2956	7242	211	4,098	49944	5340.70	1218	22.03		3905	9595	280
5/16/1975	4511.70	3473.80	35955	1,964	85908.00	5360.70	2339	0.50	68.22		3246	7959	232	4,484	49963	5340.70	1218	35.53		4261	10825	316
5/17/1975	4957.40	3958.10	37926	1,971	87848.00	5361.50	2366	0.35	48.31		3747	9205	268	4,957	49942	5340.70	1218	24.87		4787	12824	374
5/18/1975	5151.00	4958.10	37958	32	88187.00	5361.70	2374	0.31	42.93		4529	11842	345	5,129	49964	5340.70	1218	22.03		5069	13894	405
5/19/1975	5249.80	5709.80	37280	-679	87225.00	5361.30	2359	0.36	49.54		5311	14816	432	5,246	49945	5340.70	1218	25.58		5114	14066	410
5/20/1975	5312.30	6116.50	35662	-1,617	85574.00	5360.60	2336	0.41	55.87		5778	16592	484	5,308	49924	5340.60	1215	29.06		5104	14027	409
5/21/1975	4429.50	6193.20	32138	-3,524	82008.00	5359.00	2253	0.51	67.03		5892	17022	510	4,424	49900	5340.60	1215	36.15		4546	11907	347
5/22/1975	4247.50	6177.30	28287	-3,851	78119.00	5357.30	2180	0.50	63.58		5922	17137	517	4,246	49870	5340.60	1215	35.44		4127	10315	301
5/23/1975	4516.30	6216.30	24924	-3,363	74721.00	5355.70	2093	0.21	25.64		5928	17159	518	4,523	49842	5340.60	1215	14.88		4169	10474	305
5/24/1975	4667.00	6253.40	21761	-3,163	71527.00	5354.10	1969	0.40	45.94		5917	17119	516	4,659	49830	5340.60	1215	28.35		4303	10983	320
5/25/1975	4550.50	6074.20	18720	-3,041	68460.00	5352.50	1904	0.40	44.43		5668	16172	472	4,548	49806	5340.60	1215	28.35		4179	10511	307
5/26/1975	4143.70	5804.10	15169	-3,551	65091.00	5350.70	1800	0.70	73.50		5444	15322	447	4,045	49953	5340.70	1218	49.73		3862	9488	277
5/27/1975	3741.90	5569.60	11521	-3,647	61432.00	5348.60	1651	0.33	31.78		5197	14382	419	3,748	49918	5340.60	1215	23.39		3505	8604	251
5/28/1975	4336.80	5245.80	9633	-1,889	59585.00	5347.40	1597	0.48	44.72		4968	13512	394	4,299	49961	5340.70	1218	34.10		3660	8988	262
5/29/1975	4893.90	4858.30	9703	71	59650.00	5347.50	1603	0.19	17.77		4797	12862	375	4,899	49946	5340.70	1218	13.50		4390	11313	330
5/30/1975	4726.00	4585.90	9930	227	59921.00	5347.60	1608	0.07	6.57		4485	11675	341	4,700	49992	5340.70	1218	4.97		4537	11871	346
5/31/1975	4371.60	4429.40	9804	-126	59782.00	5347.60	1608	0.26	24.39		4162	10448	305	4,363	49992	5340.70	1218	18.47		4173	10489	306
6/1/1975	3937.50	4237.70	9189	-614	59149.00	5347.20	1584	0.40	36.96		3919	9629	281	3,935	49967	5340.70	1218	28.42		3743	9194	268
6/2/1975	3469.60	3992.00	8120	-1,069	58070.00	5346.50	1540	0.47	42.22		3695	9075	265	3,460	49953	5340.70	1218	33.39		3311	8120	237
6/3/1975	3224.10	3727.10	7084	-1,036	57036.00	5345.80	1508	0.41	36.07		3459	8490	248	3,214	49945	5340.70	1218	29.13		2942	7206	210
6/4/1975	3299.20	3459.60	6726	-358	56681.00	5345.50	1501	0.42	36.77		3213	7879	230	3,281	49952	5340.70	1218	29.84		2871	7030	205
6/5/1975	3349.60	3680.40	6009	-717	55967.00	5345.10	1492	0.66	57.44		3136	7686	224	3,327	49951	5340.70	1218	46.89		2851	6980	204
6/6/1975	3474.20	3827.20	5295	-714	55222.00	5344.60	1479	0.52	44.86		3248	7964	232	3,470	49923	5340.60	1215	36.85		2932	7182	209
6/7/1975	3672.30	4003.40	4582	-713	54524.00	5344.10	1460	0.48	40.88		3425	8403	245	3,647	49939	5340.70	1218	34.10		3077	7540	220
6/8/1975	3942.00	4282.30	3871	-711	53817.00	5343.60	1436	0.38	31.83		3623	8897	259	3,926	49944	5340.70	1218	27.00		3266	8009	234
6/9/1975	3912.80	4244.70	3159	-712	53117.00	5343.10	1403	0.50	40.92		3710	9112	266	3,889	49955	5340.70	1218	35.53		3359	8242	240
6/10/1975	4272.20	4641.40	2452	-707	52396.00	5342.60	1358	0.32	25.35		3902	9588	280	4,284	49942	5340.70	1218	22.74		3542	8695	254
6/11/1975	3854.30	4166.00	1744	-708	51757.00	5342.10	1308	0.27	20.60		3816	9375	273	3,809	50013	5340.70	1218	19.18		3475	8529	249
6/12/1975	4007.10	4367.30	1035	-709	51006.00	5341.50	1256	0.49	35.90		3719	9135	266	4,013	49967	5340.70	1218	34.81		3371	8270	241
6/13/1975	4409.90	4758.50	327	-707	50274.00	5340.90	1224	0.56	39.98		3967	9750	284	4,402	49943	5340.70	1218	39.79		3606	8853	258
6/14/1975	4557.60	4705.20	1	-327	49936.00	5340.70	1218	0.63	44.76		4094	10188	297	4,539	49934	5340.70	1218	44.76		3842	9438	275
6/15/1975	4479.00	4463.20	0	-1	49926.00	5340.70	1218	0.58	41.21		3973	9764	285	4,462	49926	5340.70	1218	41.21		3891	9561	279
										1938			12740						1332			12102

Table 2 Elephant Butte Reservoir Overbank Action

	With Deviation						Without Deviation				
Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft/)
5/1/1975	398,811	4,331.40	11,432	0.47	313.43		403,248	4,331.70	11,488	314.96	
5/2/1975	399,640	4,331.40	11,432	0.4	266.75		404,546	4,331.90	11,525	268.92	
5/3/1975	399,501	4,331.40	11,432	0.36	240.07		405,684	4,332.00	11,544	242.42	
5/4/1975	398,712	4,331.30	11,413	0.54	359.51		406,634	4,332.00	11,544	363.64	
5/5/1975	397,430	4,331.20	11,394	0.86	571.60		407,164	4,332.10	11,563	580.08	
5/6/1975	396,389	4,331.10	11,375	0.45	298.59		408,191	4,332.20	11,582	304.03	
5/7/1975	395,701	4,331.10	11,375	0.42	278.69		409,561	4,332.30	11,601	284.22	
5/8/1975	394,974	4,331.00	11,356	0.44	291.47		410,863	4,332.40	11,619	298.22	
5/9/1975	394,083	4,330.90	11,338	0.48	317.46		411,755	4,332.50	11,638	325.86	
5/10/1975	392,847	4,330.80	11,319	0.41	270.71		412,237	4,332.50	11,638	278.34	
5/11/1975	391,337	4,330.70	11,300	0.4	263.67		412,612	4,332.60	11,657	272.00	
5/12/1975	389,780	4,330.60	11,281	0.5	329.03		413,096	4,332.60	11,657	340.00	
5/13/1975	388,441	4,330.40	11,244	0.53	347.63		413,874	4,332.70	11,676	360.98	
5/14/1975	387,422	4,330.30	11,225	0.46	301.20		414,947	4,332.80	11,694	313.79	
5/15/1975	386,780	4,330.30	11,225	0.49	320.85		416,430	4,332.90	11,713	334.80	
5/16/1975	386,744	4,330.30	11,225	0.54	353.59		418,447	4,333.00	11,732	369.56	
5/17/1975	387,837	4,330.40	11,244	0.42	275.48		421,579	4,333.30	11,788	288.81	
5/18/1975	390,267	4,330.60	11,281	0.33	217.16		426,074	4,333.70	11,863	228.36	
5/19/1975	393,782	4,330.90	11,338	0.57	376.99		430,915	4,334.10	11,939	396.97	
5/20/1975	398,764	4,331.40	11,432	0.61	406.79		435,671	4,334.50	12,014	427.50	
5/21/1975	404,498	4,331.90	11,525	0.73	490.77		440,190	4,334.90	12,089	514.79	
5/22/1975	410,492	4,332.40	11,619	0.58	393.11		443,896	4,335.20	12,145	410.91	
5/23/1975	416,662	4,332.90	11,713	0.41	280.14		446,663	4,335.40	12,183	291.38	
5/24/1975	422,831	4,333.40	11,807	0.45	309.93		449,367	4,335.60	12,220	320.78	
5/25/1975	429,135	4,334.00	11,920	0.56	389.39		452,560	4,335.90	12,277	401.05	
5/26/1975	435,185	4,334.50	12,014	0.49	343.40		455,729	4,336.10	12,314	351.98	
5/27/1975	440,642	4,334.90	12,089	0.58	409.01		458,091	4,336.30	12,352	417.91	
5/28/1975	445,517	4,335.30	12,164	0.59	418.64		459,730	4,336.50	12,389	426.39	
5/29/1975	450,531	4,335.70	12,239	0.21	149.93		461,971	4,336.70	12,427	152.23	
5/30/1975	455,641	4,336.10	12,314	0.2	143.66		465,779	4,337.00	12,483	145.64	
5/31/1975	459,651	4,336.50	12,389	0.41	296.30		469,624	4,337.30	12,539	299.89	
6/1/1975	462,778	4,336.70	12,427	0.39	282.71		472,828	4,337.50	12,577	286.13	
6/2/1975	464,712	4,336.90	12,464	0.49	356.26		474,556	4,337.70	12,615	360.58	
6/3/1975	466,127	4,337.00	12,483	0.57	415.06		475,312	4,337.70	12,615	419.45	
6/4/1975	467,041	4,337.10	12,502	0.69	503.21		475,330	4,337.70	12,615	507.75	
6/5/1975	467,485	4,337.10	12,502	0.54	393.81		474,989	4,337.70	12,615	397.37	
6/6/1975	467,338	4,337.10	12,502	0.55	401.11		474,259	4,337.60	12,596	404.12	
6/7/1975	467,307	4,337.10	12,502	0.5	364.64		473,643	4,337.60	12,596	367.38	
6/8/1975	467,716	4,337.10	12,502	0.44	320.88		473,335	4,337.60	12,596	323.30	
6/9/1975	468,412	4,337.20	12,521	0.46	335.98		473,278	4,337.60	12,596	337.99	
6/10/1975	469,442	4,337.30	12,539	0.45	329.15		473,567	4,337.60	12,596	330.65	
6/11/1975	470,730	4,337.40	12,558	0.51	373.60		474,161	4,337.60	12,596	374.73	
6/12/1975	471,957	4,337.50	12,577	0.51	374.17		474,703	4,337.70	12,615	375.30	
6/13/1975	472,945	4,337.50	12,577	0.52	381.50		475,002	4,337.70	12,615	382.66	
6/14/1975	473,964	4,337.60	12,596	0.68	499.64		475,314	4,337.70	12,615	500.40	
6/15/1975	475,517	4,337.70	12,615	0.53	390.01	**15746.69**	476,339	4,337.80	12,633	390.57	**16084.75**

