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El Vado Dam – Safety of Dams Modification Project Draft Environmental Assessment

**Middle Rio Grande Project, New Mexico
Interior Region 7 – Upper Colorado Basin**



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The Department of the Interior conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

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El Vado Dam – Safety of Dams Modification Project Draft Environmental Assessment

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Interior Region 7 – Upper Colorado Basin**

Cover Photo: El Vado Dam by Chris Ellis, July 2018

The Bureau of Reclamation (Reclamation) prepared this El Vado Safety of Dams (SOD) Modification Project, Environmental Assessment (EA) to assess the potential consequences of a proposed modification to El Vado Dam and appurtenant spillways in Rio Arriba County, New Mexico. Reclamation's proposed alternative, described in Chapter 2 of this EA, includes rehabilitation of the existing upstream lining and foundation cutoff systems, replacement of the service spillway and modification of the emergency spillway to reduce risks to below public protection guidelines as required by the Reclamation Safety of Dams Act of 1978 and outlined in the operation and emergency management plan for El Vado Dam. The dam is lined with a steel faceplate that has undergone substantial degradation since construction was completed in 1935. The service spillway was also constructed with a steel liner that has deteriorated to such an extent that it cannot be safely operated. The use of steel plating for embankment and spillway chute lining is no longer considered to be current state-of-practice. The proposed alternative includes placing a polyvinyl chloride (PVC) geomembrane liner on the existing steel faceplate in addition to performing a remedial foundation grout program on the upstream left abutment of the dam. The service spillway would be modified by removing all of the existing service spillway and replacing it with one constructed with new reinforced concrete of similar dimensions and controlled with a new radial gate of similar dimensions. The dam crest would be modified by removing the existing curved steel parapet/wave deflector and replacing it with a new reinforced concrete parapet. Finally, the proposed alternative includes constructing a small dike/fuse plug at the emergency spillway crest to delay its operation during a remote hydrologic event. Chapter 2 of this EA describes other alternatives that were considered but eliminated from further study based on risk reduction, constructability reviews, environmental impacts and economic costs.

This EA has been prepared in compliance with the National Environmental Policy Act and Reclamation procedures, and is intended to serve environmental review and consultation requirements pursuant to Executive Order 11988 (Floodplain Management), Executive Order 11990 (Wetlands Protection), Executive Order 12898 (Environmental Justice), the National Historic Preservation Act (section 106), Endangered Species Act (section 7(c)), and Departmental and Reclamation Indian Trust Asset policies.

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ACRONYMS AND ABBREVIATIONS

Ammonia	Ammonia as Nitrogen
AASHTO	American Association of State Highway and Transportation Officials
ABCWUA	Albuquerque Bernalillo County Water Utility Authority
AIANNH	American Indian/Alaska Native/Native Hawaiian
APE	Area of Potential Effects
BLM	United States Bureau of Land Management
BMP	Best Management Practice
CAS	Corrective Action Study
County	Rio Arriba County
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CLSM	Controlled Low-strength Material
CR	County Road
cy	Cubic Yards
DE	Designated Engineer
DM	Departmental Manual
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FONSI	Finding of No Significant Impact
ft	Feet
ITA	Indian Trust Assets
LOS	Level of Service
LRFD	Load and Resistance Factor Design
mm	Millimeter
MOA	Memorandum of Agreement
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMDGF	New Mexico Department of Game and Fish
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environmental Department
NMOSE	New Mexico Office of the State Engineer
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OHWM	Ordinary High Water Mark
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PVC	Polyvinyl Chloride
RCAA	Rio Chama Acequia Association

Reclamation	United States Bureau of Reclamation
RUDR	Recreation Use Data Report
SHPO	State Historic Preservation Office
SJC	San Juan-Chama
SOD	Safety of Dams
SONAR	Sound Navigation and Ranging
SR	State Road
State Park	El Vado State Park
SVOC	Semi-volatile Organic Compounds
TSC	Technical Service Center
TVS	Total Volatile Solids
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USGS	United States Geological Survey
UV	Ultraviolet
VOC	Volatile Organic Compounds

1 Purpose and Need

1.1 Introduction

1.1.1 Background and Construction

El Vado Dam is a steel-faced, rockfill dam located on the Rio Chama, approximately 10 miles southwest of Tierra Amarilla, New Mexico. Embankment materials are mostly comprised of compacted gravelly sand with cobbles. The embankment has a structural height of 175 feet (ft), a crest length of 1,326 ft, and a crest width of 20 ft at 6914.5 ft above mean sea level. The upstream face is protected by a 1/4-inch-thick steel plate that is anchored to a cutoff wall/grout curtain at the upstream toe and to a curved steel parapet (designed to force waves back into the reservoir) at the crest of the dam. El Vado Dam is the only steel-faced rockfill dam in Reclamation's inventory. New Mexico State Highway 112 crosses the dam crest.

El Vado Dam has both a service and emergency spillway. The service spillway is located at the right abutment of the dam and consists of a concrete inlet channel, a 36-ft-wide reinforced concrete crest structure with a 36-ft-wide by 24-ft-high radial gate, a 957-ft-long steel plate lined chute that exits to Rio Chama. The emergency spillway is located about 1 mile west of the right abutment of the dam in a topographic saddle comprised of erodible weathered bedrock and alluvial silts, sands, and gravels. The emergency spillway consists of a 630-foot-wide unlined channel with a crest at elevation 6906. Discharges through this spillway empty into the Cooper Arroyo which is approximately 7,000-ft-long before returning to the Rio Chama.

Original construction of El Vado Dam was completed in 1935 by the Middle Rio Grande Conservancy District (MRGCD). Due to financial hardship during the Great Depression, the MRGCD transferred El Vado Dam to Reclamation as authorized by the Flood Control Act of 1948. From 1954-1957, Reclamation rehabilitated the service spillway gate, performed a remedial foundation grouting program at the upstream toe of the dam, and modified the emergency spillway and the intake structure of the original outlet works. Reclamation constructed a second outlet works near the right abutment in 1965-1966 to accommodate the additional water from the San Juan-Chama Project. The powerplant, licensed by the Federal Energy Regulatory Commission (FERC), was constructed in 1986 by the Los Alamos County Department of Public Utilities and makes use of the original outlet works.

1.1.2 Operations

El Vado Reservoir contains a total storage capacity of about 185,770 acre-feet (ac-ft) at elevation 6902, which is the top of active conservation. The reserve capacity from elevation 6902 to 6908.6 (maximum design water surface elevation) is about 22,270 ac-ft. There is no minimum conservation pool elevation.

First filling of El Vado Reservoir began in January 1935 and was filled to elevation 6892 by August of that year. The reservoir level was cycled about 60 to 80 ft during the first 20 years of operation.

The original dead pool was elevation 6740. In the late 1940s and early 1950s the reservoir was drained, possibly due to sedimentation blocking a portion of the intake structure.

The reservoir was drained in 1955 and the original outlet work intake structure was reconstructed with a new (higher) sill elevation of 6758.5. Bulkheads have subsequently been added to the powerplant intake structure openings as sediment levels have risen. The current bulkhead level is reportedly elevation 6770, which represents the current dead pool and sediment level at the toe of the dam. During the late 1950s and early 1960s the reservoir was cycled about 60 to 80 ft each year. In 1965-1966 the reservoir was drained for construction of the second outlet work intake and conduit. The sill elevation of the new outlet work intake is elevation 6775. Following its completion, the reservoir was operated between elevation 6780 and 6815 until about 1972.

From 1972 to current, the reservoir has filled to just below the top of active conservation level (6902) about 15 times. The reservoir is typically cycled between elevation 6860 to 6900 except when it has been drawn down during drought years or to make repairs/modifications to the lining faceplate and outlet works intake structures. To date the reservoir has been drained about six times to make necessary modifications to the original outlet works and for construction of the second outlet works. The reservoir has been drawn down below elevation 6785 an additional 22 times under normal operations.

The dam and reservoir are operated as part of the Reclamation's Middle Rio Grande Project. The primary purpose of the reservoir is to provide storage for supplemental irrigation to the Middle Rio Grande Valley. The reservoir is also used for storage of San Juan-Chama Project water for irrigation, municipal and industrial uses, hydroelectric power, recreation, and fish and wildlife benefits. Project water is obtained from flows of the Rio Chama caused by snowmelt and rain. The reservoir also receives water in transit imported from the San Juan River Basin in Colorado and regulated by the upstream Heron Dam and Reservoir located on Willow Creek, a tributary of the Rio Chama.

1.1.3 Corrective Action Studies

After more than 80 years of operations, substantial degradation of the steel lining system and service spillway have occurred. Seepage through the embankment, both through cracks in the steel faceplate and through the foundation of the dam, has led to high seepage losses that can lead to erosion of the embankment materials behind the steel faceplate. The steel liner of the service spillway has similarly deteriorated and is no longer safe to operate. These seepage and structural issues have been estimated to pose risks above Reclamation's public protection guidelines.

Reclamation's Technical Service Center (TSC) in Lakewood, Colorado completed appraisal and feasibility level corrective action studies to evaluate structural and non-structural alternatives that would reduce risks below public protection guidelines. Corrective action studies (CAS), with appraisal and feasibility designs, were conducted for the issues identified with the seepage related and spillway risks. Alternatives evaluated in the appraisal level studies were either eliminated or carried forward for more detailed analysis at the feasibility level. Although the studies for the seepage reduction and spillway modifications were completed independently, the proposed combined actions for risk reduction at El Vado Dam are considered together in this EA.

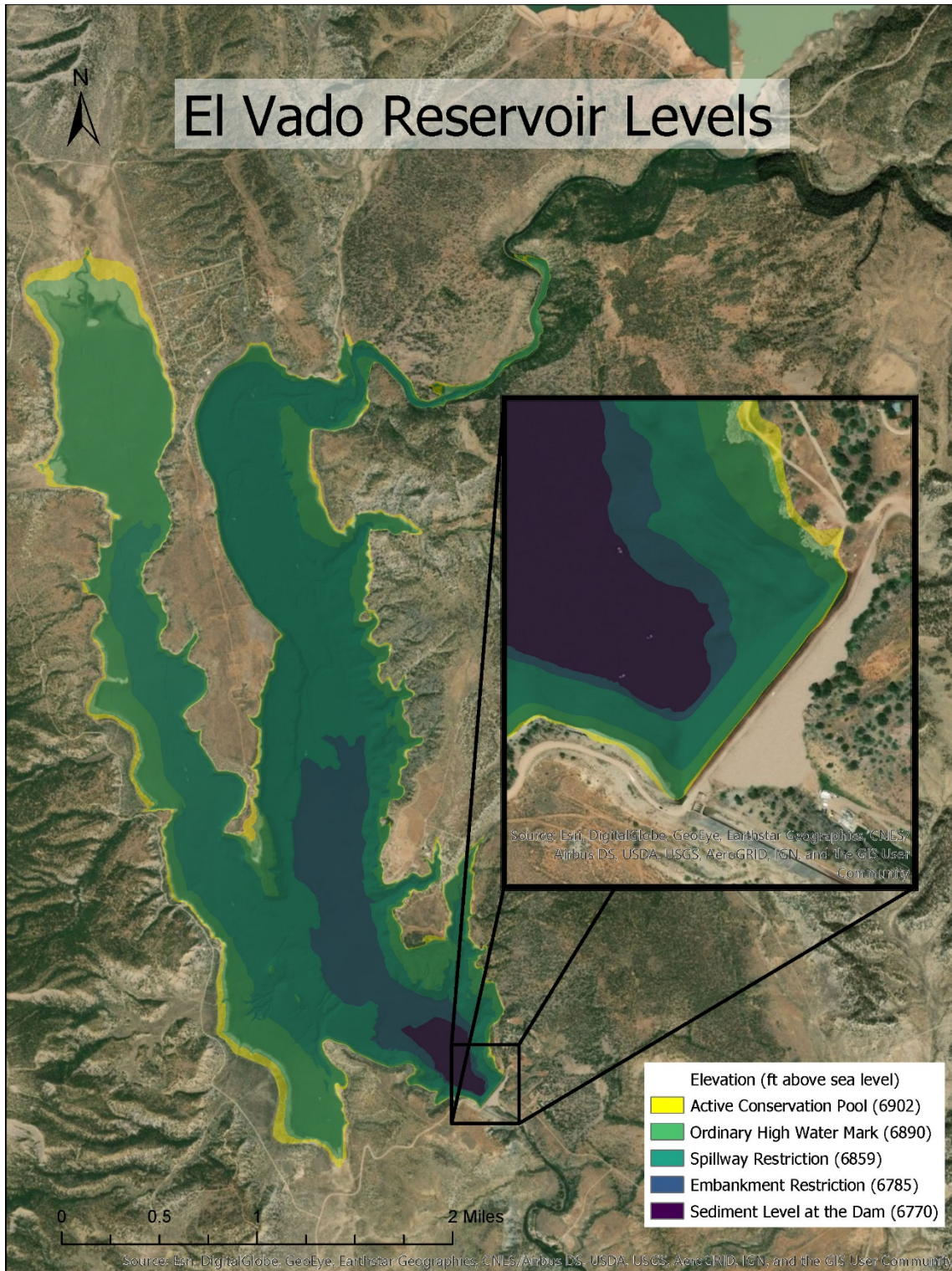


Figure 1 Proposed reservoir elevations for El Vado Dam SOD Modification Project

1.2 No Action

The No Action Alternative (in the CAS for the dam and in the CAS for the spillways) presents the reasonably foreseeable future conditions in the absence of the proposed project. The purpose of the No Action Alternative is to allow decision makers to compare the impacts of approving the project to the impacts of not approving the project. The No Action Alternative reflects existing and expected future conditions in the project area if no action is taken.