Table 3 Jemez Canyon Reservoir Overbank Action

	With Deviation														Without Deviation									
Date	Jemez Rio Grande Inflow (cfs)	Jemez Rio Grande Outflow (cfs)	Jemez Rio Grande Storage cumulative (ac-ft)	Jemez Rio Grande Storage daily (ac-ft/day)	Jemez Total Storage (actual) (ac-ft)	Computed Elevation (ft)	Computed Area (acre)	Pan Evap (in/day)	Computed Evap (acre-ft/day)	Total Jemez evap during deviation (ac-ft/day)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet	Jemez Seepage (ac-ft)	Jemez Rio Grande Outflow (theoretical w/out deviation) (cfs)	Jemez total Storage (theoretical w/out deviation) (ac-ft)	Jemez computed Elevation (theoretical w/out deviation) (ft)	Jemez computed Area (theoretical w/out deviation) (acre)	Jemez computed Evap (acre-ft/day)	Jemez total theoretical evap w/out deviation (ac-ft)	RG@Alb (cfs)	**River Channel Surface area (acres)**	**River Channel Surface Water Evap in acre-feet**	**Jemez Seepage (ac-ft)**
2/1/1975	20.20	0.00	1158.00	#REF!	1158.00	5164.50	254	0.16	2.37		513	707	21	4	20	0	5155.60	1	0.14		539	773	23	0
2/2/1975	18.10	0.00	1189.00	31	1189.00	5164.60	255	0.16	2.38		505	689	20	4	18	0	5155.60	1	0.14		525	737	21	0
2/3/1975	25.20	0.00	1233.00	44	1233.00	5164.70	258	0.16	2.41		491	653	19	4	25	0	5155.60	1	0.14		516	715	21	0
2/4/1975	20.20	0.00	1268.00	35	1268.00	5164.90	263	0.16	2.45		474	612	18	4	20	0	5155.60	1	0.14		497	669	19	0
2/5/1975	20.20	0.00	1303.00	35	1303.00	5165.00	266	0.16	2.48		473	610	18	4	20	0	5155.60	1	0.14		494	660	19	0
2/6/1975	15.10	0.00	1328.00	25	1328.00	5165.10	270	0.16	2.52		460	578	17	4	15	0	5155.60	1	0.15		477	620	18	0
2/7/1975	18.10	0.00	1358.00	30	1358.00	5165.20	274	0.16	2.56		439	526	15	4	18	0	5155.60	1	0.15		455	566	16	0
2/8/1975	20.20	0.00	1392.00	34	1392.00	5165.30	278	0.16	2.59		444	538	16	4	20	0	5155.60	1	0.15		464	587	17	0
2/9/1975	20.20	0.00	1426.00	34	1426.00	5165.40	283	0.16	2.64		463	584	17	4	20	0	5155.60	1	0.15		483	635	19	0
2/10/1975	15.10	0.00	1449.00	23	1449.00	5165.50	288	0.16	2.69		477	618	18	4	15	0	5155.60	1	0.16		495	662	19	0
2/11/1975	15.10	0.00	1473.00	24	1473.00	5165.60	293	0.16	2.73		487	644	19	4	15	0	5155.60	1	0.16		501	679	20	0
2/12/1975	15.10	0.00	1497.00	24	1497.00	5165.70	298	0.16	2.78		487	643	19	5	15	0	5155.60	1	0.16		503	683	20	0
2/13/1975	18.10	0.00	1526.00	29	1526.00	5165.80	303	0.16	2.83		477	620	18	5	18	0	5155.60	1	0.16		494	660	19	0
2/14/1975	25.20	0.00	1575.00	49	1575.00	5165.90	308	0.16	2.87		475	613	18	5	25	0	5155.60	1	0.17		496	666	19	0
2/15/1975	20.20	0.00	1608.00	33	1608.00	5166.10	316	0.16	2.95		488	646	19	5	20	0	5155.60	1	0.17		507	694	20	0
2/16/1975	18.10	0.00	1638.00	30	1638.00	5166.10	316	0.16	2.95		500	675	20	5	18	0	5155.60	1	0.17		518	721	21	0
2/17/1975	20.20	0.00	1671.00	33	1671.00	5166.30	323	0.16	3.01		498	671	20	5	20	0	5155.60	1	0.18		519	722	21	0
2/18/1975	15.10	0.00	1700.00	29	1700.00	5166.30	323	0.16	3.01		493	658	19	5	15	0	5155.60	1	0.18		511	704	21	0
2/19/1975	15.10	0.00	1723.00	23	1723.00	5166.40	326	0.16	3.04		492	655	19	5	15	0	5155.60	1	0.18		507	694	20	0
2/20/1975	20.20	0.00	1756.00	33	1756.00	5166.50	329	0.16	3.07		484	636	19	5	20	0	5155.60	1	0.18		503	683	20	0
2/21/1975	20.20	0.00	1789.00	33	1789.00	5166.60	331	0.16	3.09		483	634	18	5	20	0	5155.60	1	0.18		501	679	20	0
2/22/1975	6.00	0.00	1794.00	5	1794.00	5166.60	331	0.16	3.09		490	650	19	5	6	0	5155.60	1	0.18		504	686	20	0
2/23/1975	10.10	0.00	1807.00	13	1807.00	5166.70	333	0.16	3.11		476	617	18	5	10	0	5155.60	1	0.18		484	636	19	0
2/24/1975	18.10	0.00	1842.00	35	1842.00	5166.80	335	0.16	3.13		448	547	16	5	18	0	5155.60	1	0.18		461	579	17	0
2/25/1975	20.20	0.00	1874.00	32	1874.00	5166.90	337	0.16	3.15		440	529	15	5	20	0	5155.60	1	0.18		460	578	17	0
2/26/1975	18.10	0.00	1902.00	28	1902.00	5167.00	338	0.16	3.15		481	629	18	6	18	0	5155.60	1	0.18		497	669	20	0
2/27/1975	20.20	0.00	1934.00	32	1934.00	5167.10	339	0.16	3.16		525	737	22	6	20	0	5155.60	1	0.18		544	785	23	0
2/28/1975	25.20	0.00	1976.00	42	1976.00	5167.20	340	0.16	3.17		550	798	23	6	25	0	5155.60	1	0.19		572	853	25	0
3/1/1975	30.20	0.00	2027.00	51	2027.00	5167.30	341	0.25	4.97		562	829	24	6	30	0	5155.60	1	0.29		589	896	26	0
3/2/1975	30.20	0.00	2076.00	49	2076.00	5167.50	343	0.25	5.00		569	846	25	6	30	0	5155.60	1	0.29		600	921	27	0
3/3/1975	25.20	0.00	2116.00	40	2116.00	5167.60	344	0.25	5.02		584	882	26	6	25	0	5155.60	1	0.29		612	951	28	0
3/4/1975	25.20	0.00	2156.00	40	2156.00	5167.70	345	0.25	5.03		636	1011	29	6	25	0	5155.60	1	0.29		664	1078	31	0
3/5/1975	28.20	0.00	2202.00	46	2202.00	5167.80	346	0.25	5.05		788	1385	40	6	28	0	5155.60	1	0.29		813	1447	42	0
3/6/1975	25.20	0.00	2241.00	39	2241.00	5167.90	347	0.25	5.06		858	1558	45	6	25	0	5155.60	1	0.30		884	1622	47	0
3/7/1975	30.20	0.00	2291.00	50	2291.00	5168.10	349	0.25	5.09		777	1359	40	6	30	0	5155.60	1	0.30		804	1425	42	0
3/8/1975	62.00	0.00	2408.00	117	2408.00	5168.40	354	0.25	5.16		841	1515	44	7	62	0	5155.60	1	0.30		885	1623	47	0
3/9/1975	107.90	0.00	2617.00	209	2617.00	5169.00	364	0.25	5.31		993	1889	55	7	108	0	5155.60	1	0.31		1071	2081	61	0
3/10/1975	74.10	0.00	2758.00	141	2758.00	5169.40	371	0.25	5.41		1009	1930	56	7	74	0	5155.60	1	0.32		1106	2167	63	0
3/11/1975	35.30	0.00	2816.00	58	2816.00	5169.50	373	0.25	5.44		977	1851	54	8	35	0	5155.60	1	0.32		1035	1992	58	0
3/12/1975	40.30	0.00	2885.00	69	2885.00	5169.70	376	0.25	5.48		982	1862	54	8	40	0	5155.60	1	0.32		1020	1956	57	0
3/13/1975	38.30	0.00	2949.00	64	2949.00	5169.90	379	0.25	5.53		839	1511	44	8	38	0	5155.60	1	0.32		879	1608	47	0
3/14/1975	40.30	0.00	3017.00	68	3017.00	5170.10	383	0.25	5.59		674	1104	32	8	40	0	5155.60	1	0.33		712	1197	35	0
3/15/1975	45.40	0.00	3095.00	78	3095.00	5170.30	386	0.25	5.63		590	897	26	8	45	0	5155.60	1	0.33		632	1001	29	0
3/16/1975	35.30	0.00	3153.00	58	3153.00	5170.40	387	0.25	5.64		591	899	26	8	35	0	5155.60	1	0.33		631	999	29	0
3/17/1975	40.30	0.00	3221.00	68	3221.00	5170.60	390	0.25	5.69		556	814	24	8	40	0	5155.60	1	0.33		592	901	26	0
3/18/1975	45.40	0.00	3299.00	78	3299.00	5170.80	393	0.25	5.73		500	675	20	9	45	0	5155.60	1	0.33		544	785	23	0
3/19/1975	60.50	0.00	3405.00	106	3405.00	5171.10	397	0.25	5.79		481	629	18	9	61	0	5155.60	1	0.34		533	756	22	0
3/20/1975	65.50	0.00	3520.00	115	3520.00	5171.40	402	0.25	5.86		471	604	18	9	66	0	5155.60	1	0.34		535	761	22	0
3/21/1975	85.70	0.00	3676.00	156	3676.00	5171.70	408	0.25	5.95		498	671	20	9	86	0	5155.60	1	0.35		566	839	24	0
3/22/1975	75.60	0.00	3811.00	135	3811.00	5172.10	416	0.25	6.07		584	883	26	10	76	0	5155.60	1	0.35		671	1096	32	0
3/23/1975	60.50	0.00	3917.00	106	3917.00	5172.30	422	0.25	6.15		653	1053	31	10	61	0	5155.60	1	0.36		722	1223	36	0
3/24/1975	90.70	0.00	4083.00	166	4083.00	5172.70	431	0.25	6.29		671	1096	32	10	91	0	5155.60	1	0.37		743	1273	37	0
3/25/1975	80.70	0.00	4227.00	144	4227.00	5173.00	435	0.25	6.34		642	1026	30	10	81	0	5155.60	1	0.37		725	1230	36	0
3/26/1975	90.70	0.00	4391.00	164	4391.00	5173.40	436	0.25	6.36		533	758	22	11	91	0	5155.60	1	0.37		619	969	28	0
3/27/1975	100.80	0.00	4575.00	184	4575.00	5173.80	442	0.25	6.45		467	595	17	11	101	0	5155.60	1	0.38		561	826	24	0
3/28/1975	90.70	0.00	4740.00	165	4740.00	5174.20	465	0.25	6.78		496	666	19	11	91	0	5155.60	1	0.40		590	897	26	0
3/29/1975	60.50	0.00	4845.00	105	4845.00	5174.40	483	0.25	7.04		503	683	20	11	61	0	5155.60	1	0.41		590	897	26	0
3/30/1975	50.40	0.00	4928.00	83	4928.00	5174.60	503	0.25	7.34		462	583	17	12	50	0	5155.60	1	0.43		516	716	21	0
3/31/1975	90.70	3.20	5085.00	157	5085.00	5174.90	532	0.25	7.76		457	570	17	12	91	0	5155.60	1	0.45		524	735	21	0
4/1/1975	90.70	48.10	5149.00	64	5149.00	5175.00	540	0.28	8.82		407	447	13	12	91	0	5155.60	1	0.51		457	569	17	0
4/2/1975	75.60	67.30	5145.00	-4	5145.00	5175.00	540	0.28	8.82		269	106	3	12	76	0	5155.60	1	0.51		322	238	7	0
4/3/1975	80.70	67.90	5149.00	4	5149.00	5175.00	540	0.28	8.82		450	552	16	12	81	0	5155.60	1	0.51		453	559	16	0
4/4/1975	90.70	100.60	5109.00	-40	5109.00	5174.90	532	0.28	8.69		431	506	15	12	91	0	5155.60	1	0.51		434	513	15	0
4/5/1975	112.90	116.00	5082.00	-27	5082.00	5174.90	532	0.28	8.69		446	543	16	12	113	0	5155.60	1	0.51		439	525	15	0
4/6/1975	143.70	58.00	5231.00	149	5231.00	5175.20	554	0.28	9.05		508	695	20	12	144	0	5155.60	1	0.53		538	769	22	0
4/7/1975	192.60	29.00	5534.00	303	5534.00	5175.70	583	0.28	9.52		678	1114	32	12	193	0	5155.60	1	0.56		795	1403	41	0
4/8/1975	211.70	14.50	5902.00	368	5902.00	5176.30	640	0.28	10.45		890	1637	48	13	212	0	5155.60	1	0.61		1065	2067	60	0
4/9/1975	170.40	7.20	6202.00	300	6202.00	5176.70	690	0.28	11.27		1252	2528	74	13	170	0	5155.60	1	0.66		1458	3033	88	0
4/10/1975	184.50	3.60	6535.00	333	6535.00	5177.20	733	0.28	11.97		1994	4354	127	14	185	0	5155.60	1	0.70		2188	4832	141	0
4/11/1975	128.60	1.80	6762.00	227	6762.00	5177.50	743	0.28	12.14		1992	4348	127	14	129	0	5155.60	1	0.71		2125	4677	136	0
4/12/1975	219.30	0.90	7169.00	407	7169.00	5178.10	749	0.28	12.23		1728	3699	108	14	219	0	5155.60	1	0.71		1899	4120	120	0
4/13/1975	189.60	0.50	7517.00	348	7517.00	5178.50	755	0.28	12.33		1630	3458	101	15	190	0	5155.60	1	0.72		1829	3949	115	0
4/14/1975	141.70	0.20	7783.00	266	7783.00	5178.90	764	0.28	12.48		1621	3437	100	15	142	0	5155.60	1	0.73		1787	3845	112	0
4/15/1975	125.50	0.10	8004.00	221	8004.00	5179.20	770	0.28	12.58		1663	3539	103	15	126	0	5155.60	1	0.73		1796	3868	113	0
4/16/1975	178.50	0.10	8330.00	326	8330.00	5179.60	779	0.28	12.72		1758	3774	110	16	179	0	5155.60	1	0.74		1918	4166	121	0
4/17/1975	330.20	0.00	8956.00	626	8956.00	5180.40	795	0.28	12.99		1849	3996	117	16	330	0	5155.60	1	0.76		2116	4655	136	0
4/18/1975	410.40	0.00	9740.00	784	9740.00	5181.40	816	0.28	13.33		1878	4068	119	17	410	0	5155.60	1	0.78		2259	5007	146	0

4/19/1975	330.70	0.00	10365.00	625	10365.00	5182.10	827	0.28	13.51		1716	3671	107	18	331	0	5155.60	1	0.79		2053	4498	131	0
4/20/1975	310.60	0.00	10949.00	584	10949.00	5182.80	836	0.28	13.65		1303	2653	77	18	311	0	5155.60	1	0.80		1587	3352	98	0
4/21/1975	426.00	0.00	11761.00	812	11761.00	5183.80	851	0.28	13.90		909	1682	49	19	426	0	5155.60	1	0.81		1261	2549	74	0
4/22/1975	621.60	112.20	12738.00	977	12738.00	5184.90	867	0.28	14.16		946	1773	52	20	622	0	5155.60	1	0.83		1430	2965	86	0
Date	Jemez Rio Grande Inflow (cfs)	Jemez Rio Grande Outflow (cfs)	Jemez Rio Grande Storage cumulative (ac-ft)	Jemez Rio Grande Storage daily (ac-ft/day)	Jemez Total Storage (actual) (ac-ft)	Computed Elevation (ft)	Computed Area (acre)	Pan Evap (in/day)	Computed Evap (acre-ft/day)	Total Jemez evap during deviation (ac-ft/day)	RG @ Alb (cfs)	River Channel Surface area (acres)	River Channel Surface Water Evap in acre-feet	Jemez Seepage (ac-ft)	Jemez Rio Grande Outflow (theoretical w/out deviation) (cfs)	Jemez total Storage (theoretical w/out deviation) (ac-ft)	Jemez computed Elevation (theoretical w/out deviation) (ft)	Jemez computed Area (theoretical w/out deviation) (acre)	Jemez computed Evap (acre-ft/day)	Jemez total theoretical evap w/out deviation (ac-ft)	RG@Alb (cfs)	**River Channel Surface area (acres)**	**River Channel Surface Water Evap in acre-feet**	**Jemez Seepage (ac-ft)**
4/23/1975	857.10	312.20	13784.00	1,046	13784.00	5186.10	885	0.28	14.46		1678	3576	104	21	857	0	5155.60	1	0.84		2325	5168	151	0
4/24/1975	1038.60	563.20	14691.00	907	14691.00	5187.10	901	0.28	14.72		2853	6468	189	22	1,039	0	5155.60	1	0.86		3303	7576	221	0
4/25/1975	1211.00	700.20	15667.00	976	15667.00	5188.20	916	0.28	14.96		3307	7586	221	22	1,211	0	5155.60	1	0.87		3808	8820	257	0
4/26/1975	1470.10	958.90	16642.00	975	16642.00	5189.30	948	0.28	15.48		3687	8523	249	23	1,470	0	5155.60	1	0.90		4212	10043	293	0
4/27/1975	1201.40	689.80	17617.00	975	17617.00	5190.30	1012	0.28	16.53		3647	8423	246	24	1,201	0	5155.60	1	0.96		4146	9809	286	0
4/28/1975	705.80	344.90	18291.00	674	18291.00	5190.90	1042	0.28	17.02		3184	7283	212	25	706	0	5155.60	1	0.99		3603	8315	243	0
4/29/1975	623.10	44.90	19395.00	1,104	19395.00	5191.90	1120	0.28	18.29		2752	6221	181	25	623	0	5155.60	1	1.07		3285	7532	220	0
4/30/1975	616.10	58.70	20456.00	1,061	20456.00	5192.80	1194	0.28	19.50		2309	5129	150	26	616	0	5155.60	1	1.14		2865	6499	190	0
5/1/1975	773.90	258.70	21424.00	968	21424.00	5193.60	1274	0.37	27.50		2178	4808	140	27	774	0	5155.60	1	1.60		2718	6137	179	0
5/2/1975	803.10	292.40	22382.00	958	22382.00	5194.40	1324	0.37	28.58		2337	5199	152	27	803	0	5155.60	1	1.67		2867	6503	190	0
5/3/1975	714.40	200.90	23344.00	962	23344.00	5195.10	1334	0.37	28.79		2361	5259	153	28	714	0	5155.60	1	1.68		2866	6502	190	0
5/4/1975	637.80	123.80	24306.00	962	24306.00	5195.80	1348	0.37	29.09		2312	5136	150	28	638	0	5155.60	1	1.70		2820	6388	186	0
5/5/1975	782.00	323.80	25157.00	851	25157.00	5196.40	1359	0.37	29.33		2503	5607	164	29	782	0	5155.60	1	1.71		2990	6805	198	0
5/6/1975	545.50	623.80	24943.00	-214	24943.00	5196.30	1357	0.37	29.29		2912	6614	193	29	546	0	5155.60	1	1.71		2995	6818	199	0
5/7/1975	489.50	490.30	24884.00	-59	24884.00	5196.20	1356	0.37	29.27		3064	6987	204	29	490	0	5155.60	1	1.71		3038	6924	202	0
5/8/1975	375.60	361.10	24854.00	-30	24854.00	5196.20	1356	0.37	29.27		2832	6417	187	29	376	0	5155.60	1	1.71		2842	6441	188	0
5/9/1975	502.60	488.20	24825.00	-29	24825.00	5196.20	1356	0.37	29.27		2739	6187	180	29	503	0	5155.60	1	1.71		2753	6223	181	0
5/10/1975	464.80	450.40	24796.00	-29	24796.00	5196.20	1356	0.37	29.27		2772	6269	183	29	465	0	5155.60	1	1.71		2786	6305	184	0
5/11/1975	495.60	481.10	24767.00	-29	24767.00	5196.10	1354	0.37	29.22		2922	6639	194	29	496	0	5155.60	1	1.70		2937	6676	195	0
5/12/1975	555.60	541.10	24737.00	-30	24737.00	5196.10	1354	0.37	29.22		3151	7201	210	29	556	0	5155.60	1	1.70		3162	7229	211	0
5/13/1975	561.10	546.70	24708.00	-29	24708.00	5196.10	1354	0.37	29.22		3285	7532	220	29	561	0	5155.60	1	1.70		3299	7567	221	0
5/14/1975	643.80	629.40	24679.00	-29	24679.00	5196.10	1354	0.37	29.22		3506	8076	236	29	644	0	5155.60	1	1.70		3521	8112	237	0
5/15/1975	630.20	615.80	24650.00	-29	24650.00	5196.10	1354	0.37	29.22		3890	9022	263	29	630	0	5155.60	1	1.70		3905	9058	264	0
5/16/1975	599.40	585.00	24621.00	-29	24621.00	5196.00	1352	0.37	29.18		4247	10168	297	29	599	0	5155.60	1	1.70		4261	10220	298	0
5/17/1975	646.30	631.90	24591.00	-30	24591.00	5196.00	1352	0.37	29.18		4772	12033	351	29	646	0	5155.60	1	1.70		4787	12085	352	0
5/18/1975	645.80	680.50	24465.00	-126	24465.00	5195.90	1350	0.37	29.14		5087	13148	383	29	646	0	5155.60	1	1.70		5069	13085	382	0
5/19/1975	561.10	1077.30	23399.00	-1,066	23399.00	5195.10	1334	0.37	28.79		5473	14519	423	28	561	0	5155.60	1	1.68		5114	13245	386	0
5/20/1975	502.60	1330.50	21702.00	-1,697	21702.00	5193.80	1292	0.37	27.89		5834	15801	439	27	503	0	5155.60	1	1.63		5104	13209	385	0
5/21/1975	432.10	1813.00	18912.00	-2,790	18912.00	5191.50	1085	0.37	23.42		5703	15334	447	25	432	0	5155.60	1	1.37		4546	11230	328	0
5/22/1975	496.10	2271.90	15347.00	-3,565	15347.00	5187.90	913	0.37	19.71		5763	15548	453	22	496	0	5155.60	1	1.15		4127	9744	284	0
5/23/1975	403.30	2179.00	11790.00	-3,557	11790.00	5183.80	851	0.37	18.37		5957	16235	464	19	403	0	5155.60	1	1.07		4169	9893	289	0
5/24/1975	355.90	1986.70	8522.00	-3,268	8522.00	5179.80	783	0.37	16.90		5985	16334	470	16	356	0	5155.60	1	0.99		4303	10368	302	0
5/25/1975	198.60	1703.40	5510.00	-3,012	5510.00	5175.70	583	0.37	12.58		5695	15307	446	12	199	0	5155.60	1	0.73		4179	9927	290	0
5/26/1975	260.10	1707.90	2621.00	-2,889	2621.00	5169.00	364	0.37	7.86		5296	13890	405	7	260	0	5155.60	1	0.46		3862	8952	261	0
5/27/1975	191.10	1510.20	1.00	-2,620	1.00	5155.60	1	0.37	0.02		4839	12269	358	0	191	0	5155.60	1	0.00		3505	8074	236	0
5/28/1975	278.30	278.30	1.00	0	1.00	5155.60	1	0.37	0.02		4190	9967	291	0	278	0	5155.60	1	0.00		3660	8456	247	0
5/29/1975	336.80	336.80	1.00	0	1.00	5155.60	1	0.37	0.02		4390	10675	311	0	337	0	5155.60	1	0.00		4390	10675	311	0
5/30/1975	340.80	340.80	1.00	0	1.00	5155.60	1	0.37	0.02		4537	11196	327	0	341	0	5155.60	1	0.00		4537	11196	327	0
5/31/1975	282.30	282.30	1.00	0	1.00	5155.60	1	0.37	0.02		4173	9906	289	0	282	0	5155.60	1	0.00		4173	9906	289	0
6/1/1975	237.00	237.00	1.00	0	1.00	5155.60	1	0.52	0.03		3743	8661	253	0	237	0	5155.60	1	0.00		3743	8661	253	0
6/2/1975	228.40	228.40	1.00	0	1.00	5155.60	1	0.52	0.03		3311	7595	222	0	228	0	5155.60	1	0.00		3311	7595	222	0
6/3/1975	228.90	228.90	1.00	0	1.00	5155.60	1	0.52	0.03		2942	6688	195	0	229	0	5155.60	1	0.00		2942	6688	195	0
6/4/1975	225.40	225.40	1.00	0	1.00	5155.60	1	0.52	0.03		2871	6514	190	0	225	0	5155.60	1	0.00		2871	6514	190	0
6/5/1975	217.30	217.30	1.00	0	1.00	5155.60	1	0.52	0.03		2851	6464	189	0	217	0	5155.60	1	0.00		2851	6464	189	0
6/6/1975	210.20	210.30	0.00	-1	0.00	5155.60	1	0.52	0.03		2932	6664	194	0	210	0	5155.60	1	0.00		2932	6664	194	0
6/7/1975	197.10	197.20	0.00	0	0.00	5155.60	1	0.52	0.03		3077	7020	205	0	197	0	5155.60	1	0.00		3077	7020	205	0
6/8/1975	183.50	183.50	0.00	0	0.00	5155.60	1	0.52	0.03		3266	7485	218	0	184	0	5155.60	1	0.00		3266	7485	218	0
6/9/1975	169.90	169.90	0.00	0	0.00	5155.60	1	0.52	0.03		3359	7716	225	0	170	0	5155.60	1	0.00		3359	7716	225	0
6/10/1975	148.70	148.80	0.00	0	0.00	5155.60	1	0.52	0.03		3542	8166	238	0	149	0	5155.60	1	0.00		3542	8166	238	0
6/11/1975	147.70	147.70	0.00	0	0.00	5155.60	1	0.52	0.03		3475	8001	233	0	148	0	5155.60	1	0.00		3475	8001	233	0
6/12/1975	133.10	133.10	0.00	0	0.00	5155.60	1	0.52	0.03		3371	7743	226	0	133	0	5155.60	1	0.00		3371	7743	226	0
6/13/1975	117.00	117.00	0.00	0	0.00	5155.60	1	0.52	0.03		3606	8322	243	0	117	0	5155.60	1	0.00		3606	8322	243	0
6/14/1975	101.80	101.80	0.00	0	0.00	5155.60	1	0.52	0.03		3842	8902	260	0	102	0	5155.60	1	0.00		3842	8902	260	0
6/15/1975	91.30	91.30	0.00	0	0.00	5155.60	1	0.52	0.03		3891	9024	263	0	91	0	5155.60	1	0.00		3891	9024	263	0
										1322			16889	1570						77.11				

Table 4 Elephant Butte Reservoir Overbank Action

	With Deviation						Without Deviation				
Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft)
2/1/1975	430,624	4,334.10	11,939	0.08	55.72		431,669	4,334.20	11,957	55.80	
2/2/1975	432,004	4,334.20	11,957	0.07	48.82		433,103	4,334.30	11,976	48.90	
2/3/1975	433,624	4,334.30	11,976	0.07	48.90		434,771	4,334.40	11,995	48.98	
2/4/1975	434,917	4,334.40	11,995	0.17	118.95		436,110	4,334.50	12,014	119.14	
2/5/1975	436,222	4,334.50	12,014	0.11	77.09		437,460	4,334.60	12,032	77.21	
2/6/1975	437,461	4,334.60	12,032	0.17	119.32		438,742	4,334.80	12,070	119.69	
2/7/1975	438,718	4,334.80	12,070	0.12	84.49		440,038	4,334.90	12,089	84.62	
2/8/1975	439,940	4,334.90	12,089	0.12	84.62		441,298	4,335.00	12,108	84.76	
2/9/1975	441,086	4,334.90	12,089	0.19	133.99		442,480	4,335.10	12,126	134.40	
2/10/1975	442,239	4,335.00	12,108	0.2	141.26		443,669	4,335.20	12,145	141.69	
2/11/1975	443,381	4,335.10	12,126	0.23	162.69		444,849	4,335.30	12,164	163.20	
2/12/1975	444,373	4,335.20	12,145	0.14	99.18		445,874	4,335.30	12,164	99.34	
2/13/1975	445,613	4,335.30	12,164	0.16	113.53		447,145	4,335.40	12,183	113.71	
2/14/1975	446,840	4,335.40	12,183	0.17	120.81		448,404	4,335.60	12,220	121.18	
2/15/1975	448,012	4,335.50	12,201	0.23	163.70		449,612	4,335.60	12,220	163.95	
2/16/1975	449,231	4,335.60	12,220	0.17	121.18		450,871	4,335.80	12,258	121.56	
2/17/1975	450,386	4,335.70	12,239	0.29	207.04		452,065	4,335.90	12,277	207.69	
2/18/1975	451,678	4,335.80	12,258	0.12	85.81		453,397	4,336.00	12,295	86.07	
2/19/1975	452,972	4,335.90	12,277	0.12	85.94		454,730	4,336.10	12,314	86.20	
2/20/1975	454,067	4,336.00	12,295	0.18	129.10		455,859	4,336.20	12,333	129.50	
2/21/1975	455,263	4,336.10	12,314	0.22	158.03		457,090	4,336.30	12,352	158.52	
2/22/1975	456,521	4,336.20	12,333	0.14	100.72		458,384	4,336.40	12,370	101.02	
2/23/1975	457,796	4,336.30	12,352	0.11	79.26		459,692	4,336.50	12,389	79.50	
2/24/1975	459,086	4,336.40	12,370	0.08	57.73		461,006	4,336.60	12,408	57.90	
2/25/1975	460,300	4,336.50	12,389	0.14	101.18		462,242	4,336.70	12,427	101.49	
2/26/1975	461,437	4,336.60	12,408	0.18	130.28		463,413	4,336.80	12,446	130.68	
2/27/1975	462,559	4,336.70	12,427	0.22	159.48		464,567	4,336.90	12,464	159.95	
2/28/1975	463,749	4,336.80	12,446	0.24	174.24		465,794	4,337.00	12,483	174.76	
3/1/1975	465,229	4,336.90	12,464	0.2	145.41		467,297	4,337.10	12,502	145.86	
3/2/1975	466,909	4,337.00	12,483	0.22	160.20		468,988	4,337.20	12,521	160.69	
3/3/1975	468,870	4,337.20	12,521	0.28	204.51		471,031	4,337.40	12,558	205.11	
3/4/1975	470,919	4,337.40	12,558	0.33	241.74		473,132	4,337.50	12,577	242.11	
3/5/1975	472,474	4,337.50	12,577	0.24	176.08		474,755	4,337.70	12,615	176.61	
3/6/1975	471,384	4,337.40	12,558	0.4	293.02		473,723	4,337.60	12,596	293.91	
3/7/1975	470,268	4,337.30	12,539	0.31	226.75		472,612	4,337.50	12,577	227.43	
3/8/1975	469,371	4,337.20	12,521	0.23	167.99		471,801	4,337.40	12,558	168.49	
3/9/1975	468,410	4,337.20	12,521	0.24	175.29		470,924	4,337.40	12,558	175.81	
3/10/1975	467,576	4,337.10	12,502	0.26	189.61		470,187	4,337.30	12,539	190.17	
3/11/1975	466,732	4,337.00	12,483	0.45	327.68		469,502	4,337.30	12,539	329.15	
3/12/1975	466,206	4,337.00	12,483	0.16	116.51		469,125	4,337.20	12,521	116.86	
3/13/1975	465,698	4,337.00	12,483	0.11	80.10		468,649	4,337.20	12,521	80.34	
3/14/1975	464,843	4,336.90	12,464	0.21	152.68		467,949	4,337.10	12,502	153.15	
3/15/1975	463,669	4,336.80	12,446	0.35	254.11		466,849	4,337.00	12,483	254.86	
3/16/1975	462,310	4,336.70	12,427	0.27	195.73		465,561	4,336.90	12,464	196.31	
3/17/1975	460,718	4,336.60	12,408	0.38	275.04		464,058	4,336.80	12,446	275.89	
3/18/1975	459,159	4,336.40	12,370	0.28	202.04		462,546	4,336.70	12,427	202.97	
3/19/1975	457,635	4,336.30	12,352	0.11	79.26		461,090	4,336.60	12,408	79.62	
3/20/1975	455,040	4,336.10	12,314	0.37	265.78		458,586	4,336.40	12,370	266.99	
3/21/1975	451,469	4,335.80	12,258	0.42	300.32		455,112	4,336.10	12,314	301.69	
3/22/1975	447,798	4,335.50	12,201	0.41	291.81		451,554	4,335.80	12,258	293.17	
3/23/1975	444,112	4,335.20	12,145	0.46	325.89		448,043	4,335.50	12,201	327.39	
3/24/1975	440,692	4,334.90	12,089	0.32	225.66		444,822	4,335.30	12,164	227.06	

Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft)
3/25/1975	437,449	4,334.60	12,032	0.38	266.71		441,693	4,335.00	12,108	268.39	
3/26/1975	434,137	4,334.40	11,995	0.52	363.85		438,503	4,334.70	12,051	365.55	
3/27/1975	430,909	4,334.10	11,939	0.29	201.97		435,376	4,334.50	12,014	203.24	
3/28/1975	427,607	4,333.80	11,882	0.15	103.97		432,235	4,334.20	11,957	104.62	
3/29/1975	424,632	4,333.60	11,845	0	0.00		429,471	4,334.00	11,920	0.00	
3/30/1975	421,487	4,333.30	11,788	0	0.00		426,493	4,333.70	11,863	0.00	
3/31/1975	418,019	4,333.00	11,732	0.18	123.19		423,240	4,333.50	11,826	124.17	
4/1/1975	414,471	4,332.70	11,676	0.47	320.12		419,806	4,333.20	11,770	322.69	
4/2/1975	411,049	4,332.40	11,619	0.32	216.89		416,482	4,332.90	11,713	218.64	
4/3/1975	407,336	4,332.10	11,563	0.21	141.65		412,874	4,332.60	11,657	142.80	
4/4/1975	403,318	4,331.70	11,488	0.35	234.55		408,904	4,332.20	11,582	236.47	
4/5/1975	399,861	4,331.40	11,432	0.49	326.76		405,516	4,331.90	11,525	329.42	
4/6/1975	396,560	4,331.20	11,394	0.48	319.03		402,244	4,331.70	11,488	321.66	
4/7/1975	393,285	4,330.90	11,338	0.39	257.94		398,953	4,331.40	11,432	260.08	
4/8/1975	390,268	4,330.60	11,281	0.25	164.51		395,948	4,331.10	11,375	165.89	
4/9/1975	387,563	4,330.40	11,244	0.19	124.62		393,559	4,330.90	11,338	125.66	
4/10/1975	385,429	4,330.20	11,206	0.29	189.57		391,685	4,330.70	11,300	191.16	
4/11/1975	384,088	4,330.10	11,187	0.25	163.14		390,822	4,330.70	11,300	164.79	
4/12/1975	383,990	4,330.00	11,169	0.22	143.34		391,040	4,330.70	11,300	145.02	
4/13/1975	383,002	4,330.00	11,169	0.28	182.43		390,397	4,330.60	11,281	184.26	
4/14/1975	382,185	4,329.90	11,153	0.3	195.18		389,859	4,330.60	11,281	197.42	
4/15/1975	380,921	4,329.80	11,137	0.44	285.85		388,993	4,330.50	11,263	289.08	
4/16/1975	379,662	4,329.70	11,121	0.66	428.16		388,079	4,330.40	11,244	432.89	
4/17/1975	378,654	4,329.60	11,104	0.72	466.37		387,381	4,330.30	11,225	471.45	
4/18/1975	378,021	4,329.50	11,088	0.46	297.53		387,159	4,330.30	11,225	301.20	
4/19/1975	377,700	4,329.50	11,088	0.34	219.91		387,472	4,330.40	11,244	223.01	
4/20/1975	377,079	4,329.40	11,072	0.42	271.26		387,517	4,330.40	11,244	275.48	
4/21/1975	376,397	4,329.40	11,072	0.35	226.05		387,314	4,330.30	11,225	229.18	
4/22/1975	374,435	4,329.20	11,040	0.64	412.16		385,917	4,330.20	11,206	418.36	
4/23/1975	372,568	4,329.00	11,008	0.42	269.70		384,612	4,330.10	11,187	274.08	
4/24/1975	370,801	4,328.90	10,992	0.38	243.66		383,969	4,330.00	11,169	247.58	
4/25/1975	370,954	4,328.90	10,992	0.52	333.42		385,488	4,330.20	11,206	339.92	
4/26/1975	372,536	4,329.00	11,008	0.66	423.81		388,242	4,330.40	11,244	432.89	
4/27/1975	375,760	4,329.30	11,056	0.53	341.81		392,601	4,330.80	11,319	349.95	
4/28/1975	378,560	4,329.60	11,104	0.35	226.71		396,408	4,331.10	11,375	232.24	
4/29/1975	380,543	4,329.70	11,121	0.47	304.90		399,263	4,331.40	11,432	313.43	
4/30/1975	381,888	4,329.90	11,153	0.41	266.74		401,590	4,331.60	11,469	274.30	
5/1/1975	382,625	4,329.90	11,153	0.47	305.78		403,248	4,331.70	11,488	314.96	
5/2/1975	382,979	4,330.00	11,169	0.4	260.61		404,546	4,331.90	11,525	268.92	
5/3/1975	383,065	4,330.00	11,169	0.36	234.55		405,684	4,332.00	11,544	242.42	
5/4/1975	382,992	4,330.00	11,169	0.54	351.82		406,634	4,332.00	11,544	363.64	
5/5/1975	382,561	4,329.90	11,153	0.86	559.51		407,164	4,332.10	11,563	580.08	
5/6/1975	382,530	4,329.90	11,153	0.45	292.77		408,191	4,332.20	11,582	304.03	
5/7/1975	383,340	4,330.00	11,169	0.42	273.64		409,561	4,332.30	11,601	284.22	
5/8/1975	384,601	4,330.10	11,187	0.44	287.13		410,863	4,332.40	11,619	298.22	
5/9/1975	385,514	4,330.20	11,206	0.48	313.77		411,755	4,332.50	11,638	325.86	
5/10/1975	385,983	4,330.20	11,206	0.41	268.01		412,237	4,332.50	11,638	278.34	
5/11/1975	386,339	4,330.30	11,225	0.4	261.92		412,612	4,332.60	11,657	272.00	
5/12/1975	386,805	4,330.30	11,225	0.5	327.40		413,096	4,332.60	11,657	340.00	
5/13/1975	387,568	4,330.40	11,244	0.53	347.63		413,874	4,332.70	11,676	360.98	
5/14/1975	388,624	4,330.50	11,263	0.46	302.22		414,947	4,332.80	11,694	313.79	
5/15/1975	390,087	4,330.60	11,281	0.49	322.45		416,430	4,332.90	11,713	334.80	
5/16/1975	392,091	4,330.80	11,319	0.54	356.55		418,447	4,333.00	11,732	369.56	
5/17/1975	395,204	4,331.00	11,356	0.42	278.22		421,579	4,333.30	11,788	288.81	
5/18/1975	399,678	4,331.40	11,432	0.33	220.07		426,074	4,333.70	11,863	228.36	
5/19/1975	404,609	4,331.90	11,525	0.57	383.21		430,915	4,334.10	11,939	396.97	
5/20/1975	410,076	4,332.30	11,601	0.61	412.80		435,671	4,334.50	12,014	427.50	
5/21/1975	415,808	4,332.80	11,694	0.73	497.97		440,190	4,334.90	12,089	514.79	

5/22/1975	421,550	4,333.30	11,788	0.58	398.83		443,896	4,335.20	12,145	410.91	
5/23/1975	427,497	4,333.80	11,882	0.41	284.18		446,663	4,335.40	12,183	291.38	
5/24/1975	433,656	4,334.30	11,976	0.45	314.37		449,367	4,335.60	12,220	320.78	
5/25/1975	440,036	4,334.90	12,089	0.56	394.91		452,560	4,335.90	12,277	401.05	
5/26/1975	446,127	4,335.40	12,183	0.49	348.23		455,729	4,336.10	12,314	351.98	
5/27/1975	451,361	4,335.80	12,258	0.58	414.73		458,091	4,336.30	12,352	417.91	
5/28/1975	455,628	4,336.10	12,314	0.59	423.81		459,730	4,336.50	12,389	426.39	
Date	Ebutte Total Storage (actual) (ac-ft)	Ebutte Computed Elevation (ft)	Ebutte Computed Area (acre)	Ebutte Pan Evap (in/day)	Ebutte Computed Total Evap (ac-ft/day)	Ebutte total Evap during deviation (ac-ft)	Ebutte total theoretical storage without deviation (ac-ft)	Ebutte computed theoretical Elevation without deviation (ft)	Ebutte Computed theoretical Area without deviation (acre)	Ebutte computed theoretical Evap without deviation (Ac-ft/day)	Ebutte total theoretical Evap without deviation (ac-ft)
5/29/1975	459,339	4,336.40	12,370	0.21	151.53		461,971	4,336.70	12,427	152.23	
5/30/1975	463,424	4,336.80	12,446	0.2	145.20		465,779	4,337.00	12,483	145.64	
5/31/1975	467,289	4,337.10	12,502	0.41	299.01		469,624	4,337.30	12,539	299.89	
6/1/1975	470,493	4,337.30	12,539	0.39	285.26		472,828	4,337.50	12,577	286.13	
6/2/1975	472,222	4,337.50	12,577	0.49	359.49		474,556	4,337.70	12,615	360.58	
6/3/1975	472,979	4,337.50	12,577	0.57	418.19		475,312	4,337.70	12,615	419.45	
6/4/1975	472,999	4,337.50	12,577	0.69	506.22		475,330	4,337.70	12,615	507.75	
6/5/1975	472,659	4,337.50	12,577	0.54	396.18		474,989	4,337.70	12,615	397.37	
6/6/1975	471,929	4,337.40	12,558	0.55	402.90		474,259	4,337.60	12,596	404.12	
6/7/1975	471,314	4,337.40	12,558	0.5	366.28		473,643	4,337.60	12,596	367.38	
6/8/1975	471,008	4,337.40	12,558	0.44	322.32		473,335	4,337.60	12,596	323.30	
6/9/1975	470,952	4,337.40	12,558	0.46	336.97		473,278	4,337.60	12,596	337.99	
6/10/1975	471,242	4,337.40	12,558	0.45	329.65		473,567	4,337.60	12,596	330.65	
6/11/1975	471,837	4,337.40	12,558	0.51	373.60		474,161	4,337.60	12,596	374.73	
6/12/1975	472,380	4,337.50	12,577	0.51	374.17		474,703	4,337.70	12,615	375.30	
6/13/1975	472,679	4,337.50	12,577	0.52	381.50		475,002	4,337.70	12,615	382.66	
6/14/1975	472,993	4,337.50	12,577	0.68	498.89		475,314	4,337.70	12,615	500.40	
6/15/1975	474,019	4,337.60	12,596	0.53	389.43	**33068**	476,339	4,337.80	12,633	390.57	**33525**

(Attachment B)
Appendix B
Rationale, Reference Material and Assumptions

Rationale, Reference Materials, and Assumptions made for Cochiti/Jemez Deviation model runs:

General
The URGWOM Accounting model layout was used with minimal rules from the WaterOps/Planning model(s). The model was trimmed down to include only objects from Cochiti to San Marcial.

Alternatives
For the purpose of this deviation of reservoir operations at Cochiti and Jemez, four alternatives are considered: Without Project, Cochiti Conservation storage only, Jemez Conservation storage only, and Cochiti and Jemez Conservation storage. Each alternative run attempts to meet one of two actions: a Recruitment hydrograph, or an Overbank hydrograph, as described below.

Data
Historic inflow and middle valley diversion, etc., data are used as input for the 1975-2005 period.

River Surface Area
The surface area used for evaporation calculations on the Rio Grande between Cochiti and Elephant Butte were obtained from Flo-2D simulations. Documentation of the Flo-2D model can be found in "FLO-2D Flood Routing Model Development Middle Rio Grande Cochiti Dam to Elephant Butte Reservoir250 Foot Grid System", 2007 and "FLO-2D Flood Routing Model Development Middle Rio Grande Cochiti Dam to Elephant Butte Reservoir 250 Foot Grid System Technical Addendum", 2008.