Under the No Action Alternative, there would be no structural or operational changes to El Vado Dam or spillways. The dam and spillways would not be improved, and no changes to the operation of El Vado Dam or the storage level of the reservoir would occur. This alternative does nothing to reduce the risk of dam failure. The steel lining materials would continue to be susceptible to corrosion and strength loss leading to the possibility of internal erosion of the embankment. If operated, the service spillway would lose structural integrity, resulting in collapse of the spillway and/or complete failure of the dam through lateral head cutting. This alternative would not meet the purpose of, or need for, the Proposed Action.

1.3 Proposed Action

Reclamation is proposing structural modifications to El Vado Dam, the service spillway, and emergency spillway. The Proposed Action consists of:

- 1) Filling voids beneath the existing faceplate grout to improve lining support;
- 2) Installing a geomembrane over the existing steel faceplate;
- 3) Performing a remedial foundation grouting program on the upstream, left abutment of the dam;
- 4) Replacement of the existing curved steel parapet with a new reinforced concrete parapet
- 5) Construction of a new service spillway using reinforced concrete in the same location and to similar dimensions as the existing spillway; and
- 6) Reestablishment of a dike/fuse plug at the emergency spillway.

These components are described in detail in section 2.3 of this EA.

1.4 Purpose and Need for the Action

Reclamation has a need to ensure that all dams and appurtenant structures are compliant with the Reclamation Safety of Dams Act of 1978. In addition, Reclamation has obligations to maintain water deliveries for authorized purposes pursuant to the Flood Control Act of 1948. These requirements demonstrate a need for Reclamation to implement corrective action to bring static and hydrologic risks below public protection guidelines. This would be principally accomplished by implementing a remedial foundation grouting program at the upstream left abutment, placing a new membrane over the existing steel plates on the dam face, replacing the existing service spillway with a new one, and constructing a small dike/fuse plug at the emergency spillway.

The purposes of the proposed project are to:

- 1) Implement cost-effective measures to reduce risks below public protection guidelines;
- 2) Maintain water deliveries to Pueblos, governmental organizations, and others through the MRG; and
- 3) Minimize impacts to the environment.

1.5 Relevant Statutes, Regulations, Permits, and other Plans

The funding and lead federal agency for this EA is Reclamation. This EA is prepared in compliance with all applicable federal statutes, regulations, and Executive Orders.

1.5.1 National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.)

- Procedures for Implementing NEPA (33 CFR 230; ER 200-2-2)
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 et seq. and 43 CFR 46 et seq.)

1.5.2 Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) and related Statutes and Orders

- Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661 et seq.)
- Secretarial Order 3206, American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act

1.5.3 National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.) and related Statutes, Regulations and Orders

- American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470)
- 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)

1.5.4 Clean Water Act (CWA) of 1972, as amended (33 U.S.C. 1251 et seq.) and related Orders

- Protection of Wetlands (Executive Order 11990)

1.5.5 Other Statutes, Regulations and Orders

- Clean Air Act of 1972, as amended (42 U.S.C. 7401 et seq.)
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 1994
- Floodplain Management (Executive Order 11988)
- Wild and Scenic Rivers, 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.)

2 Alternatives

2.1 Introduction

This section is a description of the Proposed Action Alternative. As described in section 1.2, the inclusion of the No Action Alternative serves as a benchmark against which project alternatives can be evaluated. This section also includes a short description of the alternative development process, alternatives that were considered but eliminated from further study, and a designation of the preferred alternative.

2.2 Alternatives Considered but Eliminated from Further Study

Alternatives were developed in the appraisal and feasibility corrective action studies by the TSC. Alternatives formed and evaluated at the appraisal level were either eliminated or carried forward for more detailed analysis at the feasibility level. The feasibility level phase evaluated a short list of alternatives and the findings were used to make a recommendation to Reclamation's decision makers which alternative should be carried forward to final design. All the feasibility level alternatives listed below would meet required safety guidelines and therefore would partially fulfill Reclamation's needs. Other technical factors such as impacts to operations, construction risks, construction costs, and long-term serviceability were considered during the evaluation process. Alternatives other than the Proposed Action Alternative were eliminated for not meeting Reclamation's needs, purposes of the project, accomplishing risk reduction but at greater cost than other alternatives, or because impacts to the environment would be greater than a similar alternative, as described below.

2.2.1 Spillway feasibility level alternatives

- Alternative 1 (Proposed Action Alternative) – Replace spillway with one of similar dimensions and add a small dike at the emergency spillway
 - This alternative would reduce risk to below public protection guidelines and meets Reclamation's needs and purposes of the project with the least impact to current water operations. Therefore, this alternative was carried forward for detailed analysis in this EA.
- Alternative 2 – Replace spillway with one that includes two radial gates, with no dike at emergency spillway
 - This alternative would reduce risk to below public protection guidelines but would be more expensive than Alternative 1. Therefore, this alternative was eliminated.
- Alternative 3 – Replace spillway with one with inlet elevation 12 ft lower than the existing spillway, with no dike at emergency spillway
 - This alternative would reduce risk to below public protection guidelines but would be more expensive than Alternative 1 with potential impact to water operations. Therefore, it does not meet the purposes of the proposed project.
- Alternative 4 – Establish permanent reservoir restriction to elevation 6844 with no construction modifications

- This alternative would not meet public protection guidelines and would not meet Reclamation's need or purposes of the project. Project benefits would be restricted as water deliveries could not fully satisfy prior and paramount rights, irrigation demands, or flows for recreation or fish and wildlife.
- Alternative 5 – Remove dam
 - This alternative would meet public protection guidelines but would otherwise not meet Reclamation's need or purposes of the project. All project benefits would be lost as water deliveries could not be made to satisfy prior and paramount rights, irrigation demands, or flows for recreation or fish and wildlife.

2.2.2 Seepage reduction feasibility level alternatives

- Alternative 1 – Install geomembrane over existing steel faceplate and perform remedial grouting program
 - This alternative meets Reclamation's needs and some of the purposes of the project. However, environmental effects associated with sediment releases and construction costs would be greater as compared against Alternative 1a (Proposed Action Alternative).
- Alternative 1a (Proposed Action Alternative) – Install partial geomembrane over existing steel faceplate and perform remedial grouting program
 - This alternative meets all needs and purposes of the project. The PVC lining would be installed over about 85 percent of the steel faceplate covering areas with the highest degree of flaws. Project benefits would be maintained with fewer environmental impacts and at a lower cost than similar alternatives. Therefore, this alternative was brought forward for detailed analysis in this EA.
- Alternative 2 – Install reinforced concrete on soil bedding and perform remedial grouting program
 - This alternative meets Reclamation's needs and some of the purposes of the project. However, environmental effects associated with sediment releases and construction costs would be greater as compared against Alternative 1a (Proposed Action Alternative).
- Alternative 3 – Install embankment cutoff wall
 - This alternative meets Reclamation's needs and some of the purposes of the project. However, environmental effects associated with sediment releases and construction costs would be much greater than Alternative 1a (Proposed Action Alternative).
- Alternative 4 – Remove dam
 - This alternative would meet safety guidelines but would otherwise not meet Reclamation's need or purposes of the project. All project benefits would be lost as water deliveries could not be made to satisfy prior and paramount rights, irrigation demands, or flows for recreation or fish and wildlife.
- Alternative 5 – Establish permanent reservoir restriction to 6775 ft (drained reservoir)
 - This alternative would meet safety guidelines but would otherwise not meet Reclamation's need or purposes of the project. All project benefits would be lost as water deliveries could not be made to satisfy prior and paramount rights, irrigation demands, or flows for recreation or fish and wildlife.
- Alternative 6 – Establish permanent reservoir restriction to elevation 6844 with a spillway modification

- This alternative would meet safety guidelines but would otherwise not meet Reclamation's need or purposes of the project. Project benefits would be restricted as water deliveries could not fully satisfy prior and paramount rights, irrigation demands, or flows for recreation or fish and wildlife.

Spillway Alternative 1 and seepage reduction Alternative 1a together comprise the Proposed Action evaluated in this EA.

2.3 Proposed Action

The work would involve the following project elements, described in detail below. Construction on the seepage reduction modifications has been estimated to take less than one year to complete but could extend into the next year if unforeseen circumstances arise during construction. Work on the spillways would begin following completion of construction of the seepage reduction modifications and would last for approximately 2 years. It was determined that there would not be adequate space for the construction activities for the seepage reduction features and spillway modifications to be done concurrently. Thus, total project construction time would be up to 4 years. Note that the project elements are listed in the same order as they would be constructed if the project is implemented.

2.3.1 Seepage Reduction Modifications

2.3.1.1 Access and Staging

Access for construction equipment and vehicles to El Vado Dam would be along existing state and county roads. Staging would occur above the ordinary high water mark (OHWM) in the unimproved area currently used for parking on the left abutment of the dam. A temporary access road from the staging area down to the toe of the dam on the left abutment would be required for both the grouting and lining (both of which are described below).

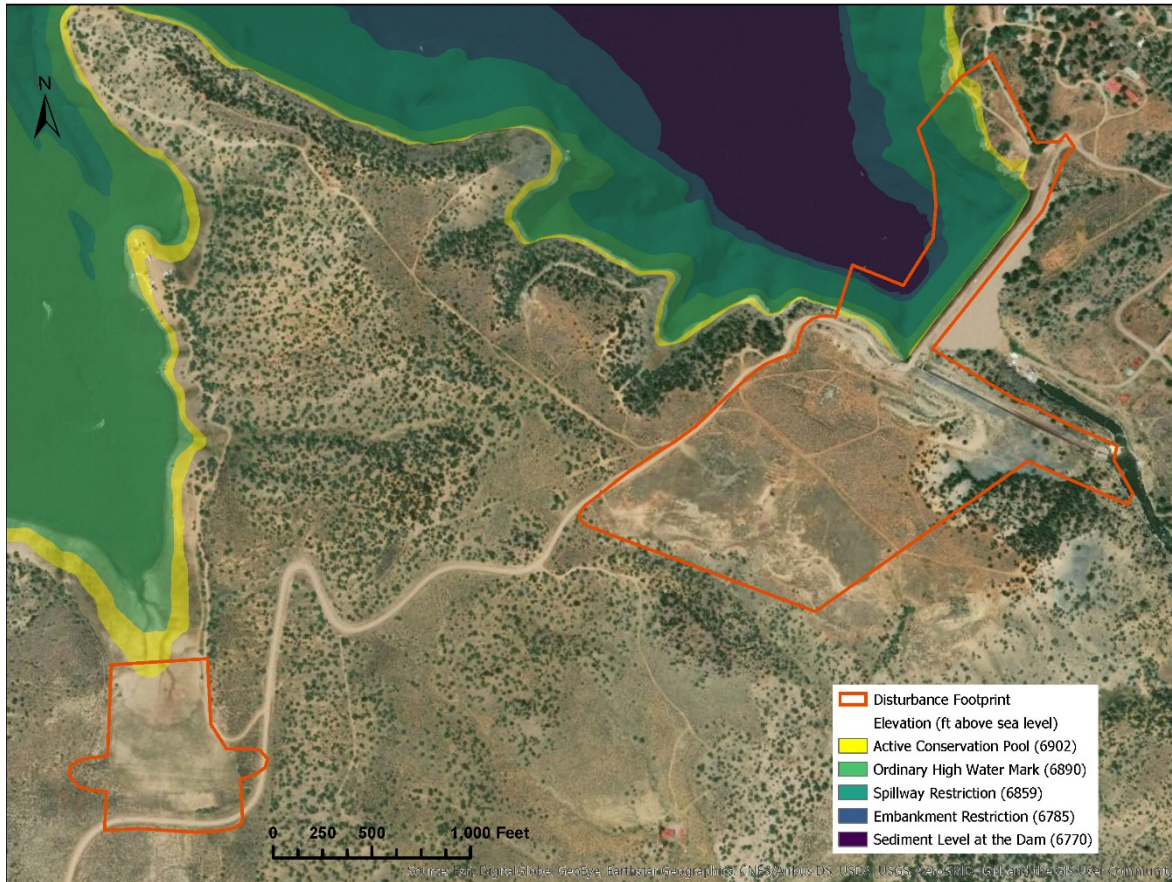


Figure 2 Construction disturbance limits

2.3.1.2 Reservoir Restriction

Performing the remedial foundation grouting program, faceplate backfill grouting and installing the geomembrane lining system would require the reservoir to be drawn down to expose the existing steel faceplate. The existing steel faceplate extends to elevation 6740 near the original river channel closure section. A 2018 bathymetry survey has indicated the current sediment level is elevation 6770 near the toe of the dam. Reclamation prepared sediment transport model scenarios representing the reservoir drained to the dead pool level, as well as with about 10 and 15-foot-deep pools that would serve to minimize sediment transport. Maintaining a pool of water at least 10-ft-deep greatly reduced the released sediment concentration and total sediment volume by more than half.

Based on this information, Reclamation proposes to:

- A. Restrict the reservoir elevation to 6785, a storage volume of 2,422 ac-ft, for an estimated period of seven to eight months during construction of the seepage reduction modifications. The pool of water would extend about 1 mile upstream of the dam as shown on Figure 1. This restriction would affect one irrigation season. Based on the reservoir level at the end of the prior irrigation season and the storage level during fall/winter, the reservoir will begin to be lowered early in the year to get the elevation to 6785 by May 1st.

- B. Restrict the reservoir elevation to 6859, a storage volume of 80,986 ac-ft, for an estimated period of just under two years, from the end of the year in which seepage reduction modifications are completed until approximately October two years past. This restriction would affect two irrigation seasons and would span the period of service spillway construction.
- C. Resume normal operations upon completion of service spillway construction and lift all reservoir restrictions. The temporary restrictions described above would cover a period of approximately three and a half years. New issues or deficiencies discovered during the construction period may extend the construction period.

See section 3.2.1, Reservoir Operations and Hydrology for a full discussion on reservoir restrictions and the potential impacts to reservoir operations and hydrology.

2.3.1.3 Remedial Foundation Grouting Program

Per the TSC's CAS, Reclamation is proposing that remedial foundation grouting of the existing concrete cutoff wall/grout curtain be completed on the upstream left abutment to reduce foundation seepage (Figure 3). Based on available subsurface information and instrumentation monitoring, the area between station 0+65 and 6+25, is believed to be a main source of foundation seepage. A single additional grout row would be completed from station 0+65 to station 2+65, a length of approximately 200 ft. To the right (west) of station 2+65, a double grout row is needed to treat the more permeable foundation materials in this area. The right end of the remedial grout curtain would extend approximately 460 ft from station 2+65 to 6+25.

The reservoir restriction results in the ability to expose the concrete plinth at the base of the steel faceplate to approximately station 6+70 (right of this location the concrete plinth would be under water). Given the constraints of the reservoir elevation, remedial grouting to the right of station 6+25 is not practical or justified at this time.

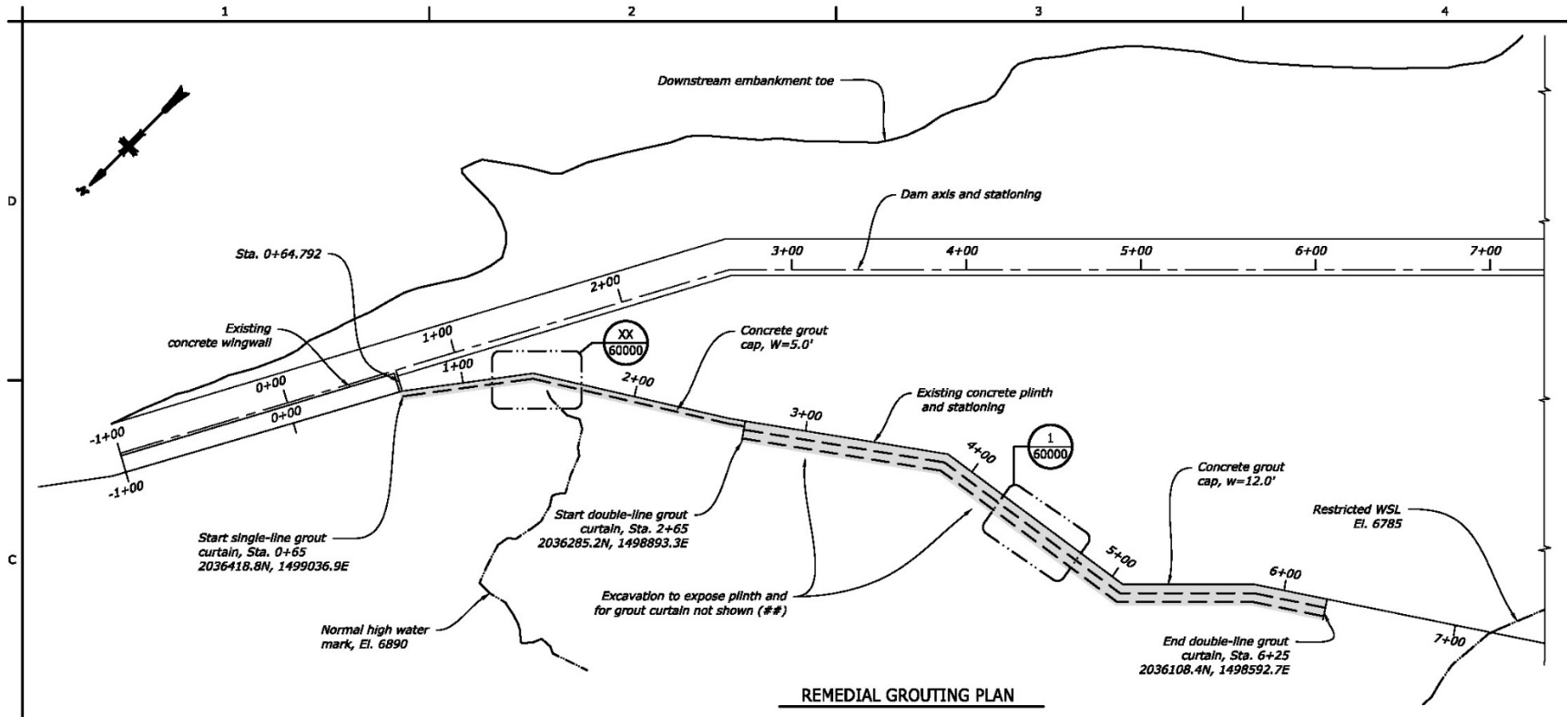


Figure 3 Remedial foundation grouting program plan

2.3.2 Geomembrane over the Existing Steel Faceplate

2.3.2.1 Initial Inspection and Repair

Prior to placement of the geomembrane liner, the steel faceplate would be inspected, and open cracks or defects would be sealed/repared. Generally, flaws with a crack or gap greater than 1/4-inch in size/width would be repaired/patched as to not allow the geomembrane materials to be drawn into the flaw during reservoir loading. Smaller cracks would be sealed to minimize loss of grout from behind the steel faceplate described below.

2.3.2.2 Backfill Grouting behind Steel Liner

Due to, in part, the original construction practices, erosion and settlement, a void behind the steel faceplate has developed. The void would be filled with grout to prevent the steel faceplate from collapsing into the void when loaded by the reservoir. The initial (Phase I) grouting would occur at elevation 6790. Ports would be cut through the existing steel faceplate just above the restricted reservoir level and tremie pipes would be inserted downwards into the void beneath the steel faceplate. The grouting program would be designed to utilize the tremie pipes to fill the void from the bottom up. Monitoring pipes inserted behind the steel faceplate would be used to monitor the grout level. A cement/water grout mixture with a stabilizing admixture would be used to fill the void space. The stabilizing admixture would be used to minimize the potential for bleeding of cement into the reservoir water. The grout would be placed in defined vertical increments and allowed to set/harden to avoid deformation of the steel faceplate. The access ports through the steel faceplate would be covered with a 0.25-inch thick steel cover plate. The Phase I grouting program would reduce the potential for seepage through the lower portion of the steel faceplate not covered with the geomembrane and sediment.

Phase II grouting would involve filling the void beneath the steel faceplate from elevation 6790 up to elevation 6907. A series of regularly spaced holes would be drilled through the faceplate and used to inject the grout. Low pressure grouting methods would be used to prevent damage to the steel faceplate. A high bentonite/cement mixture with a fluidifier admixture would be used to fill the void above elevation 6790. In the event of a leak through the PVC liner and steel faceplate, the cement-bentonite grout would further reduce the potential for leakage.

2.3.2.3 Install Geomembrane

The selected geomembrane material would be designed for long-term ultraviolet (UV) light exposure, ice loading, and protected from debris impact. Based on market research, a geomembrane installation field trial completed at the dam site and laboratory testing program, a 120-millimeter (mm) UV-stabilized PVC geomembrane would be best suited for El Vado Dam. A system of intermediate stainless-steel mechanical anchorages would be welded to the steel faceplate. The mechanical connections would be manufactured to provide mild steel tabs that would be welded to the steel faceplate. This avoids the welding of dissimilar materials in the field. To reduce the potential for the existing steel faceplate and mechanical connection welds to corrode, a new active cathodic protection system would be installed.

A drainage layer would be constructed against the steel faceplate to collect and convey water leakage through the geomembrane to drains through the base of the steel faceplate into the embankment. Strips of geonet would be secured to the steel faceplate and then covered with a 2,000 gram/square

meter (approx. 60 ounce/square yard) non-woven geotextile cushion. The heavy geotextile cushion is needed to cover irregularities in the surface of the existing steel faceplate so that they do not become preferential wear areas. Multiple layers of the geotextile cushion may be required where the steel faceplate irregularities are more severe.

The initial lining construction project would install the geomembrane lining from elevation 6788 to elevation 6709 (just below the existing curved steel parapet). Approximately 175,000 square ft of geomembrane and would cover about 85 percent of the steel faceplate area. The lowest portion of the steel faceplate at the right third of the dam near the original river alignment would not be covered with geomembrane. Based on a bathymetric survey, the steel faceplate below elevation 6770 is covered with sediment. The sediment limits seepage below this level. The steel faceplate would only be directly exposed to the reservoir between elevations 6770 and 6788.

The geomembrane at the base of the curved wave deflector would be sealed to the steel faceplate with a welded batten strip. The geomembrane would be sealed to the concrete plinth at the upstream toe down to elevation 6788. The base of the geomembrane would be at elevation 6788 across the upstream face of the dam. At this elevation the lower perimeter seal would need to cross about 17 V-shaped expansion joints. Special considerations would need to be made to ensure a water tight seal where the lower perimeter seal crosses the expansion joints, while continuing to allow them to flex.

Once the existing curved parapet is replaced with a new concrete parapet, the geomembrane lining would be extended from elevation 6907 up to the base of the new parapet (approximate elevation 6910). This would provide a water tight seal up the design dam crest elevation of 6914.5.

2.3.2.4 Monitoring and Maintenance

Leak detection instrumentation would be installed beneath the geomembrane in the existing V-shaped expansion joint channels to monitor potential leaks. A 0.25-inch thick cover plate would be welded on one side that would span the expansion joints to prevent the geomembrane from being pressed into the expansion joints. Should a leak occur, the instrumentation may be used to help identify which area of the geomembrane lining is leaking.

Damage to the exposed geomembrane lining is most likely to occur from vandalism. To minimize the potential vandalism a security fence would be installed across the upstream edge of the dam crest and extend down the abutments.

There is an existing log boom system at El Vado Dam which is stored along the access road to the power plant. The log boom system would be installed following the geomembrane installation to prevent floating debris and/or boats from impacting the geomembrane. Installation would be by Reclamation's maintenance staff.

Following construction, maintenance staff with Reclamation would receive training to make repairs to the geomembrane. Repair equipment and materials would be staged at the local Reclamation office. Service life of the PVC lining materials is expected to be in excess of 75-years.

2.3.3 Spillways and Dam Crest Modifications

2.3.3.1 Access, Borrow Area, and Staging Areas

Construction access to El Vado Dam for work on the spillways would be along existing roads. State Highway 112 provides access to the left abutment. Highway 95 and County Road 322 provide access to the emergency spillway and the right abutment. Temporary access roads would be constructed along the right side of the new service spillway. At the emergency spillway, a temporary haul road would be constructed from the borrow area upstream of the proposed dike location to the proposed dike location. Material from that borrow area would be placed above the OHWM.

There would likely be two staging sites - above the right side of the service spillway, and the other at the left abutment. Both would be needed because there would be no access across the dam during construction affecting the bridge across the service spillway. Process materials would be brought in from an existing sand and gravel business about 15 miles from the dam site (in or near Tierra Amarilla). The road across the dam is expected to be closed for a minimum of nine months but could extend to one year, or more in duration.

2.3.3.2 Remove and Replace Service Spillway

Remove Existing Spillway and Intake Structure

The original steel-lined service spillway would be removed prior to constructing the new service spillway. The existing spillway intake structure will be removed except for the left wall adjacent to the embankment.

Construct New Service Spillway

During construction of the new service spillway, temporary and permanent cut slopes in the rock would be excavated. The excavation cut slope design would include reinforcement elements that would be installed to provide both a safe working environment and stable slopes for the final concrete spillway construction and crest structure. This would require removing powerlines in close proximity to the service spillway.

To provide enough freeboard along the spillway chute and account for surface roughness, wave action, air bulking, splash, and spray within the service spillway chute, additional wall height would be needed. A vertical parapet wall would be constructed on top of the walkway area on each side (left and right) of the chute section beginning about 100 ft downstream.

Install New Radial Gate

The new radial gate would be the same size as the original, 36-foot-wide by 24-foot-high. The radial gate pins would be located approximately 18 ft above the invert and the radius from the pin to the inside of the skinplate would be approximately 30 ft. The skinplate, horizontal beams and radial arms would be designed for the hydrostatic loading.

The wire-rope hoist would be located on a concrete deck above the radial gate skinplate. The existing counterweight system could be reused, replaced or abandoned, depending on its condition.

2.3.3.3 New Bridge and Realigned Road on Right Abutment

The new spillway bridge would be a single span, with a length of 39 ft from centerline of bearings to centerline of bearings. The bridge would be designed for HL-93 live load according to the American

Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Fifth Edition, 2010 with 2010 Interim Revisions. The bridge, spanning the reconstructed spillway channel, would provide a 28-foot clear width, and the bridge would cross the spillway at a skew angle. The beams would be equal length. The new spillway channel would have a 36-foot clear width, requiring the bridge beam to be supported on top of the spillway walls. This would result in a 39-foot span from centerline of bearing to centerline of bearing. The spillway walls serve as the bridge abutments.

A hoist deck would be constructed downstream of the bridge. It would have a 12-foot clear width. Span would be 39 ft. It would cross the spillway perpendicular. Construction materials are to be similar steel beams and cast in place deck.

The bridge superstructure would consist of a reinforced cast-in-place concrete deck slab supported on structural steel wide flange beams, with New Jersey shape concrete barriers on both sides. The steel beams would be spaced at 6-ft, 6-inches on center. The steel beam and reinforced concrete deck cross section would be designed as a composite section.

County Road 322 ends at the right abutment of the dam. Approximately the last 400 ft of this road would be realigned to accommodate a longer inlet channel to the service spillway. This realignment would be constructed as part of the Proposed Action Alternative.

2.3.3.4 Reestablish Dike/Fuse Plug at Emergency Spillway

The existing emergency spillway is a 630-foot-wide unlined channel located one mile west of the right abutment. The emergency spillway is comprised of erodible surficial soil that is underlain by erodible Mancos shale, with invert elevation 6906. The new dike/fuse would be approximately 700 ft long with a crest elevation at 6913 (1.5 ft lower than the dam crest). It would be constructed of borrowed onsite materials located just upstream and concrete sand imported from offsite. The dike/fuse would be designed to fail and the emergency spillway to operate should it overtop, thereby preventing the main embankment from overtopping.