Model Setup
The model(s) include the addition of Rio Grande Conservation pools in Cochiti and Jemez for storing and releasing water to supplement flows for Recruitment and Overbanking operations, as described in the March 2003 Biological Opinion (BO) Reasonable and Prudent Alternatives (RPA).

Overbank Actions
Overbank is represented as 5800 cfs for 5 days at Central. The recession of the hydrograph(s) is required to drop by 250 cfs per day until reaching a flow of 1500 cfs. The ruleset for the model determines when the peak of the historical peak inflows occurs and then sets the target flow at Central using template values for 30 days for each Overbank action. The amount to store at Cochiti Lake and/or Jemez Canyon Reservoir and which action to attempt to operate to is determined based on the historic NRCS Forecasts at the Rio Grande at Otowi Bridge (Otowi). For Each month from February through April, the historic forecasts are used to determine if conservation storage at Cochiti and/or Jemez should take place (not too dry, < 50% of average, or too wet, >120% of average). Note the maximum storage for a overbanking action is 45,000 af. The maximum storage allowed at Cochiti Lake is 45,000 af and 25,000 af for Jemez Canyon

Reservoir. On April 15th , Cochiti Lake can begin to store up to the action requested amount, while Jemez Canyon Reservoir can store beginning in February. Because of the impacts to riparian and wetland vegetation, the model(s) force the conservation storage to be released by June 15. NOTE: There are occasions when the peak of the runoff can occur prior to May 1, or after June 15, thus water may not be captured in time to meet the action hydrograph, or is released prior to meeting the action hydrograph.

Other Assumptions

Set Trap Efficiencies at Cochiti and Jemez to a very low value to not capture sediment over the 30 year period, this keeps the permanent pool elevation from increasing up each year.

Use some of the inflow to counteract losses at Cochiti to keep recreation pool near full (about 50,000 af).

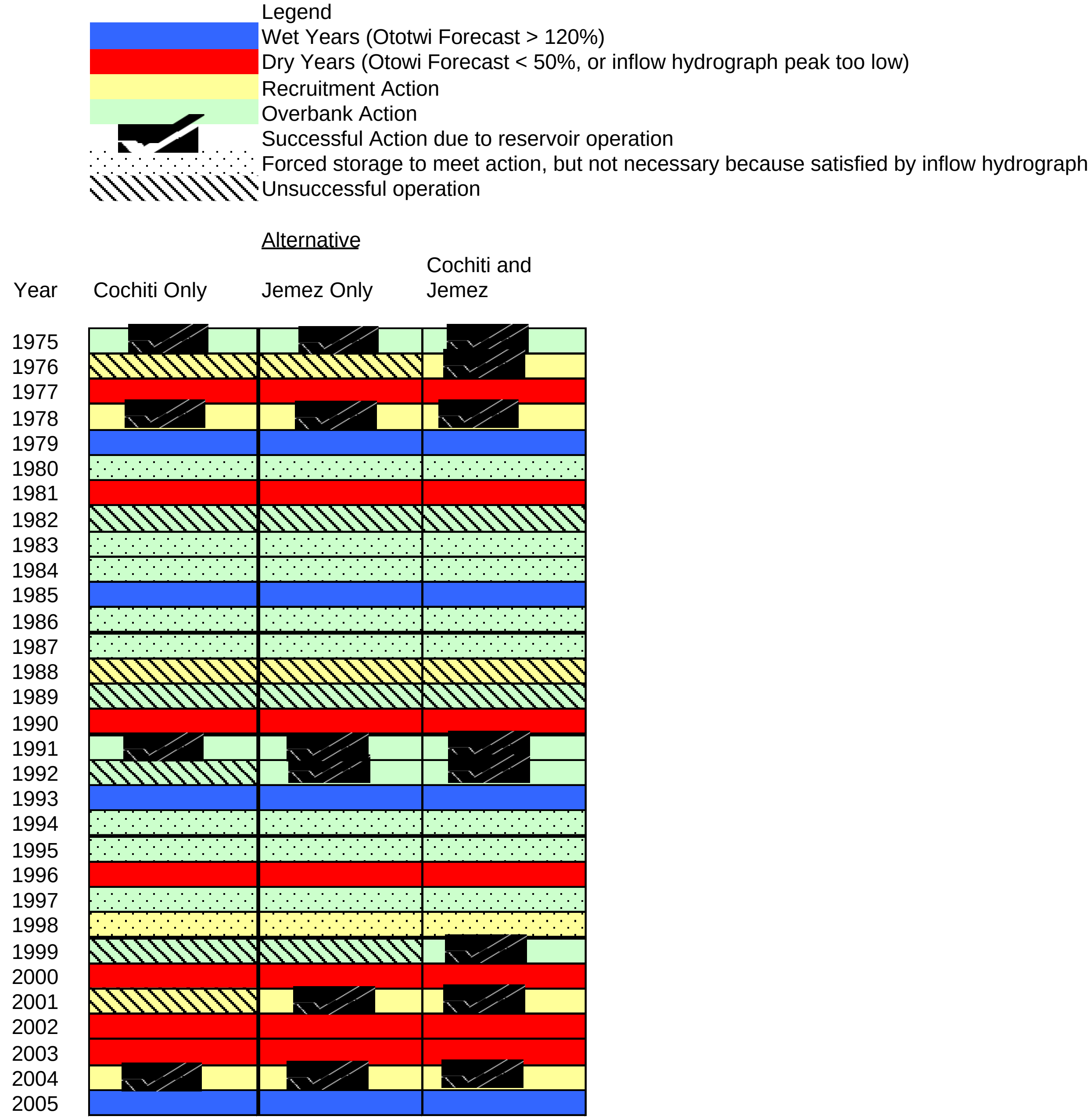
When Cochiti and Jemez are both storing and releasing conservation water, Jemez releases first to meet action.

To attempt to account for extra losses filling an empty Jemez Reservoir, seepage was included as another loss parameter in the mass balance - Seepage Coefficients used:
Base Elevation - 5160 ft (bottom of reservoir)
Slope - 0.4 ft2/s
Intercept - 0cfs
These coefficients result in seepage rates from 0 (when empty) to 14 cfs (when near 25,000 af).

Summary of Overbanking Actions at Cochiti Lake and Jemez Canyon Reservoir

Figure 2 provides an estimate of often a overbanking overbanking action might have been attempted over a 31-year period (1975 to 2005). As shown on Figure 2, overbanking conditions realizing at least 5,800 cfs for 5 days at the Albuquerque gage occurred in 10 of 31 years. During most of these years (8 of 31), overbanking flows occurred either through naturally wet years or attempted overbank actions. Spawning and recruitment actions were attempted only in 4 of 31 years, with a fully successful action occurring in only two of those years. In the other four years, the operation was either not fully successful, or the inflow hydrograph provided a sufficient overbanking flow.

Figure 2. Total Years in model runs: 31 (1975-2005)



NOTE: The figure above is based on Cochiti Lake storing starting May 1 and Jemez Canyon Reservoir on February 1. The number of years could change if storage at Cochiti Lake started on April 15, which is the earliest that an action would take place.

Appendix B

Cultural Resources Coordination

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

August 4, 2008

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Ms. Katherine Slick
State Historic Preservation Officer
New Mexico Department of Cultural Affairs
Historic Preservation Division
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Dear Ms. Slick:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers (Corps), Albuquerque District, is seeking your concurrence with our proposal for a study to determine the effects of inundation on sites and artifacts at Cochiti Lake, Sandoval County, New Mexico. The Corps is proposing to implement a temporary deviation from its water control plans for the Cochiti Lake Project (Cochiti) and the Jemez Canyon Reservoir Project (Jemez) to facilitate spawning and recruitment flows for the federally endangered Rio Grande silvery minnow (*Hybognathus amarus*) and provide overbanking opportunities to create ideal habitat for the federally endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*). The Projects are located in Sandoval County, New Mexico, and were authorized for flood and sediment control (Flood Control Acts of 1948, PL 858; 1950, PL 516; 1960, PL 86-645), recreation (Flood Control Act of 1944, PL 534), and development of fish and wildlife resources. All Project facilities and a major portion of the flood control pools are within the bounds of Cochiti and Santa Ana Pueblos. The duration of the planned deviation for both reservoirs is for five years, from late February through June, beginning in 2009.

The proposed deviation is *not* a deviation in permitted water levels at the Projects; rather it is a deviation in how and when water is stored, and what it is used for. Both Projects were designed for—and have often held—water levels at or above the maximum proposed water levels throughout the years. The deviation would not impact any land that has not already been under water for a significant period. For example, at Cochiti Lake, from 1976-2007, there have been an average of approximately 34.5 days per year with water levels within the maximum deviation level, and 27.1 days per year *above* the proposed deviation. Enclosure 1 details previous inundations at Cochiti for the last three decades. At Jemez, the water level would be consistent with and no greater than the permanent pool from 1986-2000, when the Interstate Stream Commission held 25,000 acre-feet of water per year.

Currently, the water level at Cochiti is 5,340 feet. Under the deviation, surface water elevation at Cochiti is anticipated to increase approximately 5 to 25 feet, up to a maximum of 5,366 feet. Currently, Jemez is drained, with a low point at 5,155 feet. Under the deviation, surface water elevation at Jemez is anticipated to increase approximately 10 to 41 feet, up to a maximum of 5,196 feet. The actual deviation would depend on anticipated run-off each year. Depending on actual flow conditions, water may be held in storage for 5 to 60 days prior to its release.

Impacts to historic properties as a result of the proposed deviation are hard to quantify. At Cochiti, 115 archaeological site boundaries intersect the 5,340 to 5,366-foot level (see Figure 1). However, all of these have been underwater multiple times. At Jemez, four sites intersect the 5,155 to 5,196-foot level (see Figure 2). Of these, LA 138836 is a railroad track that would not be affected by this project, LA 19231 is located 20 feet above the proposed water level, and LA 19228 is within the permanent pool and has been buried by sediment. LA 19241, a series of water control features, is partially in the area of deviation, but the area has been periodically covered by water (and sediment) since at least 1958.

Archaeological surveys and excavations at the dams served to mitigate adverse impacts from dam construction and use. Intensive surveys have been conducted for both projects. Part of that use has been water storage for flood control which has, over the past decades, inundated historic properties at both projects. The proposed deviation would not introduce adverse effects of a different kind, but may increase the duration or frequency of inundation. This use was not anticipated at the time of original construction (Jemez 1953, Cochiti 1975), and may result in unanticipated adverse effects to the sites.

The Corps is proposing a five-year study to determine the effects of inundation on artifacts and sites (see Enclosure 2).

This experimental study will track artifact movement(aluminum tags and washers) at four study locations (away from archaeological sites), each location containing 10 small artifact arrays. The purpose of this study is to assess adverse effects to historic properties (36 CFR 800.5) due to inundation. The results of the study will be used in consideration of adverse effects and resolution of adverse effects (36 CFR 800.6) for future deviations.

In sum, we seek your concurrence in our study to determine the effects of inundation on the historic resources at Jemez and Cochiti. If you have questions or require additional information regarding the Cochiti Lake and Jemez Canyon Reservoir Deviation Project, please contact Mr. Lance Lundquist, archaeologist, at (505) 342-3671.

Sincerely,

Julie Alcon
Chief, Environmental Resources Section

________________ I CONCUR ______________________________
Date
Katherine Slick
New Mexico State Historic Preservation Officer

Enclosures

Copy furnished w/Enclosures:

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DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
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August 4, 2008

Planning, Project and Program Management Division
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Ms. Katherine Slick
State Historic Preservation Officer
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Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Dear Ms. Slick:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers (Corps), Albuquerque District, is seeking your concurrence with our proposal for a study to determine the effects of inundation on sites and artifacts at Cochiti Lake, Sandoval County, New Mexico. The Corps is proposing to implement a temporary deviation from its water control plans for the Cochiti Lake Project (Cochiti) and the Jemez Canyon Reservoir Project (Jemez) to facilitate spawning and recruitment flows for the federally endangered Rio Grande silvery minnow (*Hybognathus amarus*) and provide overbanking opportunities to create ideal habitat for the federally endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*). The Projects are located in Sandoval County, New Mexico, and were authorized for flood and sediment control (Flood Control Acts of 1948, PL 858; 1950, PL 516; 1960, PL 86-645), recreation (Flood Control Act of 1944, PL 534), and development of fish and wildlife resources. All Project facilities and a major portion of the flood control pools are within the bounds of Cochiti and Santa Ana Pueblos. The duration of the planned deviation for both reservoirs is for five years, from late February through June, beginning in 2009.

The proposed deviation is *not* a deviation in permitted water levels at the Projects; rather it is a deviation in how and when water is stored, and what it is used for. Both Projects were designed for—and have often held—water levels at or above the maximum proposed water levels throughout the years. The deviation would not impact any land that has not already been under water for a significant period. For example, at Cochiti Lake, from 1976-2007, there have been an average of approximately 34.5 days per year with water levels within the maximum deviation level, and 27.1 days per year *above* the proposed deviation. Enclosure 1 details previous inundations at Cochiti for the last three decades. At Jemez, the water level would be consistent with and no greater than the permanent pool from 1986-2000, when the Interstate Stream Commission held 25,000 acre-feet of water per year.

Currently, the water level at Cochiti is 5,340 feet. Under the deviation, surface water elevation at Cochiti is anticipated to increase approximately 5 to 25 feet, up to a maximum of 5,366 feet. Currently, Jemez is drained, with a low point at 5,155 feet. Under the deviation, surface water elevation at Jemez is anticipated to increase approximately 10 to 41 feet, up to a maximum of 5,196 feet. The actual deviation would depend on anticipated run-off each year. Depending on actual flow conditions, water may be held in storage for 5 to 60 days prior to its release.

Impacts to historic properties as a result of the proposed deviation are hard to quantify. At Cochiti, 115 archaeological site boundaries intersect the 5,340 to 5,366-foot level (see Figure 1). However, all of these have been underwater multiple times. At Jemez, four sites intersect the 5,155 to 5,196-foot level (see Figure 2). Of these, LA 138836 is a railroad track that would not be affected by this project, LA 19231 is located 20 feet above the proposed water level, and LA 19228 is within the permanent pool and has been buried by sediment. LA 19241, a series of water control features, is partially in the area of deviation, but the area has been periodically covered by water (and sediment) since at least 1958.

Archaeological surveys and excavations at the dams served to mitigate adverse impacts from dam construction and use. Intensive surveys have been conducted for both projects. Part of that use has been water storage for flood control which has, over the past decades, inundated historic properties at both projects. The proposed deviation would not introduce adverse effects of a different kind, but may increase the duration or frequency of inundation. This use was not anticipated at the time of original construction (Jemez 1953, Cochiti 1975), and may result in unanticipated adverse effects to the sites.

The Corps is proposing a five-year study to determine the effects of inundation on artifacts and sites (see Enclosure 2).

This experimental study will track artifact movement(aluminum tags and washers) at four study locations (away from archaeological sites), each location containing 10 small artifact arrays. The purpose of this study is to assess adverse effects to historic properties (36 CFR 800.5) due to inundation. The results of the study will be used in consideration of adverse effects and resolution of adverse effects (36 CFR 800.6) for future deviations.

In sum, we seek your concurrence in our study to determine the effects of inundation on the historic resources at Jemez and Cochiti. If you have questions or require additional information regarding the Cochiti Lake and Jemez Canyon Reservoir Deviation Project, please contact Mr. Lance Lundquist, archaeologist, at (505) 342-3671.

Sincerely,

Julie Alcon
Chief, Environmental Resources
Section

8/7/08
Date

I CONCUR
Katherine Slick
New Mexico State Historic
Preservation Officer

Enclosures

Copy furnished w/Enclosures:

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Enclosure 1

Inundation of Cultural Resources at Cochiti Lake

The proposed deviation at Cochiti Lake would result in the inundation of 115 previously documented archaeological sites that lie at least partly above the current permanent pool water level, but whose boundaries intersect elevations between the permanent pool water level (5,340 feet) and the proposed deviation level (5,366 feet; see Figure 1). Inundation may be considered an adverse effect; however, the effects of this specific action are not likely to differ significantly from historical conditions since the dam's construction.

An important element in assessing potential impacts on sites within the deviation zone is the question of how the proposed action compares to current and past conditions. Will the requested deviation significantly change the conditions under which these sites have existed since the dam's construction? An unbroken record of daily water levels at Cochiti Lake between 1975 and the present allows for a fine-grained examination of water level patterns over time, particularly of the extent to which levels have been within or exceeded the levels of the proposed deviation. The following discussion shows that terrain at elevations within and even above the proposed deviation levels has repeatedly been inundated throughout the history of the reservoir, sometimes for periods longer than the requested deviation. As such, the Corps anticipates that the deviation will not introduce qualitatively new impacts to these sites; and further, that the limited parameters of the proposed deviation (no more than 60 days over 5,340 feet, of which no more than 45 days will be over 5,366 feet) will further limit the already minimal potential cumulative impacts to these resources.

Nonetheless, while the Corps anticipates little impact, it is also true that a fine-grained understanding of the precise effects of actions such as the proposed deviation on cultural materials is limited. The Corps therefore proposes, as a mitigation measure, a controlled study on the effects of said inundation on artifact movement (See Enclosure 2).

Because the Jemez Dam involves only four sites, the present discussion focuses solely on the archaeological sites and historical water levels at Cochiti Lake.

Archaeological Sites in the Deviation Zone

Of the 115 sites intersecting the proposed deviation zone, six percent (n=7) are recorded as dating to date to the Historic period (AD 1540 – present); 58 percent (n=67) are prehistoric; six percent (n=7) are multicomponent, including both prehistoric and historic occupations; and 30 percent (n=34) are of unknown age.

The amount of site overlap with the deviation level range (i.e. the percentage of site surface area intersecting elevations between 5,341 and 5,366 feet) averages 36 percent of each site's surface area for all sites, or a total of 78 acres for the entire project area.

This ranges from a per-site average of 31 percent for historic sites to 45 percent of multicomponent prehistoric / historic sites (Table 2), and from 29 percent for nonstructural sites to 37 percent for structural sites (Table 3). Site locations, with estimated areas of overlap, are shown in the map in Figure 1.

Table 1. **Sites intersecting elevations between the present permanent pool level and the proposed deviation level, by time period and site type.**

Period	Nonstructural	Structural	Total
Prehistoric	6.1% (n=7)	52.2% (n=60)	**58.3% (n=67)**
Historic	0% (n=0)	6.1% (n=7)	**6.1% (n=7)**
Both	0% (n=0)	6.1% (n=7)	**6.1% (n=7)**
Unknown	8.7% (n=10)	20.9% (n=24)	**29.6% (n=34)**
Total	**14.8% (n=17)**	**85.2% (n=98)**	**100% (n=115)**

Table 2. **Average proportion of sites (by time period) overlapping elevations between the permanent pool level and proposed deviation level.**

Period	Average Degree of Overlap with Deviation Levels
Prehistoric	34.3%
Historic	31.2%
Both	44.6%
Unknown	37.5%

Table 3. **Average proportion of sites (by site type) overlapping elevations between the permanent pool level and proposed deviation level.**

Period	Average Degree of Overlap with Deviation Levels
Nonstructural	28.7%
Structural	36.9%

Past Water Levels

As noted above, an examination of past water level data leads the Corps to conclude that the proposed deviation will have minimal substantive impacts beyond those associated with past reservoir conditions.