2.3.3.5 Dam Crest Modification and new Parapet Wall

The existing curved steel parapet wall was originally constructed with a top elevation of 6914.5 (design dam crest elevation). Settlement of the embankment over time has resulted in the parapet top elevation being about 2.5 ft below the design crest elevation in areas. The differential settlement has resulted in the steel curved parapet being severely deformed near the left abutment. Fill has been placed on the dam crest over the years to reestablish the design crest elevation. These fill placements have resulted in poor runoff/drainage conditions. Fill materials frequently are eroded behind the curved waved deflector and out through a gap/joint just above the steel faceplate.

During the spillway replace project, the dam crest would be excavated down to elevation 6907 to remove the existing curved parapet and its foundation system. A new L-shaped reinforced concrete parapet wall would be constructed in its place. The top elevation of the new concrete parapet wall would be elevation 6914.5. The dam crest driving surface would be reconstructed to elevation 6910, resulting a wider area than current conditions. The new concrete parapet wall would serve as the upstream guardrail. New W-beam guardrail would be installed on the downstream edge of the dam crest. A 2 to 3-ft-tall chain link security fence would be top mounted to the new concrete parapet wall.

3 Affected Environment

3.1 Introduction

This section describes the environment in which the Proposed Action Alternative would be implemented. The various associated environmental resources, including physical resources such as water resources, water quality, air quality; and biological resources such as vegetation, wetlands, noxious weeds, fish and wildlife resources, and endangered species; and socio-economic resources such as Indian Trust Assets, environmental justice, and cultural resources, are discussed.

3.2 Resources Considered but Eliminated from Further Study

Table 1 Resources considered and rationale for eliminating them

Resource	Rationale for Elimination from Further Study
Water Rights	Existing water rights would not be affected because no changes to those rights are part of the Proposed Action and delivery of water would continue according to priority. No new water rights are part of the Proposed Action. Therefore, there would be no effect to water rights from the Proposed Action.
Land Use	No changes to land use are part of the Proposed Action. Therefore, there would be no effect to land uses.
Air Quality	Effects to air quality would be temporary and mitigated by BMPs (see chapter 4). Therefore, there would be no long-term or significant impact on air quality.
Hazardous Materials	No pollutants were found at toxic levels during sediment testing in the reservoir basin. Lead-based materials on the steel faceplate would be removed and contained per BMPs in chapter 4. Therefore, there would be no effect to the environment from the Proposed Action related to hazardous materials.
ESA-listed Species	Based on the temporary changes to the river and reservoirs during the dam work, species downstream of El Vado reservoir would not be affected based on how operations will be done during the construction period. There are no listed species within El Vado Reservoir or the proposed construction limits.
Paleontological Resources	There is low potential for discovery of significant paleontological resources. Therefore, there would be no impact to these resources.
Vegetation	Reservoir elevations would have no long-term effect on vegetation in and around the construction area. Areas cleared of vegetation for staging would generally be

Resource	Rationale for Elimination from Further Study
	graded and reseeded to near-original conditions per BMPs.
Wildlife Resources (Terrestrial)	Wildlife would not be displaced during project activities. The Rio Chama would continue to provide water resources in the immediate vicinity of the project. A construction pool would remain in El Vado Reservoir. BMPs would reduce noise and air pollution during the temporary construction activities.

3.3 Description of Relevant Affected Issues and Resources

The following is a full description of the relevant affected issues and resources that potentially could be impacted through this project.

3.3.1 Reservoir Operations and Hydrology

Reclamation operates and maintains El Vado Dam and Reservoir consistent with current agreements, the Rio Grande Compact, and the operational and hydrologic constraints and conditions of the Middle Rio Grande Project. Reclamation stores the flow of the Rio Chama in El Vado Reservoir as requested by the MRGCD and to ensure delivery of water as requested by the MRGCD, and as requested by the Bureau of Indian Affairs' Designated Engineer (DE) as part of prior and paramount operations. Retention and regulation of native Rio Grande flows are consistent with the Doctrine of Prior Appropriation and in coordination with the State, and to meet downstream senior flow rights.

In particular, Reclamation operates and maintains El Vado Dam and Reservoir as follows:

1. Stores water in and releases water from El Vado Dam and Reservoir pursuant to the Flood Control Acts of 1948 and 1950, the 1951 Contract with MRGCD, in accordance with New Mexico Office of the State Engineer (NMOSE) Permit No. 1690 and not to exceed the downstream channel capacity of 4,500 cubic feet per second (cfs). Storage of native water may occur if native flows are available on the Rio Chama in excess of downstream Rio Chama direct flows rights and the MRGCD river diversion demand, and if restrictions on storage are not in place per Articles VII and VIII of the Rio Grande Compact.
2. Carry out NMOSE water user delivery requirements, Compact requirements, and MRGCD requests for water storage and release.
3. Maintain safe storage elevation of El Vado Reservoir per standard operating procedures except under specific exceptions that consider flood routing criteria, water surface elevation, and river flow in the Middle Rio Grande (MRG) Valley.
4. Store native flows when Article VII of the Compact is not in effect.
5. Store native flows as needed to meet the prior and paramount demands of the Six MRG Pueblos and release this water for the Six MRG Pueblos as requested by the DE pursuant to the 1981 Agreement, notwithstanding Article VII of the Compact.
6. Store and release San Juan-Chama (SJC) Project water, if requested by the MRGCD.

7. Bypass native Rio Grande water flows into El Vado Reservoir up to 100 cfs between April 1 and September 1 to meet demands of Rio Chama water rights holders downstream from Abiquiu Dam.
8. Operate to stay within the safe downstream channel capacity on the Rio Chama per standard operating procedures.

Additional considerations for Reclamation's operation of El Vado Dam and Reservoir are as follows:

- I. When water is available for release to downstream users or storage reservoirs, Reclamation manages releases to benefit a cold-water trout fishery below El Vado Dam from November to March.
- II. When water is available for release to downstream users or storage reservoirs, and in cooperation with affected parties, Reclamation manages releases for rafting during weekends in July, August, and September.

3.3.1.1 No Action Alternative

Based on the constraints and requirements set forth in the previous section, typical operations that would be associated with the No Action Alternative are as follows.

- Releases, November 1 to December 31 – At times when the basin is or recently was under Article VII restrictions, releases from El Vado Dam are likely to be 300 to 500 cfs, as water stored for Prior and Paramount uses is released to Elephant Butte. In addition, there may be some SJC Project water being moved to Abiquiu Reservoir. If the basin has not been under Article VII restrictions, Prior and Paramount water would not be released, and some or all of the native inflow would be stored. Then, flows would likely be less than 200 cfs, composed of San Juan – Chama Project water moving to Abiquiu.
- Releases, January 1 to beginning of runoff (generally April – May) – At times when the basin is under Article VII restrictions, El Vado Dam may begin storing native water on January 1 for Prior and Paramount use and relinquishment credit. Reclamation would then release available SJC Project water, moving it from El Vado to Abiquiu at the highest steady rate achievable, which likely would be between 50 to 150 cfs. If the basin has not been under Article VII restrictions, most native inflow to El Vado would be stored first for Prior and Paramount use and then for MRGCD. If the expected runoff volume is high, some natural inflow may be bypassed. Reclamation would aim to make the highest steady release rate achievable for the period, potentially utilizing available SJC water to move between El Vado to Abiquiu, likely between 50 to 150 cfs. Beginning on April 1st, all natural inflow up to 100 cfs must be bypassed to meet the Rio Chama Acequia Association's (RCAA) instream flow right.
- Releases, runoff (generally April – May) to October 31 – Flow below El Vado during irrigation season is largely dependent on MRGCD's irrigation demand. If irrigation needs can be met by flow on the main stem Rio Grande, then the El Vado release may only consist of natural flow up to 100 cfs to meet RCAA's instream flow right. After about June or July, if flow on the main stem decreases, El Vado releases may be between 500 -1,000 cfs. If flow on the main stem remains high, releases may be between 200 – 500 cfs. Later in the season, irrigation demand tapers off, but SJC Project waived water may be moving to Abiquiu, so the El Vado release is likely to remain between 400 -800 cfs until the end of September.

Releases during October could fall to between 100 – 200 cfs, consisting of natural inflow and water needed to meet MRGCD demand. Typically, during this period, releases for recreation are made on the weekends at least from Memorial Day to Labor Day. Flow at that time is generally between 600 – 1,000 cfs.

- Storage during runoff, typically April to July – For periods when Article VII restrictions are in effect, water is stored for Prior and Paramount use and as relinquishment credit water. If flow on the main stem Rio Grande cannot meet middle valley irrigation demand, some natural inflow may be bypassed. Once Prior and Paramount and relinquishment credit water storage volumes are met, all natural inflow is bypassed. If Article VII restrictions are not in effect, then natural flow not needed to meet middle valley irrigation demand would be stored up to the full reservoir volume of 184,452 ac-ft. Under both conditions, natural flow up to 100 cfs is bypassed for the RCAA from April 1 to October 31. If snowpack is well above normal, higher releases may be made to ensure that the reservoir does not overflow. The reservoir would be topped off during the receding limb of the hydrograph. Under either condition, snowpack would be monitored to ensure that flow is captured in the most beneficial manner, which may include looking for opportunities to augment spike flows to meet environmental goals.
- November 1 to December 31 – At times when the basin is or recently was under Article VII restrictions, releases from El Vado Dam are likely to be 300 to 500 cfs. If the basin has not been under Article VII restrictions, flows would likely be less than 200 cfs.
- January 1 to beginning of runoff (generally April – May) – Releases from El Vado would likely be between 100 – 200 cfs.
- Runoff to October 31 – After about June or July, when flow on the main stem typically decreases, El Vado releases would generally be between 400 -1,000 cfs. During September, the El Vado release would likely be between 400 -800 cfs. Releases during October could fall to between 100 – 200 cfs. Typically releases for recreation are made on weekends from Memorial Day to Labor Day. Flow on weekends during that period is generally between 600 – 1,000 cfs, although weekday flows may be lower.
- Storage during runoff, typically April to July – When Article VII restrictions are in effect, natural flow is stored for certain uses, and then is bypassed when the required volume is reached. When Article VII restrictions are not in effect, natural flow not needed to meet middle valley irrigation demand would be stored up to a maximum of 184,452 ac-ft. In either case, natural inflow up to 100 cfs is bypassed from April 1 to October 31 to meet the RCAA’s instream flow right. Snowpack is monitored to ensure that flow is captured in the most beneficial manner, which may include bypassing water early in the season and storing later to decrease the chance of overflowing the reservoir and looking for opportunities to augment spike flows to meet environmental goals.

3.3.1.2 Proposed Action Alternative

Under the Proposed Action Alternative, Reclamation proposes two reservoir restrictions needed to implement the corrective action. Specifically, Reclamation proposes to:

- A. Restrict the reservoir elevation to 6785, a storage volume of 2,422 ac-ft, for an estimated period of seven to eight months during construction of the seepage reduction modifications. This restriction would affect one irrigation season. It would begin just prior to seepage reduction modifications on about May 1 and would be expected to be lifted in mid-December.

- B. Restrict the reservoir elevation to 6859, a storage volume of 80,986 ac-ft, for an estimated period of just under two years, from the end of the year in which seepage reduction modifications is completed until approximately October two years past. This restriction would affect two irrigation seasons and would span the period of service spillway construction.
- C. Resume normal operations upon completion of service spillway construction and lift all reservoir restrictions. The temporary restrictions described above would cover a period of approximately three and a half years. New issues or deficiencies discovered during the construction period may extend the construction period.

To the extent possible, Reclamation would maintain operations similar to what is currently done and as described in the baseline section. Storage would occur in Heron, Abiquiu, and/or in Cochiti Reservoirs. A description of the storage options for each use described in the baseline follows. The number below corresponds to the number in the list in the baseline section.

1. Native water that would be stored in El Vado pursuant to the Flood Control Acts of 1948 and 1950, the 1951 Contract with MRGCD, and in accordance with NMOSE Permit No. 1690, would be stored either by agreement and under a temporary permit from NMOSE in Abiquiu Reservoir, or in Heron Reservoir by exchange. Such water is used for irrigation by MRGCD. Irrigation demand would also be met by the natural flow of the Rio Grande and Rio Chama.
2. In order to carry out NMOSE water user delivery requirements, Compact requirements, and MRGCD requests for water storage and release, Rio Chama flow and water released from Heron would be bypassed at El Vado. MRGCD requests for storage and release would be carried out at the reservoir in which the water is stored.
3. With the proposed construction on El Vado dam, reservoir elevations would be maintained at restricted levels to ensure the safety of the construction crews and the integrity of the facility while construction is ongoing.
4. Native flows that would be stored in El Vado when Article VII of the Compact is not in effect would be stored in Abiquiu Reservoir or in Heron Reservoir by exchange. Such water is used for irrigation by MRGCD. Irrigation demand would also be met by the natural flow of the Rio Grande and Rio Chama.
5. Native flows stored and released to meet the prior and paramount demands of the Six MRG Pueblos and as requested by the DE pursuant to the 1981 Agreement would be stored either in Abiquiu Reservoir, Heron Reservoir, Heron by exchange, Cochiti Reservoir, or in a combination of these options.
6. MRGCD's SJC Project water is currently allocated in Heron Reservoir and may remain there until the end of the calendar year in which it was allocated. MRGCD plans to negotiate an agreement with Albuquerque Bernalillo County Water Utility Authority (ABCWUA) to store MRGCD SJC Project water within ABCWUA's storage space in Abiquiu Reservoir. If necessary, Reclamation would also use waivers, which allow water to remain in Heron into the year following allocation, to store additional SJC Project water for MRGCD. Release of SJC Project water would be at the request of MRGCD to either USACE (Abiquiu) or Reclamation (Heron).
7. El Vado Reservoir outlet works would continue to bypass native Rio Grande water flows into El Vado Reservoir up to 100 cfs between April 1 and September 1 to meet demands of Rio Chama water rights holders downstream from Abiquiu Dam. While the reservoir

restriction is in place, the existing outlet works would be used to match Rio Chama inflows to maintain the restricted water surface level.

8. Reclamation would continue to operate to stay within the safe downstream channel capacity on the Rio Chama per standard operating procedures.

To the extent possible, Reclamation would also address the additional considerations related to El Vado Dam operations described in the baseline section.

- I. When water is available for release to downstream users or storage reservoirs, and in cooperation with effected parties, Reclamation would manage releases from Heron Dam and Reservoir to benefit a cold-water trout fishery below El Vado Dam from November to March.
- II. When water is available for release to downstream users or storage reservoirs, and in cooperation with effected parties, Reclamation would manage releases from Heron Dam and Reservoir for rafting during weekends in July, August, and September.

The above descriptions pertain most directly to the restricted reservoir storage, 2,422 ac-ft, described in A at the top of this section. Under B (80,986 ac-ft), less storage would be needed in other reservoirs. When restrictions described in B are in place, water for uses 1, 4, 5, and 6 above would be stored in El Vado, with the order here reflecting the storage priority.

It is important to note that forecasted water inflow and subsequent storage is highly dependent on the winter snowpack and spring runoff prior to construction. Regardless of the forecast, this plan would accommodate operations during construction.

3.3.2 Transportation and Access

The project site encompasses the roads surrounding El Vado Dam and Reservoir. State Road (SR) 112 is the primary connection to Tierra Amarilla and Chama, northeasterly of the dam. It includes the road across the dam terminating on the west side or right abutment. County Road (CR) 319 begins at the right abutment and is the primary connection from the dam southwesterly to Cuba. CR-322 is located to the west and north of the dam and connects SR-95 on the north boundary of the dam. This is the main connection to Heron Reservoir from El Vado to the north.

SR-112 is maintained by the New Mexico Department of Transportation (NMDOT). This is a paved, two-lane road that connects to Highway 84, north and east of El Vado. SR-112 is narrow at several points, with several sharp turns and some shoulder damage. Reclamation is currently working with NMDOT on an agreement outlining both parties' roles and responsibilities regarding SR-112 as it crosses United States lands administered by Reclamation.

CR-319 is maintained by the Rio Arriba County (County). This road is unpaved for approximately 15 miles south and west of the dam. It eventually becomes CR-96 and connects to Highway 550. This road can be difficult to travel on, especially after precipitation events. Due to the road realignment design on the right abutment, as well as width and weight restrictions on the dam, signs are posted restricting access to certain vehicles that comply with the standards. Reclamation is also working with the County on an agreement outlining both parties' roles and responsibilities regarding SR-112 as it crosses United States lands administered by Reclamation.

CR-322 is also maintained by the County, but not to the same Level of Service (LOS) as CR-319. This road is also unpaved and, in many places, difficult to navigate. The road is narrow, has at least one steep hill and can be dangerous in wet conditions. The agreement with the County on CR-319 would also apply to CR-322.

The project area includes access to several privately-owned parcels, including El Vado Lake, El Vado Lake Estates, El Vado Dam Cabins, Zellers, and El Poso Ranch subdivisions. No traffic studies have been conducted, therefore there is no exact traffic data. According to the County's GIS Data Map, the vast majority of these private properties are land only and recreation properties. Most of the structures are located on the east side of the dam. There are fewer than 25 residents that live near the dam year-round and fewer than 10 that cross the dam regularly.

Regulatory Setting

The Rio Arriba County Transportation element of the Rio Arriba County Comprehensive Plan (Rio Arriba County 2008, Amended 2010 and 2014), contains goals, policies, and objectives for addressing transportation issues throughout the County, including improving and maintaining the County road's level of service and condition (Goal 1), improving safety of the roadway system (Goal 4) and identifying roads with LOS and road width restrictions (Goal 6).

Methodology

The potential effects of the project alternatives on transportation and access were evaluated within the context of the transportation system in the project area and level of use. This was determined by gathering and reviewing information from public meetings, MRGCD, the County and NMDOT both quantitatively and qualitatively assessing how the Proposed Action could impact the transportation and access.

It was determined that a project alternative would have a significant effect on transportation and access if it would:

- Result in significant physical constraints or congestion that would impede travel.
- Result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion.
- Exceed, either individually or cumulatively, a LOS standard established for designated roads.
- Substantially increase hazards because of a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., recreation and forestry vehicles).

3.3.2.1 No Action Alternative

Under the No Action Alternative, the seepage reduction and spillway modifications would not occur. This means there would be no construction, no construction equipment, no increase in traffic and no closures needed. Therefore, this alternative would have no effect on existing transportation, access, or roads.

3.3.2.2 Proposed Action Alternative

The Proposed Action would not have a significant negative effect on transportation and access.

As described in Section 2.3.3 and 2.3.4, the remedial foundation grouting and faceplate backfill requires the import of a grout mixing plant and regular deliveries of the dry cement and admixture materials on SH-112. Construction of the geomembrane lining would require deliveries of the lining

and mechanical connection metal work. These deliveries would occur multiple times a day for about 5 to 6 months. These deliveries are expected to increase traffic on SH-112 from current conditions. During the geomembrane installation, flatbed trucks with hoists would be used to deploy the geomembrane materials rolls from the dam crest road, after the grouting. These deliveries would result in intermittent road closures throughout the day. To minimize the effects on the residents, we would ask the contractor to limit deliveries to “off-peak” travel times (late morning and early afternoon) and follow a schedule to help predictability of road closures. This could include after-school starts and before the bus returns during the school season.

The seepage reduction modification project may require imported fill to level the existing parking area for the staging area and grout plant, for access ramps and pads on the left abutment and to supplement local fill to cover the concrete plinth once the remedial foundation grouting is complete. Reclamation plans to make use of the original borrow area for the dam construction that is located about one mile upstream on the left reservoir rim. Due the relatively small volumes of fill needed, the existing system of roads through El Vado State Park and then SH-112 would be used to transport the fill materials from the borrow area to the left abutment. It is expected this haul work would occur for about one month.

As described in 2.3.6 and 2.3.7, during the removal and replacement of the spillway, radial gate and bridge, and replacement of the dam crest parapet wall, the road across the dam would be closed permanently. This closure would last up to 2 years. While all efforts would be made to minimize this effect, closure is unavoidable as sections of the road would be missing, including the bridge over the spillway.

Reclamation would require its contractors to notify the public of both these short-term and long-term closures. Notification would include use of local media and signage. Additionally, the contractor would be responsible to notify emergency responders to the road closures to minimize those indirect effects. In addition, the contractor will make surveys of the existing road conditions before and after construction. The contractor will make repairs to the road if damaged by construction.

To date, there are no plans to use CR-322 for any construction vehicles. Additionally, south of the proposed emergency spillway and dike, about 1 mile from the left abutment, there are no plans to use that area for construction vehicles. If either of those roads are used, the contractor would be responsible to fix any damage caused by their use.

The Proposed Action would result in a new bridge over the spillway and a new road over the dam. This current infrastructure is as much as 80 years old. This replacement is safer and more reliable and would be a benefit to future transportation and access in this area.

3.3.3 Water Quality

Two studies were conducted to determine baseline water quality and the potential effects of the Proposed Action. First, Reclamation contracted with Bio-West, Inc. to characterize sediment in and near the project area. Fifteen samples of reservoir sediment were obtained at various locations across the reservoir area. Two additional background sediment samples were collected from within the Rio Chama channel, one upstream and one downstream of El Vado Reservoir. A total of 17 samples were submitted to Hall Environmental Analysis Laboratory (Hall) for chemical analysis. The

sediment samples were analyzed for 20 separate metals, 69 separate volatile organic compounds (VOC), 80 separate semi-volatile organic compounds (SVOC), petroleum hydrocarbons, 18 separate Polycyclic Aromatic Hydrocarbons (PAH), 15 separate herbicides, 49 separate pesticides, 12 separate carbamate and urea pesticides, 7 separate polychlorinated biphenyls (PCB), 25 separate dioxin and furan compounds, asbestos, and several miscellaneous compounds, including total volatile solids (TVS), total solids, percent moisture, and ammonia as nitrogen (ammonia). Overall, concentrations of metals were low and very few human-made organic compounds were detected in the sediment samples. The human-made organic compounds were mostly attributed to motor boat operation, tar coated railroad ties and runoff from asphalt paved roads. No mining or industrial waste byproducts were detected.

Second, a sediment transport modeling study was performed to better understand the potential for reservoir sediments to be eroded and carried through the outlet works feature(s) while the reservoir is drawn down for the planned construction activities. A multibeam SONAR bathymetry survey was completed in the spring of 2018 to understand the current sediment levels in the reservoir. Flow data at the U.S. Geological Survey (USGS) gage 08284100 at Rio Chama near La Puente, NM were selected to represent low, medium, and high flow conditions. Incoming sediment loads of fine particles were developed from suspended sediment load and gradations collected at USGS gage 08284100 at Rio Chama near La Puente, NM. Incoming sediment loads and gradations of sand and gravel were estimated by calculating sediment transport capacity in the river leading to the reservoir. Bed material data collected by Bio-West were used as the initial bed gradations. Three scenarios were simulated in the analysis: 1) reservoir drawdown to the lowest current outlet works sill elevation (empty dead pool reservoir elevation 6770), 2) reservoir drawdown and then maintained with an approximately 5-foot deep pool of water at elevation 6775 behind a coffer dam also serving as a sediment collection pond, and 3) reservoir drawdown to elevation 6785 and maintained at this level with the existing river outlet (Proposed Action Alternative). The reservoir has reached this approximate elevation about 20 times since the dam was originally built.

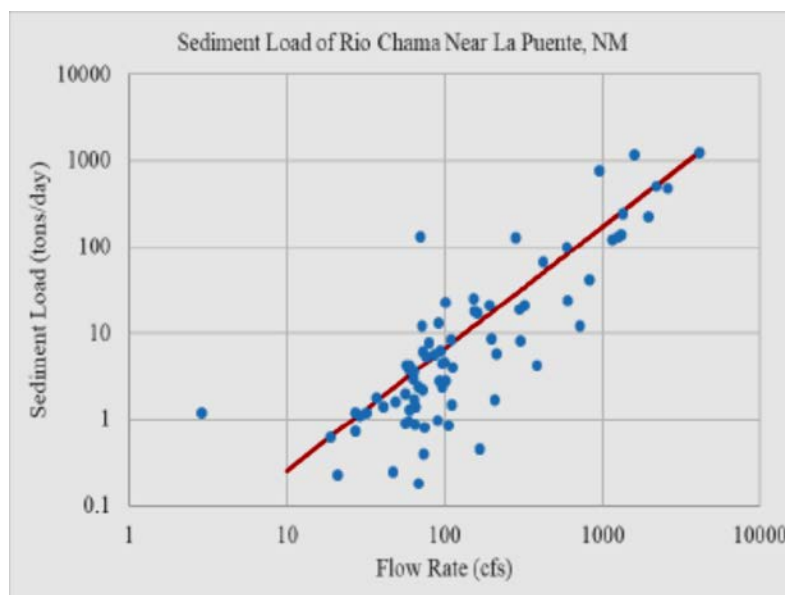


Figure 4 Suspended sediment concentration versus discharge collected at USGS gage 08284100 at Rio Chama near La Puente NM

3.3.3.1 No Action Alternative

Under the No Action Alternative, there would be no effect to water quality because no construction activities would occur.

3.3.3.2 Proposed Action Alternative

The Proposed Action would have a short-term, adverse effect on water quality based on the sediment modeling but not on the chemical analysis of sediment samples. The chemical analysis determined the majority of compounds, minerals, or other chemicals were largely within levels in the background samples.

Table 2 Sediment Concentrations under Multiple Flow Scenarios

Concentration Calculated from Average Critical Shear Stress Simulations			
	Maximum Concentration (mg/L)		
	Low Flow	Medium Flow	High Flow
Drained Reservoir (Reservoir Elev. 6770)	151	246	311
Cofferdam (Reservoir Elev. 6775)	98	246	311
Proposed Action (Reservoir Elev. 6785)	39	178	210

Lowering the reservoir for the construction on the seepage reduction features would have a short-term, relatively small adverse effect on water quality under medium and high flow scenarios based on peak concentrations (Table 2) and sediment loads (Table 3) but not under the low flow scenario. Considering the large variance of sediment concentration and load in the Rio Chama (Figure 4), the values in Tables 3 and 4 are relatively low by comparison. Moreover, peak sediment concentrations and total sediment loads during construction of the seepage reduction modifications were mitigated by multiple design features, including 1) using a 15-ft-deep, 1-mile-long pool of water to collect sediment instead of a coffer dam or completely draining the reservoir, 2) completing excavations to expose the existing concrete plinth for the geomembrane lining installation and remedial foundation grouting in the dry, and 3) use of Best Management Practices (BMPs), some of which are described in chapter 4, Environmental Commitments.

Table 3 Sediment Loads under Multiple Flow Scenarios

Sediment Loads Calculated from Average Critical Shear Stress Simulations			
	Sediment Load (Tons)		
	Low Flow	Medium Flow	High Flow
Incoming	1	16	43
Drained Reservoir (Reservoir Elev. 6770)	2	44	102
Cofferdam (Reservoir Elev. 6775)	1	43	100
Proposed Action (Reservoir Elev. 6785)	0.4	26	75

3.3.4 Recreation

El Vado Lake State Park

New Mexico State Parks, through an agreement with Reclamation, is responsible for operating and maintaining the recreation facilities at El Vado Reservoir. The reservoir has a surface area of 3,220 acres with 27 miles of shoreline and approximately 1,200 acres of recreation land area.