The period of the proposed deviation is between April 15 and June 15, a span that totals 62 days. During this period, water levels are anticipated to be raised between approximately five and 25 feet over normal conditions, for a maximum period of approximately 60 days. More specifically, the proposed deviation would be limited to a maximum of approximately 60 days above 5,340 feet; but of those 60 days, only 45 days may be at levels between 5,350 feet and 5,366 feet.

Using daily water level measurements collected at Cochiti Lake between 1975 and the present, it is possible to examine the frequency and duration of past periods during which water levels were at or above the permanent pool level of approximately 5,340 feet under historical dam conditions.

Figure 2 shows the average number of days in each month during which water levels at the lake been above the permanent pool level (5,340 feet), expressed in the three elevation increments relevant to the proposed action: within the deviation, between 5,340 and 5,350 feet; within the deviation, between 5,350 and 5,366 feet; and above the maximum deviation level entirely.

It is immediately evident that, historically, water levels typically increase between the months of February and August, peaking on average in May. As such, the period of the proposed deviation (from April 15 to June 15) falls squarely within the range during which levels already tend to be at their highest. Further, every month averages at least a few days above the permanent pool level, but the months of May and June average approximately 10 days each where water levels are within or above the proposed deviation levels.

Looking more closely at the deviation period itself, Figure 3 shows average numbers of days above the permanent pool level during the deviation period only. Breaking this period into a set of four time segments of 15 or 16 days each (April 15-30; May 1-15; May 16-31; and June 1-15), we see that these smaller time periods historically average between four and six days above the permanent pool level. Thus, the proposed deviation would result in a *maximum possible* addition of between nine and 11 additional days during each of these time segments, for a total of up to 41 additional days of higher water levels beyond the average for the last 32 years.

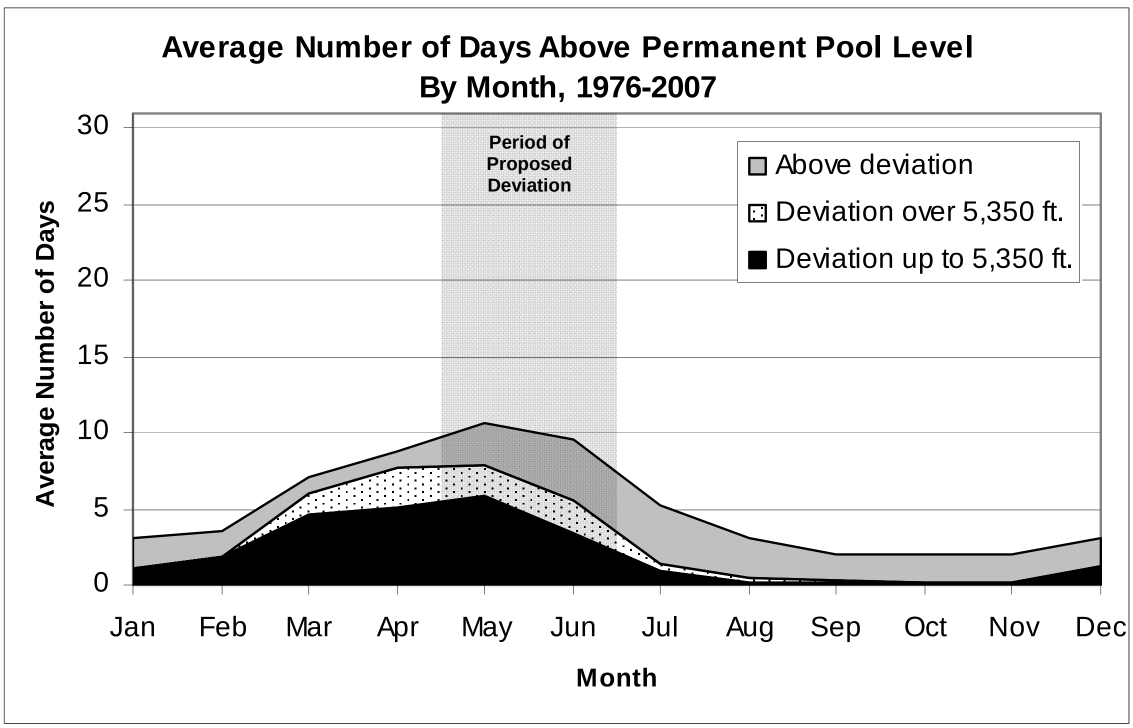

Figure 2. **Plot of the average number of days per month during which water levels at Cochiti Lake exceeded the current permanent pool level. This is based on daily water level data collected at Cochiti Lake between the years of 1976 to 2007 (the years for which entire-year data are available).**

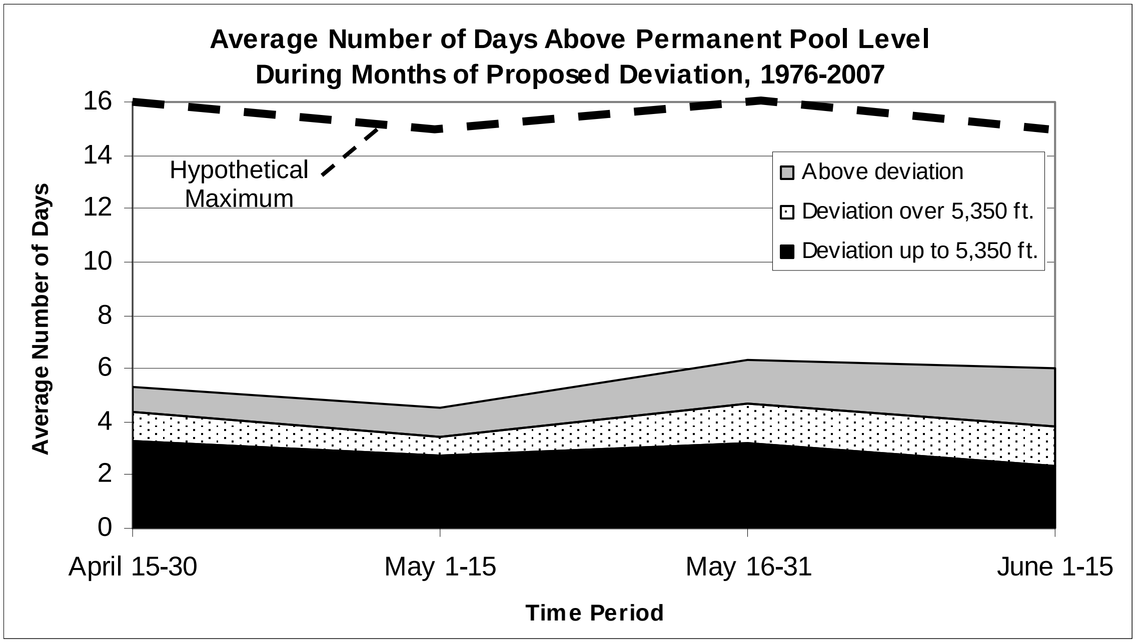

Figure 3. **Plot of the average number of days per time range (each 15 or 16 days total) during which water levels at Cochiti Lake exceeded the permanent pool level.**

These numbers are somewhat misleading, however. These are *averages* for the past three decades, but there is a great degree of variability in absolute water levels from year to year. Figure 4 shows a particularly wide range in the total number of days during which water in Cochiti Lake was above the permanent pool level for each year between 1976 and 2007 (the years for which entire-year data are available): levels have been above the permanent pool level for between zero and 300 days per year, or between zero percent and 82 percent of the year. Cumulatively, terrain at elevations within or above the deviation level – that is, elevations at or above 5,340 feet – have been at least partially inundated for a total of 1,971 days since 1975.

Focusing again only on the weeks in question for the deviation, Figure 5 shows the total number of days above the permanent pool level between April 15 and June 15 for each year between 1976 and 2007. The maximum possible number of days during this time period – 62 days – has been reached or approached three times in the last 32 years: in 1985, 1998, and 2007.

But those are figures for all water levels above the permanent pool level of 5,340 feet. While the deviation proposes a maximum of 60 days above this level, it places a further restriction on levels above 5,350 feet: no more than 45 of those days will have levels exceeding 5,340 feet. Thus, terrain at elevations above this level will experience a lower possible maximum number of days during this period at higher elevations. Figure 6 presents historic water levels above 5,340 feet between April 15 and June 15, showing that water was at elevations within this range for 45 days or more three years in a row (1985, 1986, and 1987), two of which saw water remaining at these levels for the entire April 15 – June 15 period. In all, the variability in past years strongly suggests that the proposed deviation at Cochiti Lake will not differ substantially from conditions that have existed in the recent past; indeed, it falls well within the range of variation that has characterized the last 32 years.

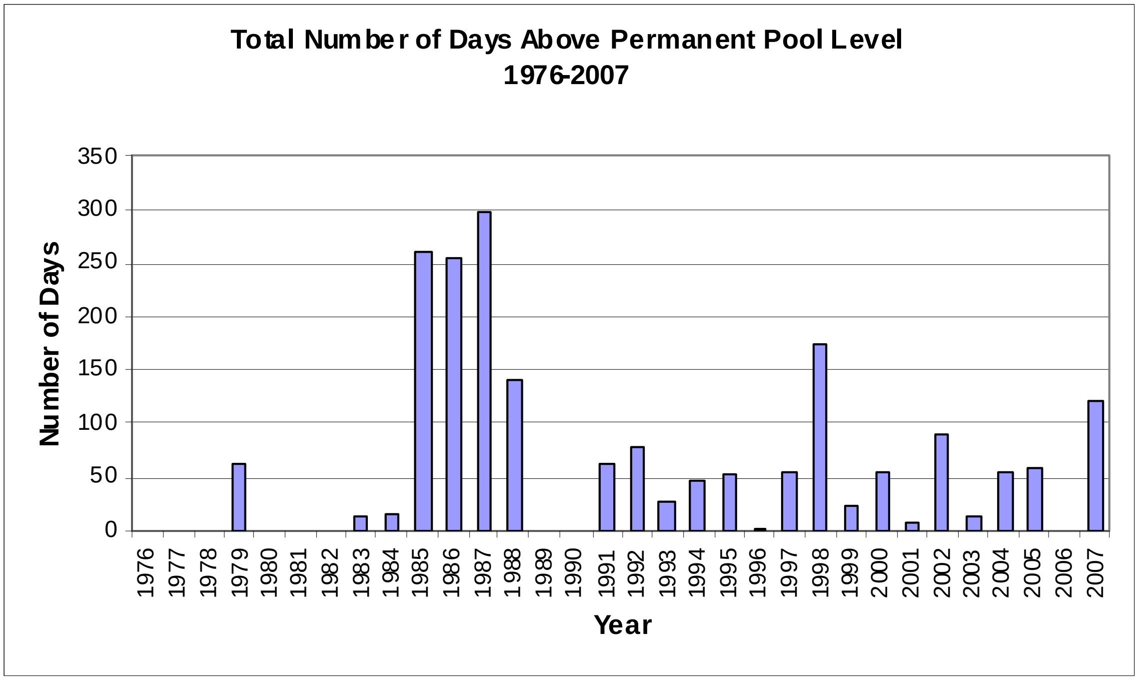

Figure 4. **Graph showing the total number of days per year during which the water level at Cochiti Lake exceeded the current permanent pool level between the years 1976 and 2007 (for which full-year data are available).**

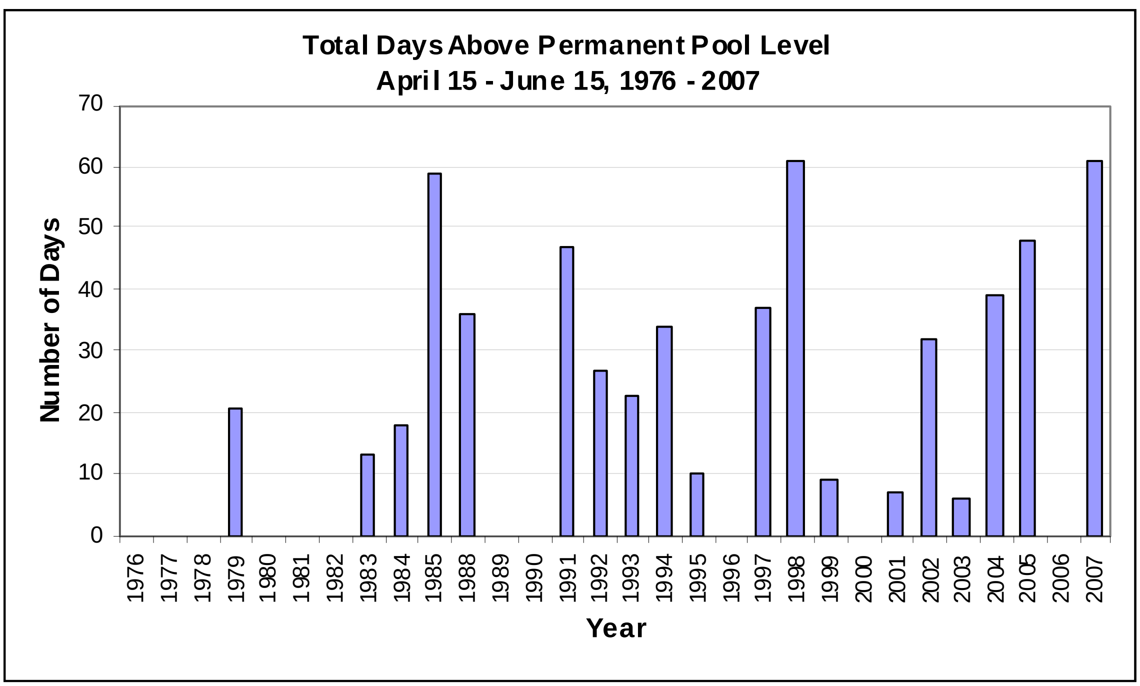

Figure 5. **Graph showing the total number of days between April 15 and June 15 (corresponding to the proposed deviation) during which the water level at Cochiti Lake exceeded the current permanent pool level for each year between 1976 and 2007.**

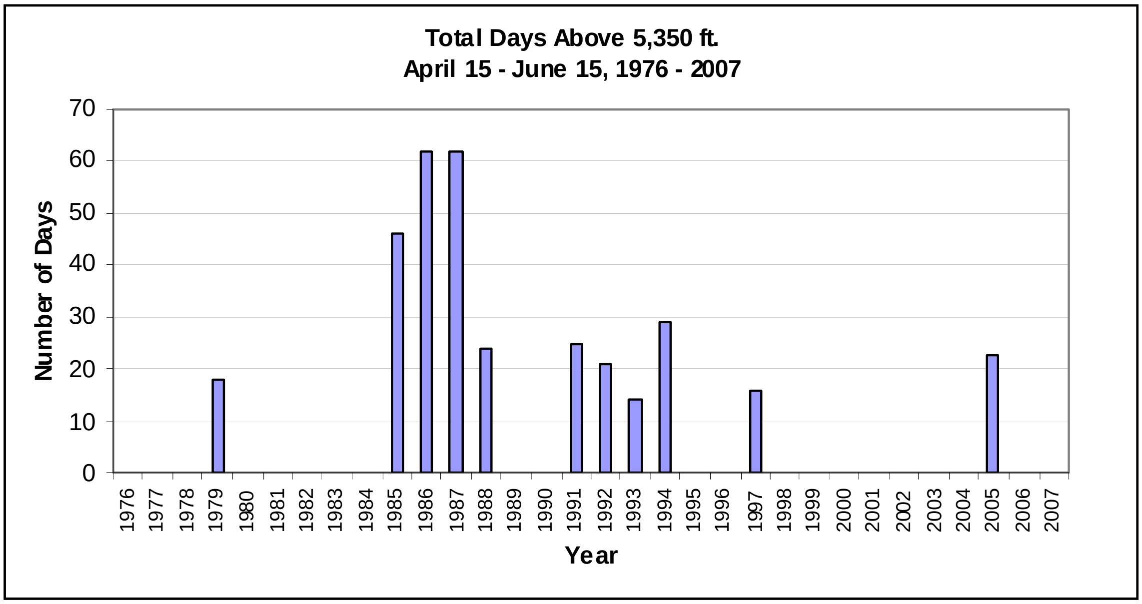

Figure 6. **Graph showing the total number of days between April 15 and June 15 (corresponding to the proposed deviation) during which the water level at Cochiti Lake exceeded 5,350 feet. The proposed deviation will not exceed this level for more than 45 days during this period.**

Summary

In sum, while the proposed deviation will result in additional inundation of 115 documented archaeological sites, the historic conditions of Cochiti Lake since dam construction have already inundated these sites frequently. The proposed deviation – particularly since it is of limited duration (up to 60 additional days per year over five years) should have relatively little additional effect beyond what has already occurred in the course of regular operation of the reservoir. Portions of these 115 sites have already been inundated for a total of 1,971 days over the last 32 years, and would be expected (on average) to be at least partially inundated for another 62 days each year. In this context, the addition of moderately increased levels within this range for a maximum of 60 days per year over five years is a relatively minor change; further, the fact that the deviation would occur during the months when water levels have historically been higher than average makes the relative potential increase even less substantial. The Corps therefore anticipates that the proposed action will have no qualitatively new impacts on these resources, and that any cumulative impact of the slightly increased duration of high water levels will be minimal. However, because the precise effects of periodic inundation on these sites are incompletely understood, the Corps proposes a controlled study of artifact movement as a mitigation measure for any potential adverse effects (see Enclosure 2).

Enclosure 2

Study of Artifact Movement in Inundated Context

The proposed deviation at Cochiti Dam will result in the inundation of 115 previously documented archaeological sites that lie at least partly above the current permanent pool level, but whose boundaries intersect elevations between 5,340 feet (the permanent pool level) and 5,366 feet (the proposed deviation level). Inundation may be considered an adverse effect on these sties; however, the specific context of this project suggests that the actual effects are not likely to differ significantly from historical conditions in this location since the construction of the dam and reservoir (see Enclosure 1). These sites have been inundated repeatedly over the last three decades, often for extended periods of time; as such, the restricted parameters of the proposed deviation will not result in qualitatively new impacts to these sites, and are not likely to significantly contribute to cumulative impact beyond those already occurring in association with normal reservoir operations.

However, while the Corps anticipates that the impacts of the proposed deviation will be minimal in comparison with past conditions, missing is a fine-grained understanding of exactly *how* actions such as the proposed deviation are specifically likely to affect cultural materials; in particular, the degree and intensity of mechanical processes on the dislocation of surface artifacts. The Corps proposes, as a mitigation measure and as a means to assess impacts to historic properties for future projects, a controlled experimental study on the effects of said inundation on artifact movement to be conducted over the five-year period of the proposed deviation. This study is intended to provide a more accurate and robust characterization of the ways in which inundation, particularly at levels near or within drawdown zones, affect archaeological resources in the environment of Cochiti Lake. The results of this study will provide a valuable baseline set of data useful for resource managers in the future, with specific focus on the effects of erosion, deposition, and spatial displacement of surface artifacts in periodically inundated contexts.