Recreational activities at El Vado State Park (State Park) include fishing, boating, swimming, hiking, camping and picnicking. The park is open year around and is used mainly in the winter by hunters and fishermen. El Vado Reservoir is designated as a coldwater fishery. The New Mexico Department of Game and Fish (NMDGF) stocks the lake annually with rainbow trout fry. In addition to rainbow trout there exists a healthy population of brown trout and kokanee salmon. Other fish species present in the reservoir that anglers may catch include Largemouth bass, bluegill, and lake trout. Fishing is more productive during the spring and fall seasons. During the heat of the summer, El Vado is home to personal watercraft, water skiers and water sports enthusiasts.

There are 8 campgrounds at the State Park, 3 developed and 5 primitive. Developed sites are located at Grassy Point, Elk Run, and Pinon Beach in the main recreation area. There are a total 80 developed sites in the main recreation area. Of these 80 sites, 19 of them are electric and water sites located in the Grassy Point Campground. Facilities such as bathrooms, dump stations and pay phone are all incorporated within the main area. The primitive campgrounds which are called Sands Cove Campground, South Point Campground, West El Vado, North Shore Primitive and the Peninsula are located on the north, south and west sides of the lake.

There are two boat ramps and two courtesy boat docks at the State Park. One is located at North El Vado, and the other concrete boat ramp and dock is at the main campground. There are no concessions at the State Park at this time. The developed areas of the park are located adjacent to small stores that provide products and services for park visitors. The scenic 5.5-mile Rio Chama Trail connects El Vado Reservoir with nearby Heron Lake. See Figure 5 for a map of recreation facilities at El Vado.

According to the most recent Recreation Use Data Report (RUDR) compiled by Reclamation, the State Park had 35,198 visitors from May 1, 2018 through September 30, 2018.

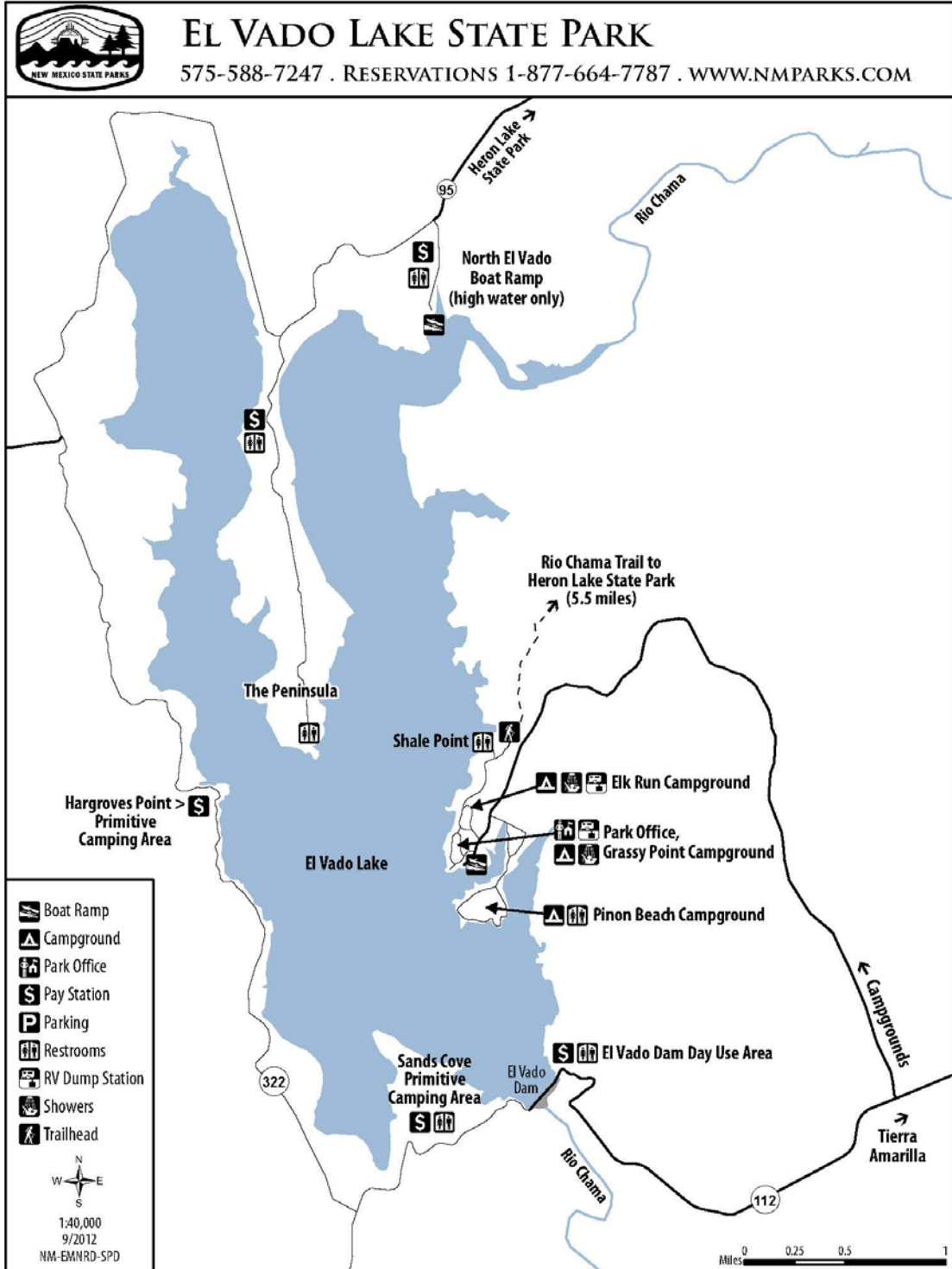


Figure 5 Map of El Vado Lake State Park

Rio Chama Wild and Scenic River

A 24.6-mile section of the Rio Chama River downstream of El Vado Dam was Congressionally designated as a Wild and Scenic River in 1988. This section of river flows through the Rio Chama Wilderness Study Area managed by the U.S. Bureau of Land Management (BLM), and the Chama

River Canyon Wilderness managed by the U.S. Forest Service. Popular recreation activities within this section of river include boating, camping, fishing, hiking/backpacking, and wildlife viewing, with boating being the primary recreational activity. Trout fishing is especially good on the upper mile of this river segment. Car camping is popular on the lower 8 miles, and boaters enjoy two or three-day trips on Class II rapids on the entire 31-mile segment (advance permits required), or half-day trips on the lower segment (no advance permits required). Because of the demand for float trips in late spring and summer, to protect the river environment from overuse, and to maintain an opportunity for a high-quality experience, the BLM uses a lottery system to reserve weekend (Friday-Saturday) launch dates from May 1 through Labor Day weekend. Advance reservations are not required from Labor Day through April 30 of each year. However, winter minimum flows are around 50 cfs, which is not a boatable flow.

River flows below the dam are highly variable and unpredictable, based on water availability, irrigation demand, and rainfall in spring and summer. Often spring time flows are released to coincide with inflow to reservoirs above El Vado Dam. Summer flows are often increased for weekends (Friday-Sunday) for boater needs.

Floaters in a canoe or kayak can have a good run from El Vado to Chavez Canyon at flows as low as 200 cfs, or to Big Eddy, at flows of 300 cfs. For small rafts, minimum recommended flows are 300 to 400 cfs. For large rafts (14 ft or bigger) minimum flows of 500 cfs are recommended.

There are no facilities on the river itself. However, lodging, restrooms, and drinking water are available at El Vado Ranch located approximately 1 mile downstream of El Vado Dam. El Vado Ranch is the official “put in” of the Rio Chama Wild and Scenic River.

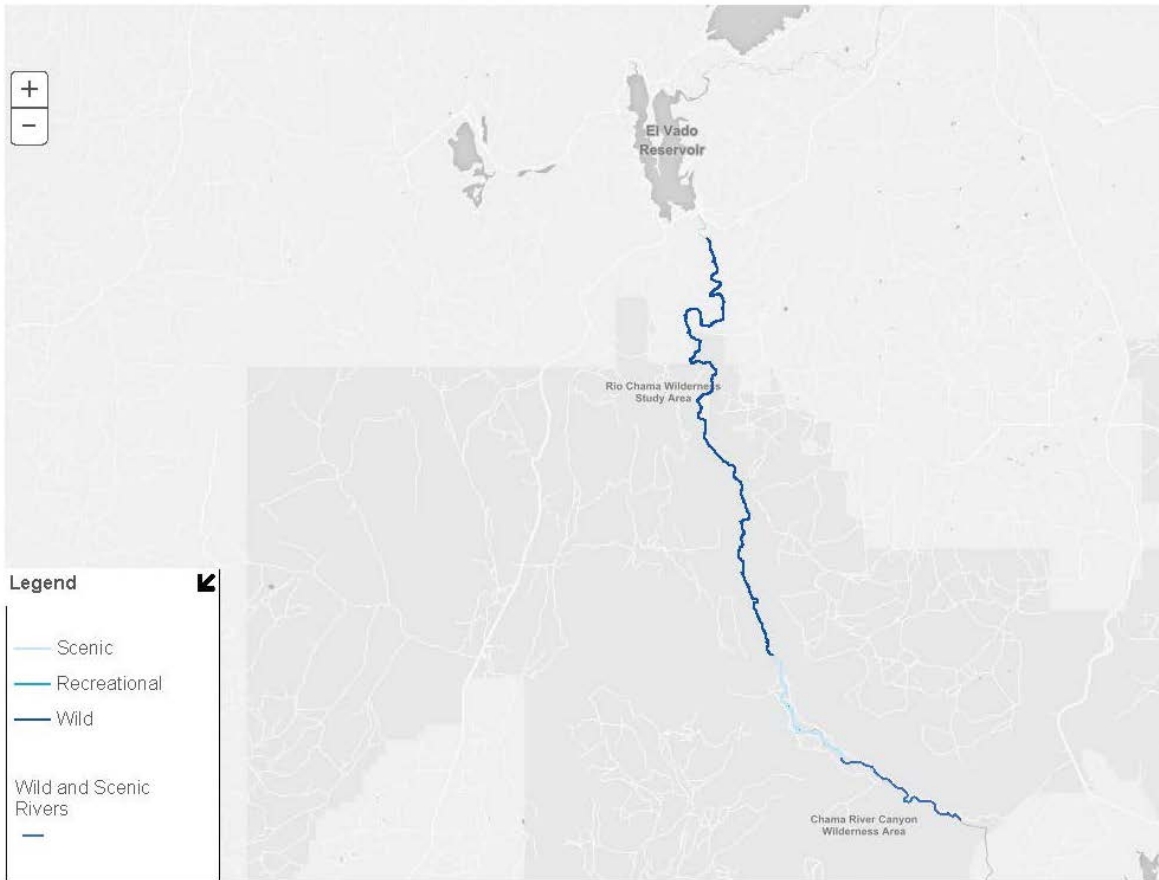


Figure 6 Rio Chama Wild and Scenic River designations

3.3.4.1 No Action Alternative

Under the No Action Alternative, there would be no short-term effects to current recreational activities upstream or downstream from the dam since there would be no structural or operational changes to El Vado Dam or spillways. No changes to the operation of El Vado Dam or the storage level of the reservoir would occur. Recreation activities would continue in the same manner as they have historically occurred.

Potential long-term impacts to recreation activities could occur under this alternative. The steel lining materials would continue to be susceptible to corrosion and strength loss leading to the possibility of an internal erosion dam failure. If operated, the service spillway would lose structural integrity, resulting in collapse of the spillway and/or complete failure of the dam through lateral head cutting. Failure of the dam would lead to a loss of boating and boating-related recreation at the reservoir which would in turn impact visitation and camping use within the State Park. According to Reclamation’s 2018 RUDR, boating is the highest ranked recreation activity at the State Park. Failure of the dam would lead to severe flooding and damage to the downstream river channel and recreation areas.

3.3.4.2 Proposed Action Alternative

El Vado Lake State Park

Under the Proposed Action, it is anticipated that recreation activities on El Vado reservoir would be temporarily impacted from about May 1 through mid-December of the year construction of the seepage reduction modifications would begin. At the restricted reservoir elevation 6785, both boat ramps would become unusable for launching as the bottom elevation of the main campground ramp is 6820 ft and the North El Vado ramp is 6899 ft. According to State Parks, at reservoir elevation 6785 the water level becomes low enough to warrant no motorboating. Lake water conditions show shoreline mud flats before that level making it difficult for paddle craft access as well (State Parks, 2019). Lack of accessible access to the reservoir and reservoir shoreline would have a temporary negative impact on recreation visitation at the reservoir for water recreation and fishing activities. It is anticipated that with this reduced reservoir visitation would come reduced annual revenue for the State Park.

Upon completion of the seepage reduction modifications, the remainder of the reservoir restriction at elevation 6859 would have no adverse effects upon recreation activities at the State Park or downstream of the dam. However, there would be no access across the dam during construction affecting the bridge across the service spillway. The road across the dam would need to be closed for a minimum of 6 months but could extend to 1 year in duration.

Since all of the developed recreation facilities and reservoir access points are located on the eastern side of the reservoir, lack of access across the dam for recreation visitor approaching from the south on SR-112 would have negative temporary impacts to access the State Park facilities. Until the bridge construction is complete, an approximate 33-mile detour would be required by visitors approaching from the south on SR-112 to access the main State Park campground area by traveling around the north side of the reservoir on CR-322, past Heron Lake State Park on Highway 95, and then circling back on SR-112 from the east.

Rio Chama Wild and Scenic River

To the extent possible, Reclamation would maintain operations similar to what is currently done and as described in Section 3.2.1 Water Operations and Hydrology. Water storage would occur in Heron, Abiquiu, and/or in Cochiti Reservoirs. Water stored at Heron Reservoir would be delivered to downstream users through El Vado Dam and Reservoir.

El Vado Reservoir outlet works would continue to bypass native Rio Grande water flows into the river channel below the dam up to 100 cfs between April 1 and September 1 to meet demands of Rio Chama water rights holders downstream from Abiquiu Dam.