Background

An important component of predicting possible impacts to sites in the proposed deviation zone involves understanding the effects of inundation – especially periodic inundation, as is characteristic in reservoir drawdown zones – on the integrity of archaeological sites. There have been several studies investigating inundation effects in reservoir contexts (e.g., Dunn 1996; Lenihan et al. 1977; Lenihan et al. 1981; Phillips and Rozen 1982). Most of these have centered on observing actual archaeological sites that have experienced inundation, by examining site conditions at known sites during periods of low water levels. But while these studies allow us to generate certain expectations for probable impacts, we have not found any previous study that has studied such effects systematically within a controlled experimental framework. This proposed study will therefore augment the conclusions of these others; further, it will provide a baseline understanding of specific effects locally at Cochiti Lake for use in future decision making at the dam.

Archaeological sites in drawdown zones – areas that are periodically and repeatedly inundated and exposed due to shifting water levels – are particularly subject to impacts. Major processes affecting archaeological sites in these contexts are:

- **Mechanical processes**, including wave action, siltation, and slumping. Shallow-water wave action is seen to be the most important mechanical process affecting archaeological sites (Dunn 1996:16).
- **Biochemical processes**, which affect the degree of preservation of archaeological materials.
- **Human activity**, which includes both the human actions involved in constructing and use of dams and reservoirs, but also vandalism and artifact collecting.

Of these, this study will focus on the effects of the first: mechanical processes. The proposed Corps study is a close analog to a study conducted by Wandsnider (1986, 1988). In that study, Wandsnider assessed the effects of weather and dune processes on the movement of flaked stone artifacts in dune contexts. She placed lithic artifacts in a grid pattern at known positions on and around dunes on Albuquerque's West Mesa, and recorded their locations periodically over a period of approximately a year to gauge the relative effects of topographic context, weather conditions, wind direction, and artifact cross-sectional shape on wind-driven artifact movement. The proposed study will have a similar structure, examining the movement of artifacts at known, pre-determined locations across the landscape, although the anticipated cause of movement in the proposed study will be periodic inundation rather than wind movement.

Proposed Study

The proposed study will proceed as follows. In brief, the study calls for selecting artifacts of a standard size and shape and placing them at known locations in specific topographic contexts. On an annual basis, archaeologists will return to each location, and relocate these artifacts and record their current positions. These data will allow us to track the movement of artifacts across the landscape over time. In order to limit the scale of the undertaking, this study will not involve subsurface artifacts, except insofar as individual study artifacts may become buried by depositional processes during the course of the study. The focus on surface artifacts is also justified by the assumption that the ground surface is the interface at which the greatest impacts of the mechanical processes we seek to monitor will occur.

Selection and Marking of Test Artifacts

In order to control for factors such as artifact size, shape, and density, we will use commercially available aluminum discs in three sizes: small, medium, and large. The small and medium size classes will most likely be aluminum washers; the large size class will most likely be 1 ½-inch diameter aluminum tags. The goal is to approximate ⅛-inch, ¼-inch, and sherd-sized artifacts. Modern aluminum artifacts were selected for the following reasons.

- The use of low-value modern artifacts rather than lithic flakes or potsherds (even if of modern origin) prevents any confusion with already extant archaeological resources in the area, and will lessen the likelihood of collection and removal by passersby. Note that the study area is designed to avoid archaeological sites.

- Approximation of artifact characteristics:
  - Washers and round tags grossly approximate the shape and surface-area-to-mass ratio of the most ubiquitous prehistoric artifacts at archaeological sites (stone flakes and ceramic sherds). As larger flakes and sherds tend to be fairly thick relative to surface area, we will approximate an appropriate thickness in the largest size class by fusing three or four 1 ½-inch tags together (each 0.05 inches, or 1.3 millimeters thick) in a stacked configuration with marine-grade aluminum adhesive.
  - The density of aluminum is similar to that of most kinds of stone, glass, and ceramics[1], and aluminum would not be subject to the rusting and corrosion that would be a danger with steel in waterlogged contexts.
- Standardization:
  - The mass-produced nature of these items allows us to control for size and shape in a way that would not be possible with stone flakes.
- Benefits of metal:
  - The use of metal versus other materials allows us to stamp identifying information directly into the artifact, rather than labeling with material that may erode or dissolve over time (e.g. ink, paint, etc.; see Wandsnider 1988:21).
  - Metal allows displaced or buried artifacts to be re-located via metal detector.

Each test artifact will be stamped with unique identifying information, so that the movement of individual artifacts can be tracked across the landscape even if far removed from their starting points. The location coding system is described in the following section.

Study Location Selection

Four testing locations in two topographic contexts will be selected for this study. The central comparison of this study is between steep and level topography. Two locations in steep contexts and two locations in more level contexts will be selected, both to provide redundancy and to allow comparison not only between steep and level areas, but between steep and steep, and between level and level. Beyond topography, other criteria for selection of study locations will be a lack of overlap with archaeological sites, in order to avoid any impact the study itself might have on sites; and distance from areas of high foot traffic to lessen possible human impacts on the study.

Within each study location, placement of artifacts will be organized relative to stakes placed along a transect. In each study area, a series of 10 rebar stakes will be placed along a transect approximately perpendicular to the lake, and approximately parallel to the locale's primary topographic gradient; each transect will extend from an elevation of 5,340 feet to 5,366 feet. Nine stakes will be placed at elevation increments of approximately 39 inches (26 feet ÷ 8 increments, with stakes at both ends; see Figure 7). A single additional stake will be placed at a

[1] For comparison: aluminum (2.7 g/cm^3), glass (2.6 g/cm^3), quartz (2.6 g/cm^3), basalt (3.0 g/cm^3), and porcelain (2.4 g/cm^3), versus steel (7.9 g/cm^3).

higher elevation at each study area, above the expected level of inundation, to be used as a control. The location of each stake will be recorded via GPS.

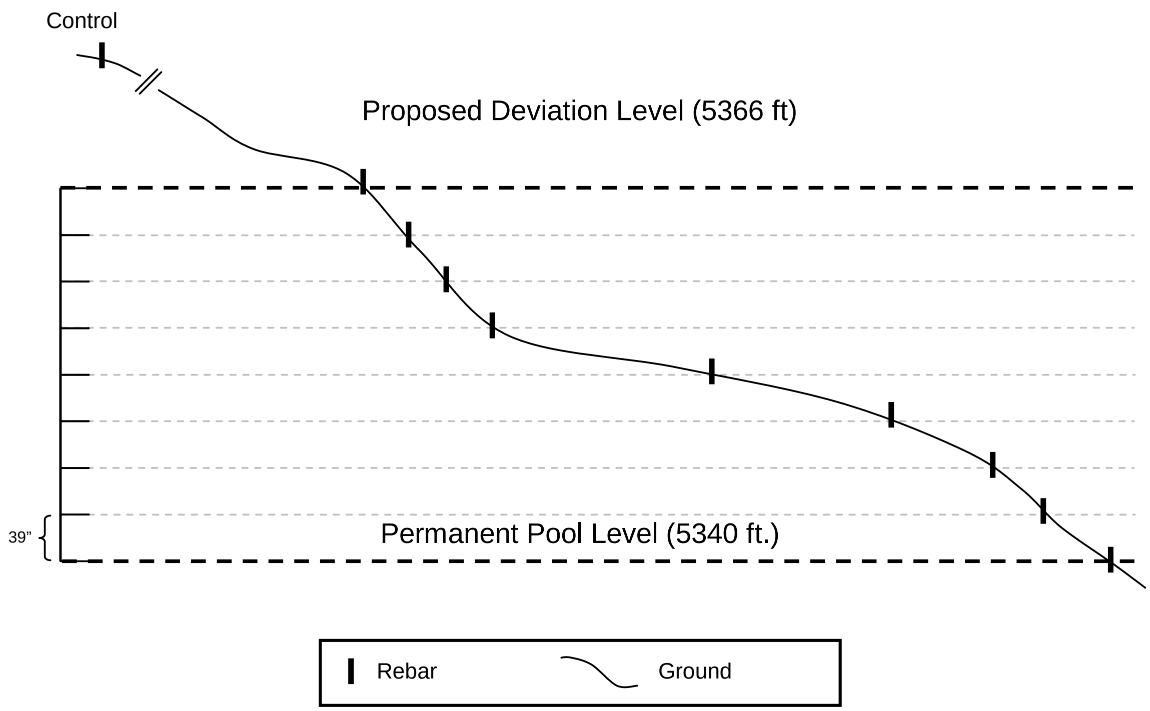

Figure 7. **Cross-sectional view of stakes placed along topographic gradient from the permanent pool level to the proposed deviation level. Stakes are placed at elevational increments of 33 inches, with a control stake placed well above the level of expected inundation.**

Each stake will form the center point for a study unit, which will consist of an artifact placement array. Using the stake as a datum, test artifacts will be placed at increments of 30 cm from the stake in the four cardinal directions (north, south, east, west). One test artifact of each size class will be placed in each of the cardinal directions from each stake, such that the small artifacts will be 30 cm from the stake, medium artifacts will be 60 cm, and large artifacts will be 90 cm (see Figure 8). In addition, the local topography of each study unit will be mapped by drawing cross-sectional profiles of ground surface slope along the north-south and east-west axes. Each profile will document surface topography extending to a distance of two meters from the stake in each cardinal direction, resulting in two perpendicular cross-sections totaling four meters in length each.

For location tracking, each stake will be numbered 1 through 9 (and "C" for the Control stake). Around each stake, there will be four test artifacts of each size class; therefore, each test artifact may be uniquely identified with two terms: stake and direction (in combination with washer size, which is self-evident in the artifact itself). For example, artifacts placed to the north of stake 2 will be stamped “2N.” Each stake will therefore represent 12 test artifacts, for a total (× 10 stakes) of 120 test artifacts at each study location.

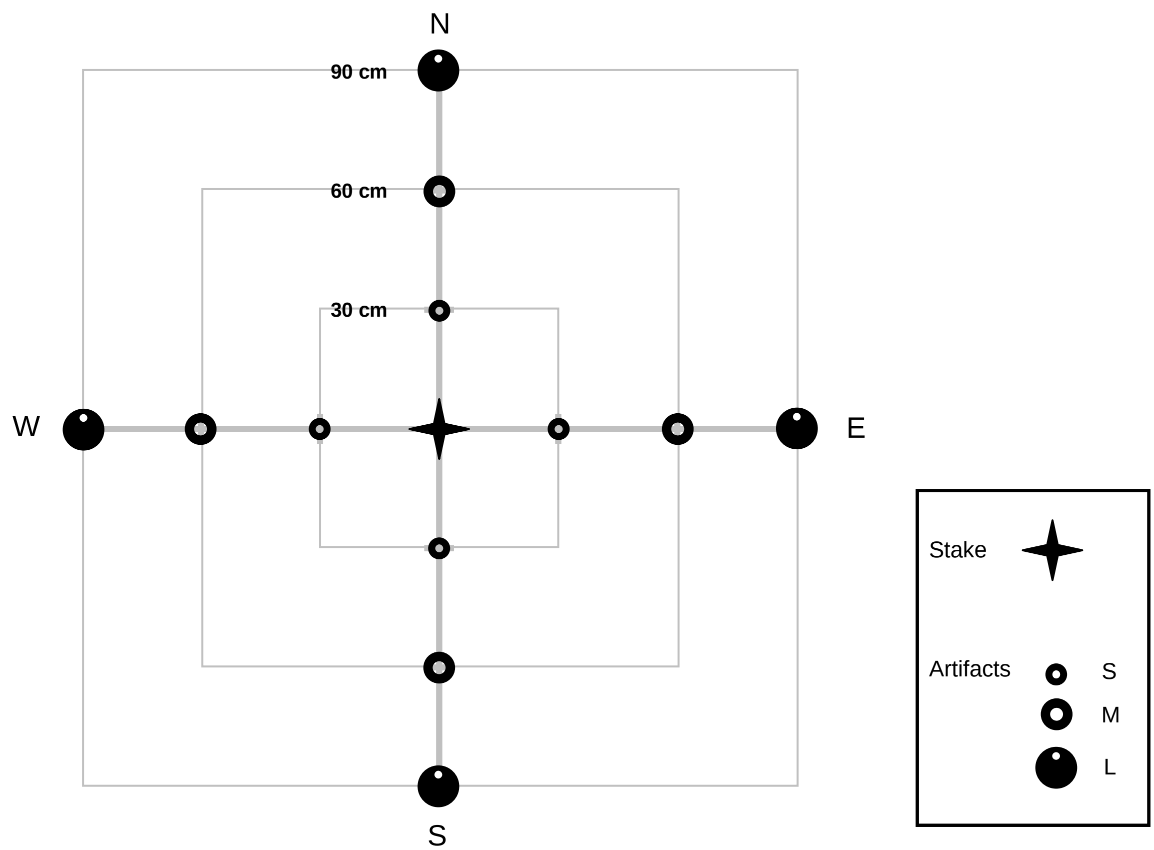

Figure 8. Individual study units: plan view of artifact placement around each rebar stake.

Four study sites will be selected, representing two topographical contexts: steep and level. For the sake of redundancy, particularly in the event that any one of these locations is disturbed during the period of the study, two steep locations and two level locations will be selected as study sites. In order to avoid any adverse effect on archaeological sites, the study will be located outside the boundaries of known archaeological sites.

Study Area Monitoring

After artifacts are in place and their locations recorded, the test locations will be revisited at intervals of approximately once a year (coinciding with low water levels) to measure artifact positions. Artifacts will be relocated first by visual observation; if not all artifacts are relocated via this method, then a sweep of the area will be conducted with a metal detector. For artifacts that are still located close to the datum stakes, their new locations will be measured relative to the base of the stake. For artifacts that are no longer within 5 m of a stake, their positions will be recorded via a sub-foot GPS.

Tracking Erosion and Deposition

The use of stakes as reference points will also provide a gross measure of the action of erosion or deposition on the individual study units. After stakes are put into position initially, the extent of the stake that is above ground will be measured (Figure 9). Upon each subsequent revisit to the area, the height of stake exposed will be remeasured, thus providing a rough gauge of erosion and/or deposition that has occurred at the study unit.

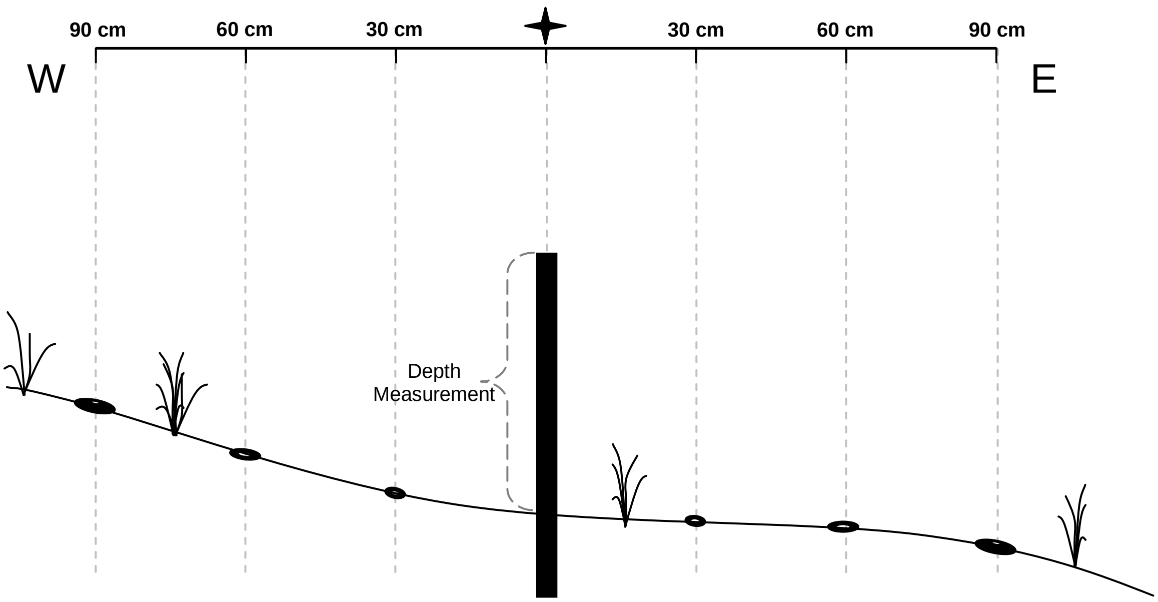

Figure 9. Cross-sectional view of washer placement around stake, showing depth measurement for tracking erosion/deposition.

Summary

Because the specific potential effects of the proposed deviation (and corresponding inundation) on these sites are incompletely understood, the Corps proposes a controlled study of artifact movement as a mitigation measure for any potential adverse effects that might result from the proposed deviation. In so doing, the effects of this deviation on site integrity under conditions specific to this locale can be assessed directly, in a controlled manner. This will provide valuable locally-specific information that will be of use to those making management decisions in the future, and it should also be more broadly applicable to similar contexts elsewhere as well.

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Appendix C

Biological Coordination

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July 17, 2008

Planning, Projects and Program Management Division
Planning Branch
Environmental Resources Section

Mr. Wally Murphy
Field Supervisor
U.S. Fish and Wildlife Service
Ecological Services Field Office
2105 Osuna NE
Albuquerque, NM 87113

Dear Mr. Murphy:

Please find enclosed a copy of the **Biological Assessment (BA) for the Temporary Deviation in the Operation Of Cochiti Lake And Jemez Canyon Reservoir, Sandoval County, New Mexico,** dated July 14, 2008.

The U.S. Army Corps of Engineers, Albuquerque District, (Corps) would like to pursue informal consultation on this project, pursuant to Section 7 of the Endangered Species Act (ESA) of 1973. The BA considers the potential effects to the federally-listed endangered Rio Grande silvery minnow (*Hybognathus amarus*) (minnow), and endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (flycatcher). This project proposes to support recruitment for the minnow and improve habitat for both the minnow and flycatcher throughout the Middle Rio Grande by increasing peak spring flows in some years by managing storage at Cochiti Lake and Jemez Canyon Reservoir. The BA addresses potential impacts on minnow reproduction and habitat during this project on listed threatened, endangered, or other special status species that may occur in the project area.

The Corps has determined that the proposed action may affect and is not likely to adversely affect the endangered silvery minnow, and may affect but is not likely to adversely affect designated Critical Habitat of the Rio Grande silvery minnow. The proposed action may affect, but is not likely to adversely affect the flycatcher, and may affect but is not likely to adversely affect designated Critical Habitat of the Southwest Willow Flycatcher. There are no other federally-listed species in the action area.