When water is available for release to downstream users or storage reservoirs, and in cooperation with effected parties, Reclamation would manage releases from Heron Dam and Reservoir to benefit a cold-water trout fishery below El Vado Dam from November to March. Also, when water is available for release to downstream users or storage reservoirs, and in cooperation with effected parties, Reclamation would manage releases from Heron Dam and Reservoir for rafting during weekends in July, August, and September.

It is not anticipated that there would be any adverse effects to recreational users downstream of El Vado Dam under the Proposed Action based upon water flows. However, it is important to note that forecasted water inflow and subsequent storage is highly dependent on the winter snowpack and spring runoff prior to construction. Regardless of the forecast, the water operations plan

identified in Section 3.3.1 Water Operations and Hydrology would accommodate water operations during construction.

The loss of road access across the dam for up to two years during the spillway bridge construction would have negative temporary impacts for river recreationists below the dam for those approaching from the south on SR-112. El Vado Ranch, approximately one mile downstream of the dam, is the official “put in” location for the Rio Chama Wild and Scenic River and access to this location would be particularly impacted for rafters who may need to approach from west of the dam. Until the bridge construction is complete, an approximate 35-mile detour would be required by river recreationists approaching from the south on SR-112 to access El Vado Ranch by traveling around the north side of the reservoir on CR-322, past Heron Lake State Park on Highway 95, and then circling back on SR-112 from the east. While river recreation is available year-round, the peak recreation season is May 1 through Labor Day weekend.

3.3.5 Waters of the United States

Waters of the U.S. (i.e. wetlands and other surface waters) provide important and beneficial functions including: protecting and improving water quality, providing fish and wildlife habitat, and storing floodwaters. Because they provide these important functions this resource is protected via two Acts: section 10 of the Rivers and Harbors Act (1899) and section 404 of the Clean Water Act (CWA) of 1972, as amended. These Acts require that Reclamation strive to first avoid adverse impacts, and then minimize adverse impacts, and finally offset unavoidable adverse impacts to existing aquatic resources; and for wetlands, strive to achieve a goal of no overall net loss of values and functions.

The USACE has authority to regulate work in the Nation’s waters (i.e. Waters of the U.S.) through the Rivers and Harbors Act. The Act established permit requirements to prevent unauthorized obstruction or alteration of any navigable water. However, no section 10 permit is anticipated for the Proposed Action.

The USACE also regulates work in, on or over Waters of the U.S. via the CWA, which authorizes the USACE to require permits for the discharge of dredge and fill material into Waters of the U.S. Specifically, in this assessment it will be determined whether a USACE section 404 permit is required for affecting wetlands and/or other surface waters.

The Proposed Action area includes land immediately adjacent to El Vado Dam and submerged lands below the OHWM of the El Vado Reservoir. Reclamation assessed the action area for USACE jurisdictional wetland area by reviewing the U.S. Fish and Wildlife Service’s online tool, the Wetland Mapper, and through ground truthing.

No wetland area would be affected by the Proposed Action as none occur in the project area. However, since USACE exerts jurisdiction over areas of open water and streams, any activity in El Vado Reservoir, below the OHWM, would require USACE authorization.

3.3.5.1 No Action Alternative

Under current conditions, normal operations and maintenance of the dam would not affect Waters of the U.S. However, long-term operation and maintenance would not correct the continuing

degradation of dam integrity. Therefore, it is anticipated that Waters of the U.S. would be affected by this alternative in the long-term.

3.3.5.2 Proposed Action Alternative

This alternative would produce mostly temporary effects to Waters of the U.S. with some minor permanent effects from displacement. Total displacement from fill is up to 1,350 cubic yards (cy): up to 350 cy for the seepage reduction modifications and up to 1,000 cy for work on the service spillway. No fill below the OHWM is anticipated for work on the dike/fuse plug at the emergency spillway. The total volume represents the upper end of potential fill for the entire Proposed Action and is the necessary for the repair and/or rehabilitation of the dam.

For the remedial foundation grout curtain installation, temporary effects would result from lowering the reservoir's surface elevation so that the toe of the upstream dam face is exposed, allowing heavy equipment to access the existing concrete plinth, which is partially covered under man placed fill and sediment. Excavation of accumulated materials over the concrete plinth is required to install the geomembrane lining and for construction of a concrete cap/matt for the remedial foundation grout curtain. All this work would occur above the restricted water level in the dry (i.e. no underwater work). This minimizes discharge of sediment into the water.

Upon completing the grout curtain installation, the excavated materials would be returned to the area over the concrete plinth in conjunction with a matt of articulated concrete blocks at the surface to minimize future runoff erosion along the upstream toe. The only new fill materials would be concrete for the grout cap/matt. The grout cap/matt would abut to the existing concrete plinth at the upstream toe. The grout cap/matt would be about 7 to 12 ft wide, about 1-foot thick. The grout cap/matt is needed to support the grout hole drilling equipment and to minimize grout leaks at the ground surface. Approximately 350 cy of concrete would displace fill materials currently at the upstream toe of the dam. The surface area of the grout cap/matt covers approximately 6200 square ft (from an aerial view). The concrete grout cap/matt would be covered by the excavated materials to near the existing contours. In the event the excavated materials are not suitable as fill, backfill at the toe of the dam would be supplemented with fill obtained from the existing borrow area on the left reservoir rim.

Access to the plinth for installation of the remedial grout curtain would require a temporary access ramps be constructed on the upstream left abutment. At this time, it is anticipated that the access ramp/pad fill materials placed in this area during original construction, local soil and rock materials on the left abutment, both above and below the OHWM, would provide enough suitable material to establish the temporary access ramps. If there is an insufficient volume of fill materials locally near the dam, the contractor would be allowed to import fill from the existing borrow area on the left reservoir rim. Once the lining installation and remedial foundation grout curtain is installed, the access ramp/pad fill materials would be regraded to match pre-construction contours below the OHWM.

Repairs and improvements to the service spillway would also require excavation and fill below the OHWM. In its essence, the spillway would be shifted a minimal distance to the west to bring the spillway up to current safety and engineering standards. Not shifting the spillway entrance about 20 ft to the west would require substantial excavation eastward back into the dam, removing and replacing the steel faceplate, increasing risks to the maintenance building on top of the dam, etc.

Shifting the spillway west would require up to 1,000 cy of fill. This fill covers approximately 1,500 square ft (from an aerial view). This accounts for the structural concrete in the curved wall, controlled low-strength material (CLSM), and compacted backfill.

Overall, there would be a minor permanent effect relative to the El Vado Reservoir volume as the new fill amount would not exceed 1,350 total cy and an increase in substrate area of approximately 7700 square ft. As described in section 3.3.3, Water Quality, multiple design features were incorporated into the Proposed Action to avoid and/or minimize impacts to water quality, which is regulated by section 401 of the CWA for Waters of the U.S. and administered by the New Mexico Environment Department (NMED). Fill was also minimized through design features by performing a remedial foundation grouting program instead of a seepage blanket, maintaining the service spillway at approximately the same dimensions as the original, and using the existing access ramp to the spillway approach channel on the right abutment.

Based on the effects described here, Reclamation anticipates that, under the CWA, section 404 permit(s) would be required. Coordination with the U.S. Army Corps of Engineers has occurred, with the determination that Nationwide Permits 3 and 33 would be required for all proposed activity below the OHWM.

3.3.6 Fisheries Resources

El Vado Reservoir is designated as a coldwater fishery that primarily provides recreational fishing opportunities for brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), and kokanee salmon (*Oncorhynchus nerka*). Some cool- and warmwater fish species such as smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis cyanellus*), common carp (*Cyprinus carpio*), and white sucker (*Catostomus commersonii*) also provide recreational opportunities. The fish species present are primarily a result of intensive stocking efforts by the NMDGF. Kokanee salmon snagging is a popular recreational angling method in the fall. Each autumn NMDGF collects kokanee eggs and milt to hatch fry. The young fry are used to stock El Vado Reservoir along with several other impoundments including Heron Lake, Navajo Lake, Abiquiu Lake, and Eagle Nest Lake.

The Rio Chama flows north and south of El Vado Reservoir and provides numerous recreational opportunities. The river reach downstream of the dam is designated as a Wild and Scenic River that provides excellent trout fishing. The current state record brown trout was caught below El Vado Dam and the river continually produces trophy-sized brown trout. In addition to angling, the river provides recreational rafting and floating based on a lottery system (see 3.3.4 Recreation).

3.3.6.1 No Action Alternative

Under the No Action Alternative, there would be no structural or operational changes to El Vado Dam or spillways. The fishery in the reservoir and downstream of the dam would continue to be stocked and intensively managed by the NMDGF. The threat of dam failure would increase throughout time and the likeliness of losing the reservoir fishery along with the downstream habitat, including the section of Wild and Scenic River, would be at risk.

3.3.6.2 Proposed Action Alternative

El Vado Reservoir has historically fluctuated based on operations and maintenance (O&M) needs and water deliveries. The designated purpose of the reservoir is to provide storage for irrigation and incidental flood control. In 2002, the reservoir was drained to dead pool (6770 ft) for outlet works intake bulkhead installation. In 2013, the reservoir was drained to 6790 ft due to drought conditions. If the Proposed Action is implemented, the reservoir would be drained to an elevation of 6785 and maintained at this elevation for approximately seven to eight months during construction of the seepage reduction modifications. Following completion of the seepage reduction modifications work, the reservoir would fill to an elevation of 6859 for a period of just under two years while the spillway construction is completed. The original river channel was at elevation 6740. A bathymetry survey has indicated the current sediment level is at elevation 6770 near the toe of the dam. This leaves approximately 15 ft of water depth near the toe of the dam during the first phase of construction (May 1st – December) with about 2,422 ac-ft available in total. After the seepage reduction modifications are complete, the reservoir would be operated at 6859 ft, a storage volume of 80,986 ac-ft for the duration of the project (less than two years).

There would likely be a reduction of total fish biomass in the reservoir due to water quality and resource limitations that occur at the initial lower reservoir elevations. These elevations would be maintained throughout the hot summer months, potentially resulting in some fish mortality. However, a major fish kill has not historically occurred and is not expected due to cooler, oxygenated inflows from the Rio Chama and Heron Reservoir. The inflow is unlikely to sustain the non-native coldwater fishery. Species such as smallmouth bass and green sunfish are well-adapted to higher temperatures and lower dissolved oxygen. Therefore, impacts to these species would be negligible compared to trout and salmon. The fish population is a closely managed nonnative population that persists due to current stocking efforts, primarily for rainbow trout and kokanee salmon. The remaining fishery would be supplemented by stocking following the project and could begin within the first year of construction, depending on the hydrologic condition of the area.

According to NMDGF, kokanee salmon stocking has been tentatively postponed in anticipation of work to repair the dam. The kokanee salmon stocking at El Vado would be deferred during the seepage reduction modification work on the dam (approximately seven to eight months). The NMDGF would stock the remaining fry into Heron Lake, Navajo Lake, Abiquiu Lake, and Eagle Nest Lake. Salmon stocking could resume during the spillway construction phase of the Project because of the increased water elevation (6859 ft), which would be maintained at sufficient levels for successful salmon stocking and recreational opportunities. Rainbow trout stocking would cease the year before anticipated construction but could also resume during spillway construction, resulting in up to 2 years without stocking.

Upon Project completion, operational capacity would return to the entire 185,770 ac-ft of water, although actual storage in the reservoir following construction is highly dependent on the hydrologic year. Returning El Vado Reservoir to full active conservation pool (contingent on water availability for storage) would likely result in an overall increase in water quality, cooler water temperatures, a reduced potential for drawdowns that negatively impact the reservoir fishery, re-inundation of shoreline habitat, and provide a deeper thermal refuge for fish. There would be minimal effects to the fishery during the short construction timeline in the first year. The last two years of construction are not expected to impact the fishery. Therefore, the short-term effects to the reservoir fishery

would be less than a year due to the stocking program and the overall fishery would be enhanced upon completion of the Project.

Downstream Effects in the Rio Chama

The Rio Chama is classified as excellent fishing that consistently produces trophy sized brown trout and has produced the current state record brown trout. Fish species include brown trout, rainbow trout, and kokanee salmon. The best fishing is considered to be within several miles of the dam. In addition to game fish, a few native species such as the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), Rio Grande chub (*Gila pandora*), and Rio Grande sucker (*Catostomus plebeius*) occur in the Rio Chama. The Wild and Scenic designation of the river begins about 1 mile downstream of the dam. Releases from El Vado Dam correspond to operational requirements and/or considerations such as the following:

- Native Rio Grande water flows into El Vado Reservoir up to 100 cfs are bypassed to meet demands of Rio Chama water rights holders.
- Reclamation targets a release of 150 to 185 cfs for fisheries below El Vado from November to March.
- Reclamation targets 400 to 600 cfs for rafting during the weekends during July, August and September when possible, given the needs of downstream water users.

Sediment releases are a primary concern for riverine fishes in the Rio Chama. The Rio Grande chub is especially susceptible to high sediment loads, although specific thresholds are unavailable to predict potential impacts (Rees et al. 2005). Impacts from the project would be minimized through careful design considerations. A 2,422 ac-ft pool would be maintained in the reservoir to mitigate sediment releases through the outlet works. Additionally, the only work to occur below the water line would be grouting behind the steel faceplate of the dam and an admixture would be used in the grout mixture to prevent loss of the cement particles into the reservoir water. During construction, sediment release concentrations would be similar to natural concentrations during spring runoff. The total amount/mass of sediment released during construction may be higher than what is conveyed by natural flows into the reservoir but would be similar to conditions observed when the reservoir is lowered to similarly low levels during normal operations described herein. Due to the limited release of sediments and short construction timeframe, there would be no effect to the downstream fishery or Wild and Scenic designation of the Rio Chama.