In conclusion, we request a letter of concurrence on the proposed action due to the potential benefits for the silvery minnow and willow flycatcher.

Please contact me at 505/342-3281 or Dr. Michael Porter, Fish Biologist at 505/ 342-3264 with any questions or comments.

Sincerely,

Julie Alcon, Chief
Environmental Resources
Section

Enclosures

United States Department of the Interior

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

August 25, 2008

Cons. # 22420-2008-I-0141

Ms. Julie A. Alcon
Chief, Environmental Resources
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Ms. Alcon:

Thank you for your letter of July 17, 2008, requesting concurrence on determinations made in the July 14, 2008, Environmental Assessment (EA) for a temporary deviation in the operation of Cochiti and Jemez Canyon Dams under section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1534 et seq.). You determined in your EA that the proposed project "may affect, not likely to adversely affect" the Rio Grande silvery minnow (*Hybognathus amarus*) (minnow), the endangered southwestern willow flycatcher (*Empidonax trailli extiums)* (flycatcher) and their designated critical habitat. The project located in Sandoval County, New Mexico at Cochiti Lake and at Jemez Canyon Reservoir.

The U.S. Army Corps of Engineers (Corps) proposes to temporarily store up to 45,000 acre-feet of water in the flood pool at Cochiti Lake, and up to 25,000 acre-feet at Jemez Canyon Reservoir, to be released in a manner that provides a silvery minnow recruitment flow of 3,000 cubic feet per second (cfs) (at the Albuquerque gage) for 10 days and/or overbank flows of up to 5,800 cfs for 5 days for flycatcher habitat enhancement. Storage would begin in late April or early March, on the ascending limb of the runoff hydrograph, and only when native flows exceed downstream demands. It is anticipated that the release of the stored water would occur in mid-May through early June and would not exceed 1,000 cfs per day. Recession associated with the recruitment flow would drop by no more than 250 cfs per day until flows reach 1,500 cfs. All temporarily stored water not used to meet recruitment or overbank flows would be completely evacuated from the reservoir by June 15 to assure its downstream delivery to Elephant Butte Lake. The timing of storage and release would be coordinated with Middle Rio Grande stakeholders, including the U.S. Fish and Wildlife Service (Service) and Bureau of Reclamation (Reclamation).

This action is proposed pursuant to the Service's March 2003, *Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers'*

Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico (USFWS 2003a). The Reasonable and Prudent Alternative of this Biological Opinion requires, in part, that the Corps and Reclamation annually provide an increase in flows to cue spawning of the minnow.

The Service recognizes that this proposed deviation is contingent upon the following:

1. A Memorandum of Agreement for temporary storage between the Corps and the Pueblo de Cochiti and between the Corps and Pueblo of Santa Ana;
2. Approval by the Rio Grande Compact Commission; and

We concur with your determinations for the following reasons:

Flycatcher. The proposed action may affect, but would not adversely affect the flycatcher. Small linear patches of willows that may be suitable habitat for flycatchers exist within the project area. Migrant flycatchers have been observed in recent surveys however, nesting has not been documented. With the proposed action, emergent and shrub wetland communities in White Rock Canyon may become partially inundated during late April through mid-June. Migrant flycatchers may be temporarily displaced from vegetation shorter than 5 meters (m) in height, however, taller vegetation (7-10 m) will be only partially submerged. Additionally, suitable foraging habitat and cover exists immediately upstream and downstream from the inundated reach. Because vegetation will not be completely submerged and flycatchers will be able to find suitable habitat within White Rock Canyon the effects of this the proposed temporary storage on flycatchers is expected to be insignificant and discountable.

Minnow. The proposed action may affect, but would not adversely affect the endangered minnow. Rather, the species is expected to directly benefit from the increased spawning and recruitment potential provided by augmented flows in the Middle Rio Grande. A protracted recruitment flow of 3,000 cfs for 10 days is expected to improve minnow spawning and recruitment by increasing the amount of available nursery habitat during spring snowmelt.

Minnow and Flycatcher Designated Critical Habitat. Effects to designated critical habitat are not expected to be adverse. Instead, increased discharge over a longer peak than might occur naturally is likely to result in beneficial effects on critical habitat.

The proposed action is likely to have a positive short-term impact on three of the four primary constituent elements (PCEs) of critical habitat for the minnow. These include backwaters, shallow side channels, pools, and runs of varying depth and velocity; substrates of primarily sand and silt; and the presence of eddies created by debris piles, pools or backwaters, or other refuge habitat within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wider range of depth and velocities. The proposed action will increase the availability of these critical nursery habitats for minnow eggs and larvae and enhance opportunities for minnow recruitment.

Additionally, the proposed action is expected to have a positive impact on the PCEs of flycatcher habitat by increasing the duration of higher spring flows. High flows support critical habitat elements including a riparian habitat in a dynamic successional riverine environment, and a variety of insect prey populations found within or adjacent to riparian floodplains or moist environments.

Please contact the Service to verify the above determinations are still valid if: 1) Future surveys detect listed, proposed or candidate species in habitats where they have not been previously observed; 2) the project is changed or new information reveals effects of the actions to the listed species or their habitats to an extent not considered in these evaluations; or 3) a new species is listed that may be affected by these projects.

This concludes section 7 consultation on the proposed temporary deviation in the operation of Cochiti and Jemez Canyon Dams. Thank you for your concern for endangered species and New Mexico's wildlife habitats. If we can be of further assistance, please contact Jennifer Norris of my staff at the letterhead address, or at 505-761-4710.

Sincerely,

Wally Murphy
Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Albuquerque Area Manger, Bureau of Reclamation, Albuquerque, New Mexico

Appendix D

Public Review Comments

Review Comments

U.S. Army Corps of Engineers
Draft Environmental Assessment for a
Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir,
Sandoval County, New Mexico
August 2008

General Comments:

1. Review use of Cochiti Lake or Cochiti Dam,

2. There are 2 Projects and the deviation could be worded as a proposed "Project",

3. Species information needs to be updated with 2006, 2007, and 2008 if available,

4. The only flows being discussed in the EA as part of the proposed action are spawning and recruitment flows, so on page 2, 3rd paragraph where it states that "… provide suitable flows essential for …" what flows are being referred to?

5. Separating all the categories under Chapter 3 into Cochiti, Jemez and RG channel would be an effective way to describe baseline conditions and carry over to Chapter 4. In Chapter 4 then the EA is assessing the impacts from the deviation on Cochiti and Jemez reservoirs, and on the use of the water stored by the deviation in the RG channel.

6. At a recent meeting, 10/08/08, with the Corps, we discussed the need to be flexible in our decision making regarding the subject EA as new silvery minnow information becomes available. The subject EA should reflect this need.

Specific comments:

Page ii, last sentence: Why not explicitly define the duration of spawning and recruitment flows at either seven or ten days to remove ambiguity? (the next paragraph is more explicit in the magnitude and duration of flows needed to accomplish overbanking).

Page iii, first paragraph: Should explicitly define this second action as an overbanking flow.

Page 1, third paragraph: The way this paragraph reads suggests that an annual BO requirement was not met. Propose that a sentence be added to clarify that the need for, timing, magnitude, and duration of the spawning spike is determined in coordination with the Service and that in some years, the natural flows in the river system are sufficient to provide such flows without action agency intervention. Also, the last two sentences in this paragraph would be better served as a part of the following paragraph discussing the history of spawning spike occurrences. The last sentence should mention that for the Cochiti Lake Project a deviation was done in 2007.

Section 2.02, Paragraph 2: revise first sentence to read: The U.S. Bureau of Reclamation (Reclamation) acquires and maintains a pool of Supplemental Water (USBR 2006b) used to meet the various flow and habitat support requirements in the 2003 Biological Opinion (USFWS 2003a).

Section 2.02, Paragraph 2: change last sentence as follows: If the Service determines that augmentation of native Rio Grande flows to provide sufficient spawning and recruitment opportunities is necessary and is a high priority need (recognizing the limited Supplemental Water supply), then the action agencies, in coordination with parties to the consultation, would discuss this request with the Service.

Section 2.03, Paragraph 1: Shouldn't the proposed deviation action be predicated on the need for an action as requested by the Service? The 2003 Biological Opinion, RPA A, states the need for, timing, magnitude, and duration of spawning flows will be determined in coordination with the Service and RPA V states the timing, amount, and locations of overbank flooding will be planned each year in conjunction with the Service.

Page 3, 1st paragraph states that coordination has been done with Cochiti and Santa Ana Pueblos on the deviation, but has coordination been done with Isleta Pueblo on the overbanking because that will affect Isleta Pueblo. Coordination with the Interstate Stream Commission (NMISC), Reclamation, and the Service is also necessary. Reclamation has a shared 2003 Biological Opinion responsibility in providing recruitment flows, when necessary, and in determining if offsets for recruitment flows are available. While Reclamation does not have a 2003 Biological Opinion responsibility for overbank flows, coordination with Reclamation is necessary due to our river maintenance responsibilities.

Page 3, 5th paragraph, under the No Action, Reclamation and all appropriate parties discuss and implement the best ways to use any available supplemental water.

Page 4, first paragraph, 2nd full sentence: Remove the ambiguity on duration and select either a seven or a ten-day flow for spawning and recruitment flow

Page 4, paragraph 3: The creation of overbank flows below Isleta Diversion Dam will also require coordination with Reclamation and the MRGCD to ensure that sufficient flows are passed over Isleta Diversion Dam to allow for the overbanking condition to happen. The MRGCD diverts native flows to meet irrigation demands regardless of how those flows in the river are created.

Page 4, last paragraph: The parsing of reservoirs according to action does not make sense – from the description it appears that both reservoirs either individually, or in concert, could be used to contribute recruitment and overbanking flows? Also – who are the "parties agreeing" with the Corps prior to the coordination with Rio Grande Engineer Advisers, USFWS, and Reclamation? NMISC should be explicitly included here. Regarding recruitment flows, state that every year of the five years Reclamation and the

USACE will coordinate annually with the Service to determine if a recruitment flow is needed for silvery minnow population management . Reclamation, the USACE, the NMISC need to agree on the magnitude and the source of offsets for recruitment flows prior to the Corps initiating storage for such flows.

Page 5, Paragraph 1, third sentence: Based on travel time, is it possible to extend the evacuation period to June 20 or later to assist in managing recession flows? An extension in the evacuation period could provide additional benefit to RGSM rescue and salvage efforts.

Page 5, Paragraph 1, last two sentences: There is no discussion of why depletions associated with this action are of concern or the impacts of not offsetting depletions. The methods to estimate losses consider other factors such as seepage, and are being developed jointly between the Corps, the NMISC, and Reclamation. Delete the last sentence and refer to the draft MOU between Reclamation, the Corps, and the NMISC ~~Commission~~ regarding who will offset losses associated with the Corps' actions. Reclamation has a shared 2003 Biological Opinion responsibility with the Corps to provide recruitment flows. If Reclamation determines sufficient supplemental water is available and appropriate for use in a given year to meet the 2003 Biological Opinion instream flow targets, then additional supplemental water could be made available to offset all or part of the depletions associated with recruitment flows. Reclamation will not provide supplemental water to offset depletions associated with overbank flows.

Page 5, sixth paragraph mentions a MOA with Cochiti Pueblo in Appendix B. The agreement is not in the appendix for review, and based on the agreement that was done in 2007 there may be issues with such an agreement. One of the stipulations in the 2007 agreement was the consideration that would be required for future deviations. Why wouldn't a similar agreement be executed with Santa Ana Pueblo?

Page 8, 4th paragraph last sentence does not seem to be in the right place because this section is alternatives eliminated.

Page 8, last paragraph: The 2003 Biological Opinion states under RPA element V that the Corps is responsible for the bypass or release of floodwater during the spring to provide for overbank flooding. Under the 2003 BO, Reclamation's is not required to provide such flows or offset associated depletions. RPA element B states that, in coordination with the Service, Reclamation and the Corps shall release any supplemental water in a manner that will most benefit the species. Reclamation's main water–related priority from the 2003 Biological Opinion is meeting instream flow targets. As was stated previously, the amount of San Juan-Chama project water available for lease to Reclamation's Supplemental Water Program is projected to decrease thereby requiring careful future management of this diminishing resource. See the comment above for Page 5, Paragraph 1 regarding Reclamation commitment to offsetting depletions.

Page 11, Rio Grande Channel discussion: This discussion would benefit by significant expansion to discuss the fate of waters released due to the deviation. It should include the multiple uses of the channel, channel capacities, other diversions, and the importance of Rio Grande Compact deliveries with native flows. The discussion should also identify the major stakeholders who exert influence over the amount, timing and duration of waters in the channel together with brief mention of the coordination of operations in this river system.

Page 11, bottom paragraph under RG channel, Cochiti Pueblo has also constructed beneficial restoration projects. But under the heading it should be a baseline description of the entire channel from Cochiti south setting up the info on page 12-13.

Page 14, Section 3.05 – Discussion of hydrology should also include some background on the Rio Grande Compact, deliveries under the Compact and the concern over additional depletions to the system.

Page 17 to 22 could benefit from having more recent species survey information. The FONSI states needs for 3,000 cfs for 7-10 days or 5,800 cfs for 5 days, so in Chapter 3 existing information should be included to support these flows.

Page 27, Section 3.10. The section on Indian Trust Assets (ITAs) would benefit from more explicit discussion of specific assets affected during this action as well as mention of the close coordination with the Pueblos of Cochiti and Santa Ana that will be needed to ensure that ITAs are properly protected.

Page 29, Rio Grande Channel discussion, line 8: change “deceases” to “decreases”

Page 30, Section 4.03, Paragraph 3: Delete all existing references to Reclamation offsetting conveyance and evaporation losses associated with the proposed actions by using the Supplemental Water Program. Replace with the following language; Reclamation has a shared 2003 Biological Opinion responsibility with the Corps to provide recruitment flows. If Reclamation determines sufficient supplemental water is available and appropriate for use in a given year to meet the 2003 Biological Opinion instream flow targets, then additional supplemental water could be made available to offset all or part of the depletions associated with recruitment flows. Reclamation will not provide supplemental water to offset depletions associated with overbank flows.

Page 30, Section 4.03, Paragraph 4: The MRGCD should be included in the list of agencies involved in the release decision as their diversions of native flows at Isleta Diversion Dam could affect the amount of water available for overbanking downstream of the dam.

Pages 30 and 31, Section 4.03: There is no discussion of depletions as a hydrologic effect stemming from this action – yet Appendices A and B involve extensive methodology and proposed MO~~A~~U language on the issue. See attached for Reclamation’s comments on the proposed MO~~A~~U. This section should be extended to explain why depletions are an issue and the losses for each action at each reservoir associated with implementing recruitment and overbanking flows should be explicitly identified.

Page 32, Rio Grande Channel discussions: These discussions would benefit by more detailed discussion of the areas of potential impact – i.e., what differences in effects would be occurring between Cochiti Dam and Isleta Diversion Dam (highly channelized, only limited overbanking possible) versus downstream of Isleta Diversion Dam (relatively unconstrained overbanking)? The current discussion suggests that all reaches would experience similar effects.

Page 34, Foreseeable Effects paragraph 2: The sentence concerning agreements implies that the Pueblo of Santa Ana will be involved in an agreement for actions at Cochiti Lake, not at Jemez Canyon Reservoir?

Page 34, Socioeconomic Resources: The magnitude and nature of socioeconomic impacts at Cochiti Lake should be explicitly summarized rather than simply stating that they occur. Perhaps the discussion of Indian Trust Assets and Recreational Impacts on

Page 34 and 35, the socioeconomic and recreational impacts are conflicting as written. There may be socioeconomic impacts but there are no significant recreational impacts. Any impacts during Memorial Day weekend affects the local economy.

Page 35 should precede the conclusions relative to socioeconomic impacts.

Page 35, under Indian Trust Assets the deviation has been coordinated with Cochiti and Santa Ana Pueblos, but the impacts from overbanking (the use of the stored water under the deviation) has impacts on Pueblos downstream like Isleta Pueblo. The Governor has presented an opinion on the overbanking issues within Isleta Pueblo and future overbanking should be coordinated with that Pueblo. Other Pueblos have restoration projects within their boundaries at it may be prudent to also coordinate with when any higher flows are considered

Appendix A – The depletions methodology is not final and is still in discussions – it should have been identified as a draft in this EA. In a recent, 10/08/08, meeting with the Corps, it was agreed to split the methodologies for accounting for offsets between recruitment (a new Appendix A) and overbank (a new Appendix B). Reclamation will only agree to the methodology for accounting for offsets of depletions associated with recruitment flows.

Appendix B – There was no draft agreement provided for Cochiti Pueblo. Also – should a similar agreement be executed with Santa Ana Pueblo for the potential use of Jemez Reservoir?

United States Department of the Interior
NATIONAL PARK SERVICE
Bandelier National Monument
15 Entrance Road
Los Alamos, New Mexico 87544-9508

IN REPLY REFER TO:
L7619 (BAND)

October 17, 2008

U.S. Army Corps of Engineers
Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Michael Porter)
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

Dear Mr. Porter:

We appreciate the opportunity to provide written comments on the Army Corp of Engineers (ACE) Cochiti Deviation Environmental Assessment (EA) which proposes to temporarily store spring runoff in Cochiti Reservoir for purposes of silvery minnow recruitment and overbank riparian restoration flows downstream. Our recent meetings with your staff were very informative and allayed many of our initial concerns about the proposed action. Following are some of the remaining issues we think still warrant your attention and which need to be adequately addressed prior to implementation of any deviation.

As managers of the riparian corridor within the upper reach of Cochiti Reservoir, our primary concern is with the potentially negative impacts of water storage events on developing willow and cottonwood bosque vegetation, as well as to potential southwestern willow flycatcher breeding habitat. Obviously, the risks of negative impacts increase with the greater depth/duration of deviation storage associated with the overbank scenarios.

To bolster the argument that recruitment storage would not impact native riparian vegetation, it would be useful to present a reconstruction of recent (i.e. since 1990) water holding events for several cross sections representing the lower delta reach in relation to observed vegetation establishment and mortality (as reconstructed from photo series and ground observations); this would establish what types and frequencies of inundation the willow (and cottonwood) has successfully endured.

To keep impacts on Cochiti delta woody riparian plants (i.e. willows and cottonwoods) to a minimum, ACE should incorporate options to: a) minimize storage depth and duration (including continued exploration of options/opportunities to utilize storage at Jemez and Abiquiu dams; and b) perhaps limit the frequency (% or sequence of years) of excess deviation storage. For example, it would be important to determine minimum frequency for successful overbank flows (i.e. cottonwood recruitment) and whether these can generally be accomplished in high flow years without the need for a planned deviation.

It would be useful to develop and present a conceptual flow chart of annual monitoring activities, information gathering, and decision making procedures for implementing a deviation, indicating timeline, critical data inputs (i.e. time since last successful recruitment flow, runoff at Otowi Bridge, etc.), go/no-go thresholds, and timing/role of the biological working group, including opportunities to abort a deviation given changes in flow levels, etc.

We strongly support the idea that at least annual spring meetings of the Cochiti Lake Ecological Resources Team (CLERT) should be formalized so that regular communication among the participating agencies occurs, whether or not a deviation is being proposed in a particular year.

More substantive monitoring of the ecological system (including the status and trends of the keystone willow and cottonwood vegetation) in relation to hydrologic regime, channel morphology, and dam operations is required to better understand and learn how to best achieve key objectives, including maintenance and improvement of riparian habitat and species populations both downstream as well as upstream of Cochiti Dam. The CLERT likely provides strong possibilities to foster and enhance adaptive monitoring efforts.

Since the primary objective of the proposed deviation is to promote stable silvery minnow populations along the Rio Grande, we urge the ACE to partner with the USFWS in promoting the introduction of an experimental population in the reach between Otowi Bridge and the Cochiti Reservoir delta, where suitable habitat and flows for recruitment may be present in most years. In addition, because the rationale for recruitment (and overbank) flows is largely to compensate for channel and floodplain degradation (i.e. incision) downstream of Cochiti Dam (a direct result of past sediment storage and flood control), we think it would be beneficial for ACE to both continue and enhance ongoing efforts to promote and facilitate complementary downstream channel restoration efforts.

Again, we appreciate your efforts to inform and engage us regarding this deviation proposal, and we look forward to working with you in the future to improve management of the Cochiti Reservoir system, including the ongoing Cochiti Reservoir baseline studies.

Sincerely,

JoAnn Unruh

for Bradley S. Traver
Superintendent

OFFICE OF THE GOVERNOR

505-869-3111 / 6333
FAX: 505-869-4236

PUEBLO OF ISLETA

P.O. BOX 1270 ISLETA, NM 87022

July 22, 2008

Mr. Dave Sabo and Mr. Estevan Lopez, Co-chairs
Middle Rio Grande ESA Collaborative Program
c/o Lisa K. Croft, Collaborative Program Manager
Albuquerque Area Office
Bureau of Reclamation
555 Broadway NE, Suite 100
Albuquerque, NM 87102

Dear Mr. Sabo and Mr. Lopez,

I am writing to you regarding our concerns with the Collaborative Program issues brought up on my behalf by Mr. Cody B. Walker at the Executive Committee meeting on July 17, 2008. I am very concerned about the collaborative process and communication between the signatories, and what appears to be a less than complete commitment of the Program to recover the Rio Grande silvery minnow (RGSM).

My first concern is silt and sand deposition in the irrigation headings served by the Isleta Diversion Dam (IDD). During the spring runoff of both 2005 and 2008, we have experienced extensive disruptions of irrigation deliveries from the (IDD). I understand that there was very little the water managers could do about sediment entering the IDD in 2005 due to the duration and volume of the runoff. In 2005, the MRGCD removed approximately 135,000 cu/yd of sand and silt from the Peralta Main and the Belen Highline canals. This spring, two separate high releases from Cochiti Reservoir resulted in the closure of the Peralta Main on the eastside of the IDD. Between May 21st and May 24th, the release from Cochiti was increased by 2600 cfs. Then between June 5th and June 9th the release was increased by 1050 cfs. Both of these releases lead to sediment deposition in the canal headings and disruption of irrigation deliveries to the Pueblo of Isleta and the irrigation community in the Belen Division, which contains the largest amount of irrigated lands in the Middle Rio Grande Valley. I believe that with better communication between the water managers of Cochiti Reservoir and the Pueblo of Isleta, the deposition could be reduced and these disruptions minimized. While I understand that the RGSM is the primary beneficiary of these releases, there needs to be a balance between the water requirements of the species and the people that rely on the waters of the Rio Grande for their livelihood.

My second concern is what appears to be a less than complete commitment to recover and de-list the RGSM. During the runoff of 2005 and 2008, the entire floodplain within the levees and downstream of the IDD were inundated with between one to five feet of water. These over bank events produce ideal conditions for recruitment and larval development of the RGSM. My technical staff and many Federal agency personnel rescued approximately 140,000 10-12 millimeter RGSM larvae from a very small area in 2005. This year my staff observed and identified thousands of minnow eggs in the wetted flood plain on May 16th on both sides of the Rio Grande. A special project was initiated on short notice to document this process and the results identified the fish species in the floodplain to be 90-95% RGSM. There remained a clear connection between the floodplain and the active channel from early May until the third week in June when the releases from Cochiti were reduced by 2000 cfs between Jun 9th and June 13th.

This sudden drop in the release, in conjunction with full charging of the Peralta Main and the Belen Highline, resulted in loss of the connectivity between the Rio Grande and the floodplain downstream of the IDD. Hundreds of thousands of RGSM larvae were stranded on the floodplain, resulting in death. Obviously, we will not recover the RGSM when we lose the genetic diversity and large numbers of fish associated with this occurrence. We are seldom fortunate enough to experience two above normal spring runoffs three years apart that create the conditions for such large spawning events, and I believe it is imperative to ensure that the majority of these fish return to the main channel. A more controlled recession of the runoff would have provided the fish with a greater opportunity to move into the main channel. It is our opinion that the CP must focus a greater effort on connectivity between the active flood plain and the main channel to prevent this loss of the future breeding population in the near term.

Gentlemen, as a primary signatory to the CP, the Pueblo of Isleta is fully committed to recovery of both the RGSM and the SWFL. We have developed and are implementing our Bosque Restoration Master Plan, which includes projects to restore the connectivity between the floodplain and the active channel. We are restoring SWFL habitat and have increased the number of breeding pairs over the past seven years. We will continue to work on these very important projects with all CP signatories and expect nothing less from them.

These concerns must be, but thus far have not been, addressed by all signatories to the CP. I thank you for your consideration of our concerns and look forward to your response.

Sincerely,

PUEBLO OF ISLETA

J. Robert Benavides
Governor

NEW MEXICO INTERSTATE STREAM COMMISSION

SPRINGER SQUARE BUILDING
121 TIJERAS, N.E.
SUITE 2000
ALBUQUERQUE, N.M., 87102

(505) 764-3880
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September 5, 2008

Via E-mail and Postal Service

Mr. Michael Porter
U.S. Army Corps of Engineers
Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Michael Porter)
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

Re: New Mexico Interstate Stream Commission Comments on the Draft Environmental Assessment for a Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir, Sandoval County, New Mexico

Dear Mr. Porter:

The New Mexico Interstate Stream Commission (ISC) submits the following comments on the August 2008. Draft Environmental Assessment for a Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir, Sandoval County, New Mexico. The ISC supports the proposed project with the caveat outlined below. The ISC agrees that the temporary deviation in operations at Cochiti Lake and Jemez Canyon Reservoir described in the Draft EA could produce favorable Rio Grande silvery minnow spawning and recruitment conditions in the middle Rio Grande downstream of the reservoirs using far less water than would be needed if similar conditions were produced by the U.S Bureau of Reclamation (Reclamation) using water acquired as part of its Supplemental Water Program.

As you are aware, the ISC is charged by New Mexico law with investigation, protection, conservation and development of New Mexico's water resources, both interstate and intrastate. In the Rio Grande basin, the ISC performs numerous activities, some of which may be affected by the proposed project. Those activities include, but are not limited to, monitoring water operations of the U.S. Army Corps of Engineers (Corps) and Reclamation, conducting annual accounting of native Rio Grande and San Juan Chama Project water, assessing and determining Rio Grande Compact compliance, and addressing federal natural resource policy issues that may impact the river system. We reviewed the Draft EA with the above activities in mind.

The Rio Grande Compact limits the amount of water that can be depleted in the Middle Rio Grande. Deviation from the normal operation of Cochiti Lake and Jemez Canyon Reservoir will increase depletions from the river system. Any increase in net depletions has the potential to jeopardize the ability of the State of New Mexico to meet its downstream delivery obligations. Therefore, the ISC requires that new projects demonstrate that they will not result in any increases in net water depletions, or that any increases are offset by purchased or leased water rights, or by providing bulk water from another source.

The ISC has been working with the Corps and Reclamation to develop a methodology as part of a Memorandum of Agreement to calculate the increased depletions due to the proposed deviation. The ISC supports this deviation as long as it is technically defensible, the parties can agree on a methodology for calculating the additional depletions, and one of the federal agencies commits to offset increases in depletions as outlined above.

Please do not hesitate to contact me at (505) 827-6160 or Kevin Flanigan at 505-764-3865 should you have any questions. Thank you for the opportunity to comment on this project.

Sincerely,

Rolf Schmidt-Petersen, Chief
Rio Grande Basin Bureau
New Mexico Interstate Stream Commission

cc: Estevan Lopez, Director, NMISC
Herman Settemeyer, RGCC EA for Texas
Mike Sullivan, RGCC EA for Colorado
Kevin Flanigan, NMISC
Page Pegram, NMISC
Rio Grande Bureau file

BILL RICHARDSON
Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Office of the Secretary

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RON CURRY
Secretary
Jon Goldstein
Deputy Secretary

October 9, 2008

Julie Alcon, Chief
Environmental Resources Section
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza, NE
Albuquerque, NM 87109-3435

RE: Temporary Deviation in the Operations of Jemez and Cochiti Dams

Dear Ms. Alcon:

Your letter regarding the above named project was received in the New Mexico Environment Department (NMED) and was sent to various Bureaus for review and comment. Comments were provided by the Surface Water Quality Bureau and are as follows.

Surface Water Quality Bureau

The U.S. Army Corps of Engineers (Corps) is proposing to implement a temporary deviation from its water control plans for the Cochiti Lake Project and the Jemez Canyon Reservoir Project to facilitate spawning and recruitment flows for the federally endangered Rio Grande silvery minnow and provide overbanking opportunities to create habitat for the federally endangered Southwestern Willow Flycatcher. The Projects are located in Sandoval County, New Mexico, and were authorized for flood and sediment control, and development of fish and wildlife resources. All Project facilities and a major portion of the flood control pool lie within the bounds of the Pueblos. The duration of the planned deviation between both reservoirs is from late February through June beginning in 2009 for the next 5 years. Approval from Pueblo de Cochiti, Pueblo of Santa Ana and the Rio Grande Compact Commission will be required for the Corps to implement the proposed deviation. Prior to implementation, the planned 5-year deviation would require the approval of the Corp's South Pacific Division.

The decision on which action will be implemented in a given year will be based on the spring snowmelt runoff forecasts and in consultation with Pueblo de Cochiti, Pueblo of Santa Ana, and the Rio Grande Compact Commission.

If all parties agree on the deviation the Corps will consult with the Rio Grande Engineer Advisers, U.S. Fish and Wildlife Service, and Bureau of Reclamation on where the storage takes place and how much is required for the proposed deviation based on hydrological conditions in a particular year.

Under the no-action alternative, temporary storage of native Rio Grande water at Cochiti Lake and Jemez Canyon Reservoir for later release to facilitate downstream recruitment flows and provide overbank flows below Isleta Diversion Dam would not occur. The dams would be operated to safely pass inflow according to the existing water control plan. The change in surface elevations at the reservoirs would not exceed normal operating conditions.

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

The proposed action has been fully coordinated with Federal, tribal, state, and local governments with jurisdiction over the ecological, cultural, and hydrologic resources in the affected area. Overall, potential impacts on environmental resources are anticipated to be minimal under the proposed guidelines.

I hope this information is helpful to you.

Sincerely,

Georgia Cleverley

Georgia Cleverley
Environmental Impact Review Coordinator
NMED File #2735

Terrell H. Johnson
PO Box 63
La Jara, NM 87027
yomi@zianet.com

October 22, 2008

U.S. Army Corps of Engineers, Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Michael Porter)
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Mr. Porter:

The following comments pertain to the draft Environmental Assessment on the proposed temporary operational deviation to occasionally augment spring flows below Cochiti Lake. Thank you for the extended comment period, meeting with the Cochiti Lake Ecological Resources Team (CLERT), and the additional graphic information you and Dennis Garcia provided the Team.

As you know, the Cochiti Lake delta has grown into a valuable wetland resource with complex channels and sloughs and dense, tall stands of willows and cottonwoods that developed during the last 20 years. I think we all recognize the importance of protecting this resource from damage due to extraordinary water storage. Except for augmented storage in 2007, which fell within the ordinary range of variation, water storage during the 19 years since 1990 has followed ordinary patterns that have been productive for delta vegetation. Therefore, they provide a general guide and template for maintaining Cochiti delta vegetation. Even with this guide, it is important to deviate from ordinary operations incrementally, to monitor effects, and to adapt to what we learn.

I believe that the primary factors in assessing impacts of inundation of delta vegetation are first its duration, and second its timing. Ordinary spring floodwater storage occurred 7 times during the last 19 years. Many of those years were during the early to mid 1990s, so it is impossible to know their short-term impacts. However, the median duration of storage and median end of storage during those 7 occasions should be safe starting points to ensure protection all of the delta vegetation. I propose that these medians be established as limits for any extraordinary storage of spring floodwaters in Cochiti Lake. I do not know what the medians are, but guess from the graphs that they would be not be more than 30 days, ending in late May or early June. These median storage limits should be explicitly added to a volume limit for extraordinary storage in the final EA.

Additional specific comments follow:

- Storage for overbank flows should be dropped from the proposal, because it would far exceed the median duration limit. The benefits of more frequent overbank flows are vague, and there are simply insufficient data to assess the effects on the delta of extraordinary storage of up to 45,000 acre-feet for up to 60 days. However, those effects are likely to be substantial.

- The CLERT should be involved in planning and monitoring any extraordinary storage. The Team provides a range of experience and perspectives, and provides a vital link to landowners and managers with jurisdiction over their land.

- Every opportunity to store water in Abiquiu and Jemez Reservoir should be exhausted before storage in Cochiti Lake is undertaken. These opportunities should be assessed annually in consultation with the CLERT.

- Southwestern willow flycatcher surveys should be conducted throughout the delta before any extraordinary storage is undertaken. The habitat in the delta is becoming so suitable for breeding that their presence should be assumed until proven otherwise.

- Quantitative annual monitoring of delta vegetation should be initiated, so we can learn not only how delta vegetation responds to extraordinary storage, but also how it responds to the ordinary variations in flow and storage.

- Quantitative models of downstream benefits to the silvery minnow and upstream impacts on delta vegetation should be developed or refined. Quantitative models provide the basis for true adaptive management.

Thank you for the opportunity to comment, and I look forward to participating with the CLERT.

Sincerely,

Terrell H Johnson

RIO GRANDE COMPACT COMMISSION

COLORADO TEXAS NEW MEXICO

January 13, 2009

Mark Yuska
Chief, Operations Division
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

RE: Proposed 5-year Deviation at Cochiti Lake and Jemez Canyon Reservoir

Dear Mr. Yuska:

Thank you for your November 7, 2008 letter regarding the Corp's request for advice and consent of the Rio Grande Compact Commission (Commission) to proceed with the proposed five-year water operations strategy at Cochiti Lake and Jemez Canyon Reservoir and associated depletions calculation methodology. To summarize the proposal, for five years, starting in 2009, the Corps proposes to deviate from normal operations, on an as-needed basis, at Cochiti Lake and Jemez Canyon Reservoirs to provide springtime recruitment and/or overbanking flows in the middle Rio Grande for the benefit of the endangered Rio Grande silvery minnow and Southwestern willow flycatcher. The deviation would consist of storing native Rio Grande surface water during the snowmelt runoff in excess of downstream demand in the middle valley during the months of February through June. All of this water would be released on or before June 15 of any given year for the purposes described above. Any depletions of water resulting from the deviation will be calculated as described in the depletions calculation methodology.

Based upon review of the documents provided by the Corps and discussions of concerns with Corp's staff, including a phone call on October 28, 2008, the Engineer Advisers support the Corps' overall proposed water operations strategy and will recommend and seek approval from their respective Commissioners via a Resolution at the March 31, 2009 Commission meeting in El Paso, Texas. However, that Resolution will have two remaining conditions that must be met for the Commission to provide its advice and consent on a yearly basis for a deviation. They are that 1) New Mexico is in a credit situation with respect to the Rio Grande Compact deliveries at the beginning of the year of the planned deviation and 2) the Corps must secure water and assure its availability for offset of additional depletions caused by the deviation before the deviation is conducted in any given year.

Assuming the Corps concurs, the Engineer Advisers will seek approval from the Commissioners at the March 31, 2009 Commission meeting.

Sincerely,

Estevan R. Lopez
New Mexico

Herman Settemeyer
Texas

Mike Sullivan
Colorado

Appendix E

Notice of Draft EA Availability

Notice of Availability of the Draft Environmental Assessment and
Finding of No Significant Impact for the
Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir, Sandoval County, New Mexico

Pursuant to the Council on Environmental Quality Regulations for implementing the Procedural Provisions of the National Environmental Policy Act, the U.S. Army Corps of Engineers (Corps), Albuquerque District in cooperation with the Pueblo de Cochiti, Pueblo of Santa Ana and the Rio Grande Compact Commission, has completed a Draft Environmental Assessment (DEA) and Finding of No Significant Impact (FONSI) for a proposal to implement a temporary annual deviation from its water control plans for the Cochiti Lake Project and the Jemez Canyon Reservoir Project. Depending on the forecast runoff, the temporary deviation would assist with creating the appropriate spring flows for Rio Grande silvery minnow (*Hybognathus amarus*) spawning and additional habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) on an annual basis from 2009 through 2013.

Public review of the DEA and FONSI will begin on Friday August 8, 2008 and will run for 30 days until September 7, 2008. The DEA and FONSI will be available on the Corps web site at http://www.spa.usace.army.mil (go to FONSI/Environmental Assessments). A hard copy will be sent upon written request. Comments on the DEA and FONSI should be sent to:

U.S. Army Corps of Engineers
Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Michael Porter)
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Paper copies of this document are also available for review at:

Albuquerque/Bernalillo County Library
501 Copper Ave. NW
Albuquerque, NM 87102

Santa Fe Public Library
145 Washington Street
Santa Fe, NM 87501

For more information please contact Michael Porter, USACE, (505) 342-3264 or Michael.D.Porter@usace.army.mil

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STATE OF NEW MEXICO
County of Bernalillo SS

Bill Tafoya, being duly sworn, declares and says that he is Classified Advertising Manager of **The Albuquerque Journal**, and that this newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Session Laws of 1937, and that payment therefore has been made of assessed as court cost; that the notice, copy of which is hereto attached, was published in said paper in the regular daily edition, for 1 times, the first publication being on the 8 day of August, 2008, and the subsequent consecutive publications on ______, 20___.

Sworn and subscribed to before me, a Notary Public, in and for the County of Bernalillo and State of New Mexico this 7 day of August of 2008

OFFICIAL SEAL
Elyn Sloane
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires: 4-1-10

PRICE 416.03

Statement to come at end of month.

ACCOUNT NUMBER C88913

CLA-22-A (R-1/93)

Notice of Availability of the Draft Environmental Assessment and Finding of No Significant Impact for the Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Reservoir, Sandoval County, New Mexico

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