3.3.7 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States for Indian tribes or individuals. The Department of the Interior's policy is to recognize and fulfill its legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and tribal members, and to consult with tribes on a government-to-government basis whenever plans or actions affect tribal trust resources, trust assets, or tribal safety (see Departmental Manual, 512 DM 2). Under this policy, as well as Reclamation's ITA policy, Reclamation is committed to carrying out its activities in a manner which avoids adverse impacts to ITAs when possible, and to mitigate or compensate for such impacts when it cannot. All impacts to ITAs, even those considered nonsignificant, must be discussed in the trust analyses in NEPA compliance documents and appropriate compensation or mitigation must be implemented.

Trust assets may include lands, minerals, hunting and fishing rights, traditional gathering grounds, and water rights. Impacts to ITAs are evaluated by assessing how the action affects the use and quality of ITAs. Any action that adversely affects the use, value, quality or enjoyment of an ITA is considered to have an adverse impact to the resources.

Dr. Zachary Nelson conducted a review of the Current American Indian/Alaska Native/Native Hawaiian Areas (AIANNH) National Shapefile which indicated that no ITAs were located within the project area. This review occurred on October 28, 2019. However, the Jicarilla Apache Nation Reservation is located adjacent to the proposed project area on the south. In addition, six Pueblos hold Prior and Paramount water rights that are partially satisfied through deliveries from Reclamation reservoirs in the MRG.

3.3.7.1 No Action Alternative

The No Action Alternative would have no impact on ITAs.

3.3.7.2 Proposed Action Alternative

The presence of the Jicarilla Apache Nation Reservation on the south of the proposed project area and Prior and Paramount water rights require discussion. The reservoir provides some benefits to the reservation and Pueblos in terms of steady access to water. The proposed modifications to the dam would ensure that the benefit continues. The short-term disruption of water in the reservoir would not impair the reservation or the six Pueblos, but should the repair not occur, the potential for water shortages becomes higher as reservoir restrictions would be required. Thus, it is useful and important to have the dam repaired to aid Reclamation in fulfilling its Trust responsibilities.

The construction area for the repair is not located on reservation land. However, the land was previously used by Native American people prior to Euro-American activity. In this case, the construction and staging areas are primarily located on land that was previously disturbed by the original dam construction. The re-use of the land for the project would not disturb any existing ITAs or sacred places.

Overall, the project would have no adverse effect on ITAs.

3.3.8 Socioeconomics

Reclamation’s TSC performed a draft Economic Benefit Analysis for the Proposed Action. The analysis included lost benefits of irrigation, recreation, and power generation. Baseline values of Project benefits are substantial (Table 4).

Table 4 Estimated baseline project benefits

	Baseline	
	Annual Value	Present Value
Irrigation	\$17,890,000	-
Recreation	\$6,802,187	\$179,249,000
Power	\$864,459	\$22,780,000

3.3.8.1 No Action Alternative

The No Action Alternative would have no effect on socioeconomics of the area until dam failure when all benefits would be lost. The impacts to Project benefits from the No Action Alternative would be adverse, significant and long-term if the dam were to fail.

3.3.8.2 Proposed Action Alternative

The Proposed Action would result in one season of lost benefits of irrigation, recreation and power generation for the year of construction of the seepage reduction modifications (Table 5). These would be temporary (1 season) impacts. However, the Proposed Action would have permanent (50+ year) benefits after construction is completed, allowing for complete deliveries as hydrology allows.

Table 5 Estimated lost economic benefits from Proposed Action

	Lost Benefits	
	Annual Value	Present Value
Irrigation	\$0	\$0
Recreation	\$1,216,318	\$1,216,000
Power	\$22,137	\$22,000

3.3.9 Environmental Justice

EO 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” directs all federal agencies to develop strategies for considering environmental justice in their programs, policies, and activities. Additionally, the Council on Environmental Quality has issued the “Environmental Justice Guidance under the National Environmental Policy Act (NEPA)” to further assist federal agencies with their procedures under NEPA. Environmental justice is defined as 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 of the execution of federal, state, local, and tribal programs and policies (EPA 2018). Minority (particularly Native American) and low-income populations are present in Rio Arriba County, New Mexico as described in Table 6 through Table 8.

Table 6 Demographics of Rio Arriba County, NM

	Rio Arriba County, NM	New Mexico	U.S.
Total Population, 2017*	39,455	2,084,828	321,004,407
White alone	22,085	1,547,843	234,370,202
Black or African American alone	228	42,187	40,610,815
American Indian alone	6,232	197,191	2,632,102
Asian alone	161	29,991	17,186,320
Native Hawaii & Other Pacific Is. alone	4	1,390	570,116
Some other race alone	9,731	197,944	15,553,808
Two or more races	1,014	68,282	10,081,044
Percent of Total			
White alone	56.0%	74.2%	73.0%
Black or African American alone	0.6%	2.0%	12.7%
American Indian alone	15.8%	9.5%	0.8%
Asian alone	0.4%	1.4%	5.4%
Native Hawaii & Other Pacific Is. alone	0.0%	0.1%	0.2%
Some other race alone	24.7%	9.5%	4.8%
Two or more races	2.6%	3.3%	3.1%
High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.			
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.			
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.			

3.3.9.1 No Action Alternative

There would be no effect to low-income or minority populations under the No Action Alternative until dam failure which would have a substantial negative impact on minority and low-income populations.

Table 7 Native American Population in Rio Arriba County, NM

	Rio Arriba County, NM	New Mexico	U.S.
Total Population, 2017*	39,455	2,084,828	321,004,407
Total Native American, 2017*	6,232	197,191	2,632,102
American Indian Tribes	5,600	185,807	2,019,896
Alaska Native Tribes	44	181	112,318
Non-Specified Tribes	261	7,558	421,859
Percent of Total			
Total Native American	15.8%	9.5%	0.8%
American Indian Tribes	14.2%	8.9%	0.6%
Alaska Native Tribes	0.1%	0.0%	0.0%
Non-Specified Tribes	0.7%	0.4%	0.1%
High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.			
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.			
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.			

3.3.9.2 Proposed Action Alternative

The proposed Project would not disproportionately (unequally) affect any low-income or minority communities within the Project area. Project funding would not target or disproportionately affect disadvantaged races, ethnicities, or communities of lower economic status. Inconveniences during construction would be experienced equally by those needing to cross El Vado Dam during construction, and the Reservoir is not known to be utilized disproportionately by the above-described groups. Additionally, implementation of the Proposed Action would not involve population relocation, health hazards, or property takings. For the reasons described, the Proposed Action would have no adverse human health or environmental effects on minority and low-income populations, nor Indian tribes.

Table 8 Poverty by race in Rio Arriba County, NM

	Rio Arriba County, NM	New Mexico	U.S.
Total Population in Poverty, 2017*	10,338	420,293	45,650,345
White alone	5,771	273,759	27,607,156
Black or African American alone	8	9,549	9,807,009
American Indian alone	1,734	65,053	681,207
Asian alone	1	2,896	2,011,217
Native Hawaii & Other Pacific Is. alone	0	275	104,944
Some other race	2,601	54,994	3,638,390
Two or more races	223	13,767	1,800,422
All Ethnicities in Poverty, 2017*			
Hispanic or Latino (of any race)	7,613	244,409	12,269,452
Not Hispanic or Latino (of any race)	1,009	96,793	19,820,720
Percent of Total[^]			
White alone	55.8%	65.1%	60.5%
Black or African American alone	0.1%	2.3%	21.5%
American Indian alone	16.8%	15.5%	1.5%
Asian alone	0.0%	0.7%	4.4%
Native Hawaii & Other Pacific Is. alone	0.0%	0.1%	0.2%
Some other race	25.2%	13.1%	8.0%
Two or more races	2.2%	3.3%	3.9%
Hispanic or Latino (of any race)	73.6%	58.2%	26.9%
Not Hispanic or Latino (of any race)	9.8%	23.0%	43.4%
[^] Percent of total population in poverty by race and ethnicity is calculated by dividing the number of people in poverty in each racial or ethnic category by the total population.			
High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.			
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.			
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.			

3.3.10 Cultural Resources

Cultural resources are defined as physical or other expressions of human activity or occupation that are over 50 years in age. Such resources include culturally significant landscapes, prehistoric and historic archaeological sites as well as isolated artifacts or features, traditional cultural properties,

Native American and other sacred places, and artifacts and documents of cultural and historic significance.

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), mandates that Reclamation take into account the potential effects of a proposed Federal undertaking on historic properties. Historic properties are defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for, inclusion in the National Register of Historic Places (NRHP). Potential effects of the described alternatives on historic properties are the primary focus of this analysis.

In compliance with the regulations specified in Section 106 of the NHPA (36 CFR 800.16), the affected environment for cultural resources is identified as the area of potential effects (APE). The APE is defined as the geographic area within which federal actions may directly or indirectly cause alterations in the character or use of historic properties. The APE for this Proposed Action includes the area that could be physically affected by any of the proposed project alternatives (the maximum limit of disturbance).

Reclamation completed a Class I literature review and a Class III cultural resource inventory for the APE, which was defined in the action alternative and analyzed for the Proposed Action. A single site was identified within the APE: El Vado Dam.

In accordance with 36 CFR 800.4, the site was evaluated for significance in terms of NRHP eligibility. The significance criteria applied to evaluate cultural resources are defined in 36 CFR 60.4 as follows:

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and that

1. are associated with events that have made a significant contribution to the broad patterns of our history; or
2. are associated with the lives of persons significant in our past; or
3. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
4. have yielded, or may be likely to yield, information important in prehistory or history.

Based upon these considerations, Reclamation concurred with a previous recommendation that El Vado Dam is a historic resource eligible for inclusion on the NRHP. Consultation with the New Mexico State Historic Preservation Office (SHPO) is ongoing. However, as an eligible resource, any changes made to the dam that are not in keeping with its historic integrity would result in an adverse effect to this historic resource.

3.3.10.1 No Action Alternative

Under the No Action Alternative, there would be no adverse effects to cultural resources. There would be no need for ground disturbance associated with construction activities. Existing conditions would continue.

3.3.10.2 Proposed Action Alternative

El Vado Dam was determined to be eligible for the NRHP. The Proposed Action would cause an alteration to the characteristics of the dam which make it eligible for the NRHP and would, therefore, have an adverse effect on the property according to 36 CFR 800.16(i).

Pursuant to 36 CFR 800.5, the criteria of adverse effect were applied to the dam. An adverse effect is defined as an effect that could diminish the integrity of a historic property's location, design, setting, materials, workmanship, feeling, or association. The Proposed Action would diminish the integrity of the dam by removing an important characteristic of the site and would cause an adverse effect to the historic property.

In compliance with 36 CFR 800.4(dX2) and 36 CFR 800.11(e), a copy of the cultural resource inventory report and a determination of historic properties affected would be submitted to the New Mexico SHPO, the Advisory Council on Historic Preservation (ACHP), tribes which may attach religious or cultural significance to historic properties possibly affected by the Proposed Action for consultation and other interested parties.

Pursuant to 36 CFR 800.6(c), a Memorandum of Agreement (MOA) would be developed to resolve the adverse effects to the dam. Signatories to the MOA would include Reclamation, SHPO, and other concurring parties. The MOA must be executed prior to project implementation.

3.3.11 Cumulative Impacts

In addition to Project-specific impacts, Reclamation analyzed the potential for significant cumulative impacts to resources affected by the Project and by other past, present, and reasonably foreseeable activities within the watershed. According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR §1508.7), a "cumulative impact" is an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. It focuses on whether the Proposed Action, considered together with any known or reasonably foreseeable actions by Reclamation, other Federal or state agencies, or some other entity combined to cause an effect. There is no defined area for potential cumulative effects.

Cumulative effects for this Project may include inspection, maintenance and repair work on the geomembrane liner, spillway, and other appurtenant features, all of which are existing features on previously disturbed areas. Any impacts from this work would be temporary in nature with no long-term impacts. Based on resource specialists' review of the Proposed Action, Reclamation has determined that this action would not have a significant adverse cumulative effect on any resources.

4 Environmental Commitments

Following are the environmental commitments (Conservation Measures) that will be carried out as part of this project. Reclamation will follow commitments that are derived from the U.S. Army Corps of Engineers 404 permits and New Mexico Environment Department Conditional Section

401 Certification of NWP, along with other BMPs/commitments related to water quality, air quality, and transportation/access:

- Work will comply with all general and regional conditions of Nationwide Permit 3, Maintenance and Nationwide Permit 33, Temporary Construction, Access, and Dewatering. A pre-construction notification will be submitted prior to commencement of construction activities. Specific commitments for each permit are as follows:
 - Nationwide Permit 3
 - All corrective actions taken are intended to repair, rehabilitate, or replace the existing dam and appurtenant structures.
 - Nationwide Permit 33
 - Temporary fill will be entirely removed to an area that has no waters of the United States
 - Excavated material for the remedial grouting program will be returned to its original location
 - Affected areas will be restored to pre-construction elevations
- Standard Reclamation BMPs will be applied during construction activities to minimize environmental effects. Such practices or construction specifications include but are not limited to erosion control (e.g., silt fencing), traffic control plan with notice of closures, dust and water pollution abatement, and waste material disposal.

Reclamation proposes these commitments (Conservation Measures) to minimize or avoid adverse effects of implementing the Proposed Action.

5 Consultation and Coordination

Reclamation held scoping meetings on the potential alternatives for corrective action in June 2019 in Albuquerque and Los Ojos, New Mexico. The Draft EA will go out for a 30-day public review period during which two additional meetings will be held to engage stakeholders on the Proposed Action and Draft EA. Coordination is in progress with the U.S. Army Corps of Engineers regarding permitting under section 404 of the CWA and with New Mexico Environmental Department regarding Conditional Section 401 Certification of Nationwide Permits, particularly the implementation of BMPs to minimize impacts to water quality.

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